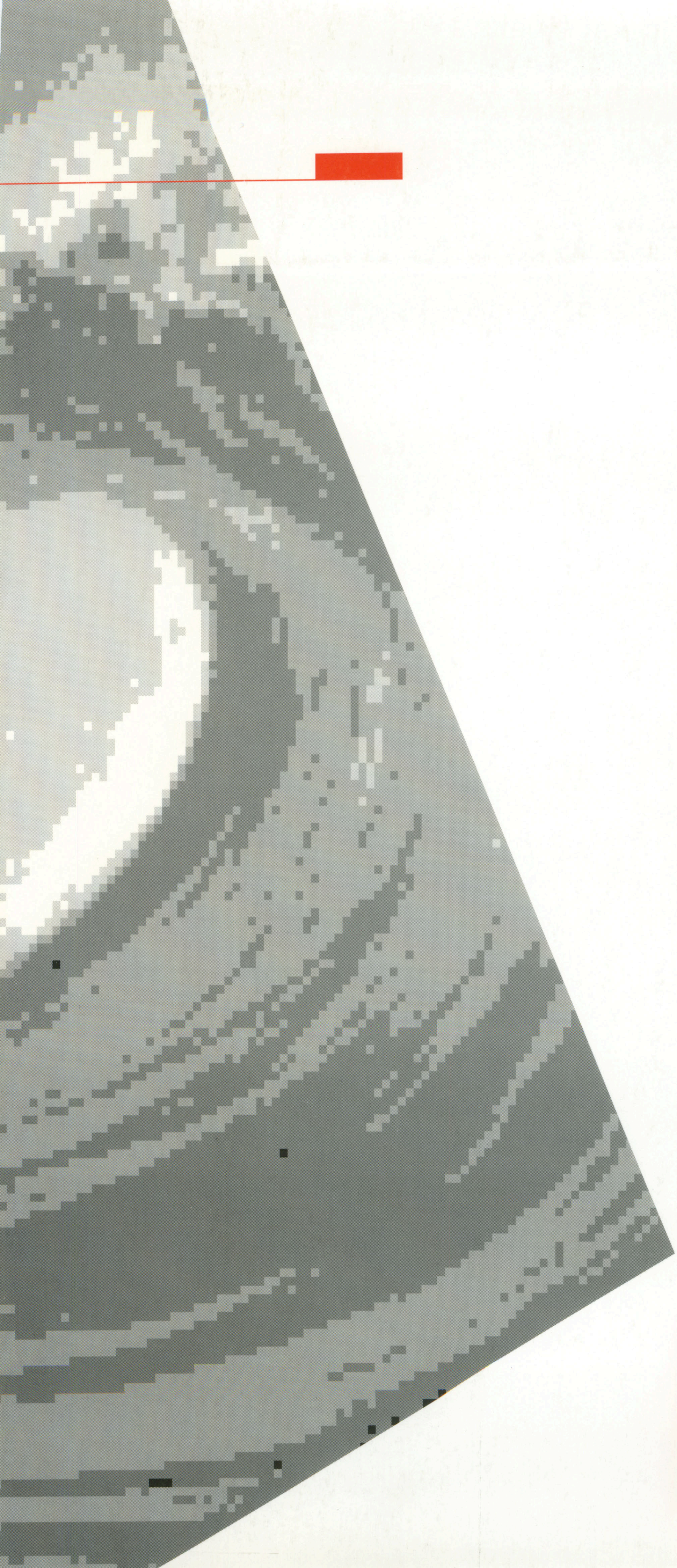

RE 204
Audio Analyzer
Service Manual

Volume I

_RE 204_
Audio Analyzer
Service Manual

PRECAUTIONS FOR ELECTRICAL EQUIPMENT

All electrically powered equipment can be dangerous. At RE TECHNOLOGY AS we have taken great care to ensure safety during the design and production of our equipment. Incorrect installation, handling, or interference, can, however, be hazardous.

INSTALLATION

This is a Safety Class I product which requires protective earthing. Normally this is obtained by the use of an IEC 320 power inlet together with a 3-wire power cable, but if the building's power installation does not include a protective earth, a separate earth connection must be established. The protective action must not be impaired by use of an extension cord (power cable) without a protective conductor. Even if the unit requires separate signal grounding, through external connections to the unit chassis, the protective earth must not be disconnected. Ensure that the line fuses have the correct value according to the voltage and power consumption.

WARNING

Disconnecting the protective earth conductor, inside or outside the equipment, is potentially hazardous to the operator. Removing the covers may expose parts carrying dangerous voltages.

SERVICE

Only trained service personnel should attempt to dismantle and repair the unit. Take great care during the installation and service of the unit, especially when adjusting or measuring an open unit under voltage. Before removing any covers, switch off the unit and remove the line cable from the power outlet.
Capacitors inside the unit may hold dangerous charges for a considerable time after the unit has been switched off. If it is necessary to replace components in the line connected partition or area, use only new parts of the correct and approved type. Take special care to maintain or re-establish the protective earthing.
The conductivity must be measured after the service or repair is finished. Do not remove any warning labels, but replace any damaged or illegible warning labels with new ones.

ESD (Electrostatic Discharge)

RE TECHNOLOGY products contain electrostatic sensitive components. You should **not** attempt to open a unit without proper precautions against electrostatic discharge, that is use a wrist strap and conductive work-bench surface. Otherwise the unit may fail or be degraded!

BACK-UP BATTERIES

For units with lithium back-up batteries ensure, when replacing them, that they are of the same type and are correctly installed before you switch the power on to the unit. Do not recharge the batteries or expose them to temperatures above 100 °C (212 °F). Dispose of used batteries according to your national/local regulations. The batteries contain chemicals which can be harmful to the environment. When you dispose of the unit itself, first remove the batteries and dispose of them separately. The estimated battery lifetime is four years.

EMC REQUIREMENTS

To meet the EMC requirements of Directives 89/336/EEC and 92/31/EEC you must use correctly shielded cables of good quality for all external connections when installing the unit. This implies that all multi-connector cables must have conductive connector housings with shield clamps, and the coaxial cables must be of the double-braided type.

SAFETY SYMBOLS

Warning. The unit will be marked with this symbol when it is necessary for the user to refer to the manual.

Ground terminal (sometimes used in the manual to indicate circuit common connected to the chassis).

Attention. Observe precautions for handling Electrostatic Sensitive Devices.

Danger. Live voltage exceeding 1000 V.

Warning label for laser radiation. The product is marked with this symbol if it is necessary to protect against laser radiation which is invisible and can cause permanent damage to the eye.

Use of Product Names. The product names mentioned herein are used for identification purposes only, and may be trademarks and/or registered trademarks of their respective companies.

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2. PRINCIPLE OF OPERATION

This section contains a description of the different parts of the RE 204 and how they work. The description emphasizes the functional aspects that you have to consider when you want to program the instrument for optimum performance.

2.1 General Description

In order to obtain a high measuring speed, the RE 204 uses digital signal processing to the widest extent possible. The tasks of the analog circuitry are reduced to a minimum, that is preparation of the raw input signal prior to analog-to-digital conversion. Refer to the block diagram shown in Fig. 2.1.

All filtering and the various detectors offered by the RE 204 are implemented using digital filter techniques, using a digital signal processor.

Before A/D conversion, the input signal passes through a low-pass filter and is level-adjusted in order to use as much of the dynamic range of the A/D converter as possible.

The analog inputs are configured as two identical dual-channel inputs. A separate input circuitry has been dedicated to each of the four inputs, while the gain section and the low-pass filter are common for two inputs.

The outputs of the Analog Frontends are routed to one 16-bit A/D converter via a multiplexer operating at a frequency which is double the sampling frequency. The sample values coming out of the converter alternate between the left and right channels. The converter transmits serial data to the signal processor.

The A/D converter and the signal processor handle two input channels simultaneously. A four-channel measurement is made by first measuring in the two front channels and then measuring in the two rear channels.

The Audio Generator option includes a separate digital signal processor, interfacing to two D/A converters, one for each output channel.

The Stereo Generator option is a conventional analog modulator with the L/R modulation signals supplied from the audio generator. Pre-emphasis is handled by adjusting the L/R levels from the audio generator.

An Intel 80C186 microprocessor controls the entire instrument and handles the interface to the IEEE 488 bus. The tasks of the processor include:

* Setup of the analog circuitry.

* Loading of the appropriate digital filter and measurement specifications to the signal analyzing processor.

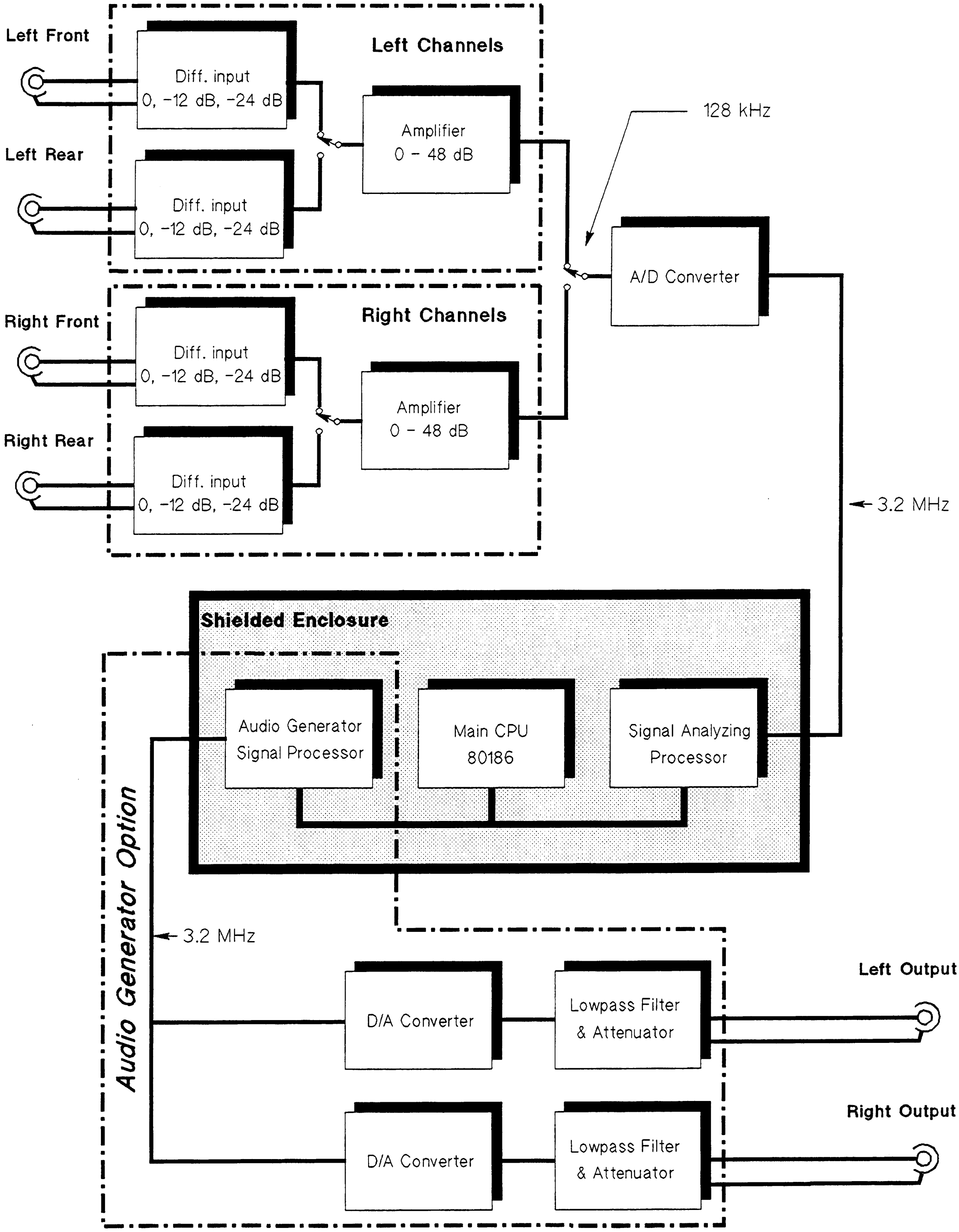

Fig. 2.1 - RE 204 Audio Analyzer, Block Diagram

* Calibration of the measurement results obtained from the signal processor.

* Calculation of frequency data for the audio generator.

Mechanically, the instrument is divided into two sections: an open frame structure holding the analog circuitries including the power supplies, and a shielded enclosure holding all digital circuitries. As some kind of filtering is necessary for each connection to and from the shielded enclosure, the number of connections are held at an absolute minimum.

2.2 Input Ranges and Autoranging

As the dynamic range of a digital instrument is dependent on the number of bits used in the analog-to-digital conversion, it is essential that the full input range of the A/D converter is used. On the other hand, it is important, that the maximum voltage is not exceeded, as this causes distortion and measurement errors.

You can control the range in different ways. For optimum measurement speed always set the input range from the IEEE 488 controller. However, in many cases this is not practically possible. Therefore, you can select auto ranging, meaning that the input range is automatically changed if the input peak voltage either overloads the A/D converter, or exceeds the dynamic range tolerance limit.

During the measurement, input overload is constantly monitored. For this purpose, analog peak detectors interfacing to a separate 8-bit A/D converter are included. The 80C186 microprocessor reads the peak detectors while the signal analyzing processor handles the measurement. When the measurement is completed, the input-low condition is also checked.

If the level is inadequate for the required measurement accuracy, the gain is adjusted and the measurement restarted.

The auto ranging procedure may also be disabled and the input range fixed for maximum measurement speed. In this case, an input level outside the selected range causes the RE 204 to report the error using a service request accompanied by a serial poll code indicating the nature of the error.

When an error occurs during a measurement, and the RE 204, despite the service request issued, is asked to output a measurement result, the result delivered is 0, except for SINAD and Wow & Flutter where a result of 100 % indicates an error. For some level measurements, however, results are delivered regardless of input-low conditions. Therefore always interrogate the serial poll code to avoid measurement errors.

The peak voltages for full scale are given in Table 2.1 together with the corresponding gain settings.

Peak Voltage	Gain Setting
30 Vp	-24 dB
24 Vp	-18 dB
12 Vp	-12 dB
6 Vp	-6 dB
3 Vp	0 dB
1.5 Vp	6 dB
750 mVp	12 dB
375 mVp	18 dB
187 mVp	24 dB
93 mVp	30 dB
46 mVp	36 dB
23 mVp	42 dB
11 mVp	48 dB

Table 2.1 - Full Scale Ranges

When the range is changed across the borders 0 dB/-6 dB and -12 dB/-18 dB, a relay is activated/deactivated. In these cases a delay of approximately 10 ms is added.

The dynamic range, that is the difference between the actual input level and the full scale level, depends on the measurement type. The RE 204 operates with the following dynamic ranges:

Measurement	Dynamic Range
RMS or Average, without filter	18 dB
RMS or Average, with filter	12 dB
Peak	24 dB
Quasi-Peak	18 dB
Frequency	18 dB
SINAD, fine range	6.5 dB
SINAD, coarse range	12 dB
Wow & Flutter	18 dB

Table 2.2 - Dynamic Ranges

2.3 Filters

The only hardware filter in the RE 204 is a 25 kHz low-pass filter used to bandlimit the input signal before A/D conversion. All other filters (weighting filters as well as the notch filter for the SINAD measurement) are created digitally by the digital signal processor.

Note that a given filter's characteristics may be created using either single or double precision in the signal processor calculations. Single precision filters create additional noise through truncation errors in the filter calculation, but allow measurements to take place in two channels simultaneously. Consequently, measurements involving double precision filters increase measurement time. At high input frequencies, however, the general measurement overhead is the dominating factor for the measurement speed, implying that the difference between single and double precision measurements are not significant.

2.3.1 Notch Filters

The notch filter is programmable, that is it may be tuned to any frequency between 20 Hz and 23750 Hz in steps of 1 Hz. For low notch frequencies, the filter may only be used if it is allowed to operate in double precision, that is measurements can only take place in one channel at a time.

Normally, the RE 204 automatically selects between single and double precision, depending on the selected notch frequency: a frequency below 700 Hz selects double precision, a frequency above 700 Hz selects single precision. It is possible, however, to control the precision from the IEEE 488 controller, for example if the notch depth at lower frequencies is not required to exceed 60 dB you can, through the filter command, force the RE 204 to use single precision and thus increase measurement speed. Selecting double precision at higher frequencies increases the depth of the notch to more than 70 dB. Refer to Fig. 2.2.

In the same way as the general-purpose notch filter, you can also use the SINAD notch filter as a single or double precision filter. Double precision is mandatory for frequencies below 700 Hz when measuring in the "fine" range, and for frequencies below 440 Hz when measuring in the "coarse" range.

Using a double-precision weighting filter with a SINAD measurement requires a double-precision notch filter. In this case, the "fine/coarse" selection is of no importance, as a double-precision filter covers the entire range from 10 % and downwards.

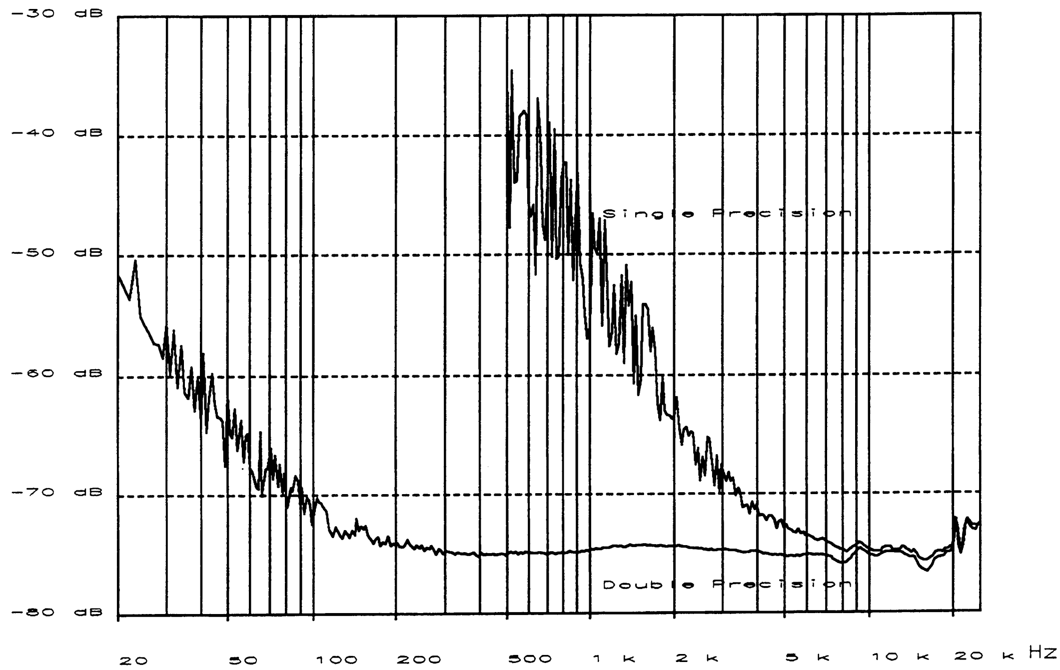

Fig. 2.2 - Notch Filter Depth

2.3.2 Band-pass Filters

The band-pass filter is programmable, that is it may be tuned to any frequency between 20 Hz and 23750 Hz in steps of 1 Hz. For low center frequencies, you can only use the filter if it is allowed to operate in double precision, that is measurements can only take place in one channel at a time.

Normally, the RE 204 automatically selects between single and double precision, depending on the selected center frequency: single precision for frequencies below 1 kHz and double precision for frequencies above 1 kHz. It is possible, however, to control the precision from the IEEE 488 controller, for example if the stop-band attenuation at lower frequencies is not required to exceed 60 dB.

In this case, selecting a single precision filter increases measurement speed. Selecting double precision at higher frequencies improves the stop-band attenuation by several dB. For example, the band-pass filter tuned to 1 kHz is shown for single and double precision in Fig. 2.3 and 2.4 respectively.

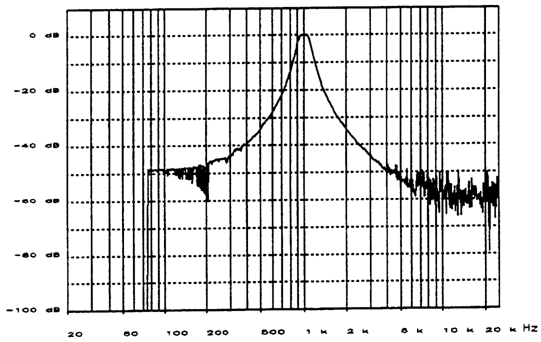

Fig. 2.3 - Single Precision Bandpass

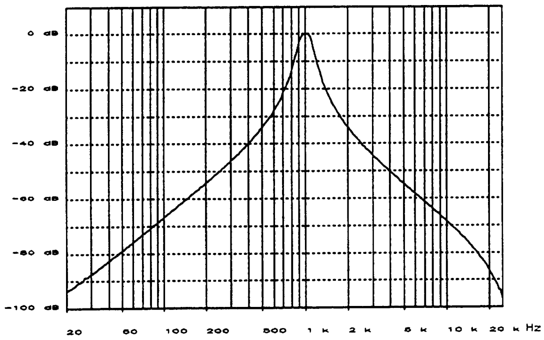

Fig. 2.4 - Double Precision Bandpass

2.3.3 User Filters

To satisfy different needs for different applications, it is possible to define digital filters for the RE 204 externally, and download them at any time. Through this feature, the number of different filters that you can use in a test sequence becomes practically unlimited. All you have to do is download new user filter coefficients to the RE 204 when you need to change a filter.

For most filters, especially filters with large attenuation at low frequencies and/or filters with tight frequency specifications, the definition of the coefficients is not a straight forward task, as topics such as internal filter gain, absolute gain, settling time, stability etc. all must be investigated.

Therefore, we do strongly recommend, that this task is handled by RE TECHNOLOGY AS based on your filter description. The resulting filter parameters may then be downloaded as explained in the programming section of the Operating Manual.

2.4 SINAD Measurement

The SINAD measurement uses a separate programmable notch filter. Due to the fact that the input signal is known to have a dominant component, the fundamental frequency, it is possible for the RE 204 to obtain a better dynamic range compared to using the notch filter on an arbitrary signal. The penalty for this is, that only a specific range of SINAD values can be covered by the same filter. Thus, it must be specified, whether the SINAD value is expected to be "coarse" or "fine".

The "coarse" range covers 10 % down to 0.1 %, while the "fine" range covers 0.3 % and downwards. However, if the RE 204 finds that a given result is outside the selected range, the range automatically changes and the measurement repeated. This increases measurement time, so selecting the correct range speeds up things.

If the fundamental frequency is below 700 Hz and/or if a double-precision weighting filter is applied, the notch filter is always double precision. In this case, the "coarse/fine" selection is of no importance, since a double precision filter covers the entire range.

The fundamental frequency is measured and the notch filter calculated accordingly. If the frequency is identical to the last one used for this channel, the filter calculation is omitted. This saves approximately 150 ms.

If the signal used for the test is known to originate from the audio generator, either directly or via the AM/FM stereo generator, the actual fundamental frequency measurement may be omitted. It is assumed, that left output from the audio generator is used for measurement in left front and left rear, and that right output is used for measurement in right front and right rear.

The SINAD value is calculated as:

$$\frac{\text{Signal excluding the fundamental}}{\text{Entire signal}} \cdot 100\%$$

In other words, the SINAD value is the output of the notch filter divided by the input to the notch filter. Both the signal, and the signal excluding the fundamental frequency, that is noise and distortion, are measured simultaneously. Note that a weighting or a band-limiting filter used with a SINAD measurement *only* affects the noise and distortion measurement and *not* the signal measurement.

If the measurement time is not specified, 10 times the period of the fundamental frequency is automatically used, except for frequencies above 10 kHz, as the measurement time cannot be set below 1 ms. Note, however, that the noise and distortion measurement may call for a significantly higher measurement time for an accurate result. In this case, the measurement time must be specified in the SINAD command.

2.5 RMS, Average and Quasi-Peak Measurements

All three detectors are implemented digitally, and weighting filters may be applied. The quasi-peak measurement, however, only accepts the CCIR 468 filters CW and CB.

When measuring RMS or average, the measurement time is determined as follows:

1. If the measurement time is specified, this value is of course used.

2. If a frequency is given as parameter, that is the input frequency, the measurement time is set to 10 times the signal period.

3. If the audio generator is known to be the origin of the test signal, possibly via the AM/FM stereo generator, the measurement time is selected according to the following rules:

    a. If the frequencies in the two channels left and right differ, a measurement time of 10 times the largest signal period is selected.

    b. If the frequency is below 400 Hz, a measurement time equal to one signal period is selected, otherwise 3 times a signal period.

4. If no parameter is given, the frequency is measured and the measurement time set to 10 times the signal period. If no frequency is found, as for noise measurements, a period of 250 ms is selected. If different frequencies are found for the left and right input channels, the measurement time is determined by the lowest of the frequencies.

As the two front channels are measured simultaneously, and then the two rear channels, the measurement time may differ for the front/rear measurements.

In addition to the rules above, note that a measurement time of less than 1 ms is never used.

As the quasi-peak measurement is used for noise measurements, linking to a specific frequency is not a legal choice.

2.6 Peak Measurement

Peak measurements are made using analog detectors, preceded by full-wave rectifiers. As the antialiasing filter is not used, the bandwidth is extended to 75 kHz, and the ripple of 0.1 dB is eliminated.

2.7 DC Measurement

The DC voltage from the separate input connector is routed to the 16-bit A/D converter. The output from the converter is then averaged in 50 ms by the signal processor, the result is compensated for gain, high or low range, and delivered to the IEEE 488 interface.

Note that no auto ranging between high and low range is implemented.

To facilitate implementation of different ranges, the gain factor may be defined, according to the actual hardware configuration.

2.8 Frequency Measurement

The frequency measurement is based on a zero-crossing detection, performed by the signal processor.

The frequency measurement algorithm searches for frequency, from the lower frequency range and upwards. If nothing is anticipated about the input, it is necessary to scan from 20 Hz and upwards. For accurate frequency determination, at least two periods of the signal are needed, so for an unknown input frequency, the minimum observation period is:

$$\frac{2}{20\ \text{Hz}} = 100\ \text{ms}$$

In practice, it is 135 ms. This amount of time is not needed if it is known that the frequency is above a certain limit, for example 500 Hz. In this case, it is only necessary to observe the signal for a period of:

$$\frac{2}{500\ \text{Hz}} = 4\ \text{ms}$$

that is a speed improvement of 25 times. Such a known lower frequency band, or alternatively an observation period, may be specified as part of the frequency measurement command in order to speed up the measurement.

High noise levels on the input signal may disturb the zero-crossing detection and result in fluctuating results. This problem is more significant when measuring at low frequencies, because the signal is in the area around zero for a longer period of time where noise may cause the signal to cross the zero line more than once. In order to measure low frequencies with a high noise content, a digital low-pass filter can be used. In this way, stable readings are obtained even in the presence of rather large noise components.

The low-pass filter is a 2nd order Butterworth filter with a cut-off frequency of 2500 Hz. Enabling/disabling of this filter is a parameter for the frequency measurement command. However, if this parameter is omitted, the RE 204 automatically detects whether the low-pass filter is required or not: if the rms level without the filter is more than 4 times the rms level with the filter, that is the main component of the signal is below approximately 3 kHz, then the filter is used during the frequency detection.

2.9 Meter Updating

The bargraph displays are used for monitoring the input levels of all four channels simultaneously, regardless of the channels set active for measurements. No filter is employed.

Each bargraph is composed of 10 LED segments, showing the peak input voltages as shown in Table 2.3. A bar lights as soon as the input level has passed the logarithmical middle of the distance between two bars. For example, the 10 Vp bar lights when the input level is above 5.62 Vp, which is the logarithmic middle between 3.16 Vp and 10 Vp.

Note that an input which is left open normally shows a level of approximately 10 - 100 mVp.

When the meter is deactivated, the upper and lowermost bars light.

Display	Input Level
10 Vp	>5.6 Vp
3.16 Vp	>1.7 Vp
1 Vp	>560 mVp
316 mVp	>170 mVp
100 mVp	>56 mVp
31.6 mVp	>17 mVp
10 mVp	>5.6 mVp
3.16 mVp	>1.7 mVp
1 mVp	>0.5 mVp

Table 2.3 - Meter Ranges

Fig. 2.5 shows that all four inputs are routed to analog peak detectors, which are allowed to charge for 50 ms. Then, the Main Computer reads the voltage using a four-input 8-bit A/D converter.

The computer compensates the reading for the actual gain set in the programmable amplifiers and reads out the result to the bargraph displays. Auto ranging may take place if the level is inappropriate, regardless of the enabling of the general auto ranging feature.

Note that updating the meters has a lower priority than making a measurement, that is when a measurement is started, updating of meters is suppressed. Consequently, if measurement commands are issued continuously by the IEEE 488 controller, the display never changes. You can deal with this problem in two ways:

* Make your program halt for approximately 100 ms whenever an update is wanted, thus allowing the meter procedure to complete.

* Issue a new **MR,ON** command which forces the meter to update.

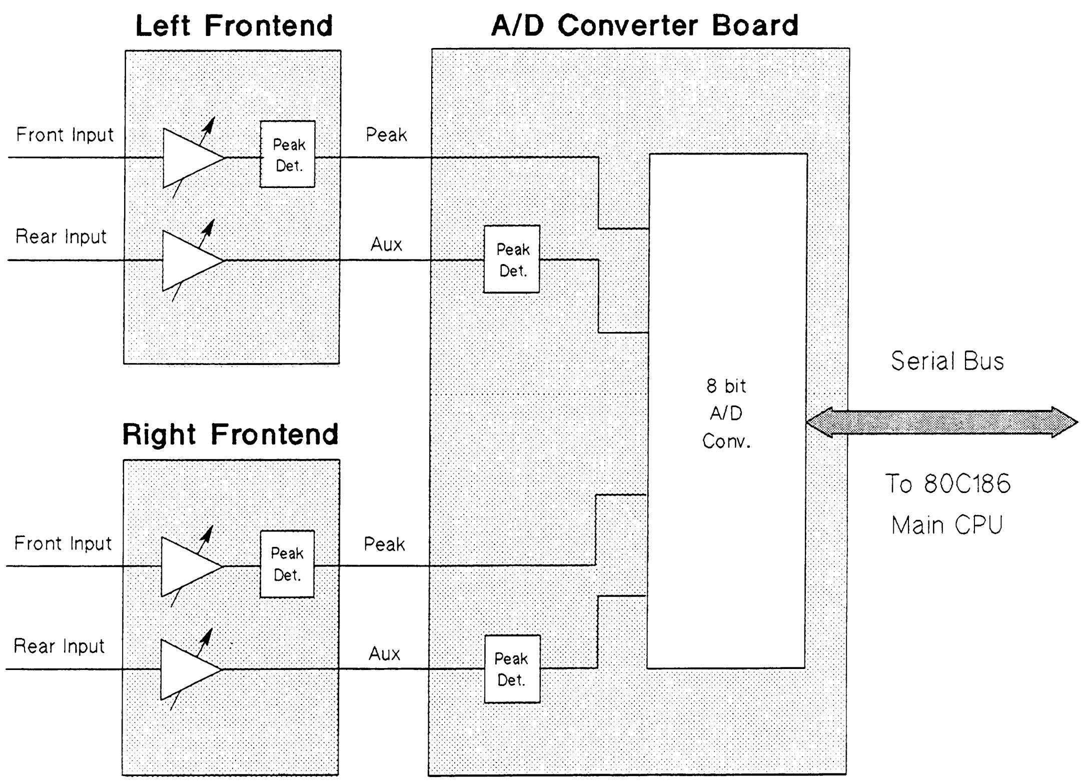

Fig. 2.5 - Meter Operation

2.10 Calibration

The fast measuring speed of the RE 204 is due to the DC coupling of the signal path. However, a DC component originating from offset voltages due to aging, temperature changes etc. will inevitably be present. When measuring, e.g. SINAD or very low rms voltages without a highpass filter, this DC voltage may corrupt the measurements.

Hence, it must be ensured, that it is always kept as low as possible. The hardware calibration feature handles this task.

The calibration may be performed either automatically or governed by the external controller. In case of automatic calibration the scheme is as follows:

* For the first 5 minutes, i.e. the initial warm-up period, no calibration is done.

* During the next 30 minutes, calibration takes place each minute. This is the final warm-up period.

* After the first 30 minutes, calibration takes place every 15 minutes.

Calibration must be performed for each channel and for each gain step and is time consuming. We recommend that you disable the automatic calibration and let the IEEE 488 controller initiate calibration during natural pauses in the test sequence.

The calibration interval necessary depends on the actual dynamic range needed. If SINAD, for example is only measured down to approximately 0.15 % and RMS down to 1 mV, it may not be necessary to calibrate so often. In this case a calibration once a week is probably enough. The actual interval depends on the temperature cycle of your set-up.

The calibration procedure, which is controlled by the Main Computer, is as follows:

* The external input is disconnected and a short circuit established.

* The DC voltage is measured using the same signal path as for measurements.

* A compensation DC voltage is inserted using a D/A converter.

* The DC measurement is repeated in order to store the residual DC value together with the D/A converter setting.

The calibration procedure is repeated for each channel. Whenever the gain and/or channel is changed, the correct DC compensation voltage is established from a stored table. When measuring small RMS values, the RE 204 may correct the result by subtracting the residual DC.

2.11 Wow & Flutter

When measuring Wow & Flutter, an optional board is installed in the right frontend channel. This board removes amplitude variations from the input signal using a clipper. The signal is then routed via the 25 kHz low-pass filter to the A/D converter. After digitalization, the signal processor performs the following steps digitally:

* 4.5 kHz low-pass filtering to remove carrier harmonics.

* FM demodulation.

* Filters the demodulated signal, 0.2 to 500 Hz, or 0.5 to 200 Hz filters.

* Weighting according to DIN standard, if selected.

* Detection according to the selected standard:

  RMS for JIS standard.
  Average for NAB standard.
  Quasi-peak for DIN standard.

* Low-pass filtering of the detector output to simulate a meter response with $\tau = 60$ ms.

* Calculation of mean value, sigma value and the result: mean + $2 \cdot \sigma$.

Before the Wow & Flutter measurement, the frequency is measured in order to tune the digital FM demodulator to the actual frequency.

2.12 Audio Generator

The Audio Generator is composed of two boards:

* A Digital Board comprising a TMS320C10 signal processor and a sine wave look-up table.

* An Analog Board comprising two channels, each equipped with a 16-bit D/A converter, an antialiasing low-pass filter, programmable level setting, and balanced output buffers.

The signal processor generates digital samples for a single sine wave by reading samples from the look-up table and multiplying them by a level factor. This factor is determined by the 80C186 Main Computer and includes three compensations:

* As the gain on the Analog Board is only programmed in steps of 3 dB, the finer gain adjustments are made digitally.

* The frequency response of a low-pass filter (not the antialiasing filter) is compensated.

* It is known from the sampling theory, that when using a staircase signal in the D/A conversion process instead of delta functions, the frequency response of the output signal follows with a sin x/x function, $x = 2\pi fT/2$, where T is the sampling period. Thus, the level factor must compensate for this frequency dependency.

As the latter two compensations are frequency dependent, different settings of the analog attenuator may be seen for the same output level at different frequencies.

2.13 Stereo Generator

The Stereo Generator option offers both FM stereo and AM stereo. In both cases, the L/R signals must be supplied by the audio generator.

2.13.1 FM Stereo

The FM stereo generator is a conventional analog design, with the exception of the pre-emphasis function which is implemented as a digital compensation of the left and right input signals.

The composite signal is generated using the time multiplexing principle, which gives completely uniform handling of the left and the right channel signals.

The modulator, operating at 38 kHz, is an integrated balanced switch modulator driven by a 38 kHz square wave. The modulator itself suppresses the 38 kHz carrier, but it produces unwanted sidebands at odd harmonics of 38 kHz.

The sidebands at the third harmonics of 38 kHz, that is 114 kHz, are balanced out by a signal from a 114 kHz modulator similar to and synchronized to the 38 kHz modulator. Higher sidebands, that is at 190 kHz and upwards, are removed by a composite filter with a linear phase response and a flat amplitude response up to 53 kHz, resulting in high L/R separation.

The sine wave pilot signal is generated by integration of a 19 kHz square wave derived from the same digital circuit which generates the 38 kHz carrier. This results in a negligible pilot phase deviation in relation to the 38 kHz carrier.

The harmonics of the 19 kHz square wave are balanced out and removed by filters. The third and the fifth harmonics, that is 57 kHz and 95 kHz, are compensated using a 57 kHz and a 95 kHz square wave. The seventh harmonic is eliminated by a 133 kHz trap while the remaining harmonics are attenuated by the composite filter.

You can set the pilot level in steps of 0.5 % composite level using an attenuator.

The left and the right signals are pre-emphasis-weighted in the audio generator. Thus, the left and right output signals available at the audio generator output connectors incorporate this weighting. Note that the pre-emphasis weighting is implemented as attenuation of the lower frequencies instead of amplification of the higher frequencies, as shown in Fig. 2.6.

Output level control is accomplished by adjusting the L/R levels from the audio generator, which you program in percent. You can adjust the actual output level for 100 % composite signal using a potentiometer.

2.13.2 AM Stereo

For modulation of an RF generator, for example the RE 122 Signal Generator, an AM stereo matrix is generated using the audio generator. The audio generator left output generates the L-R+25 Hz pilot, while the right channel generates L+R. As all components are digitally calculated, the resolution for the L/R level as well as for the pilot is very fine.

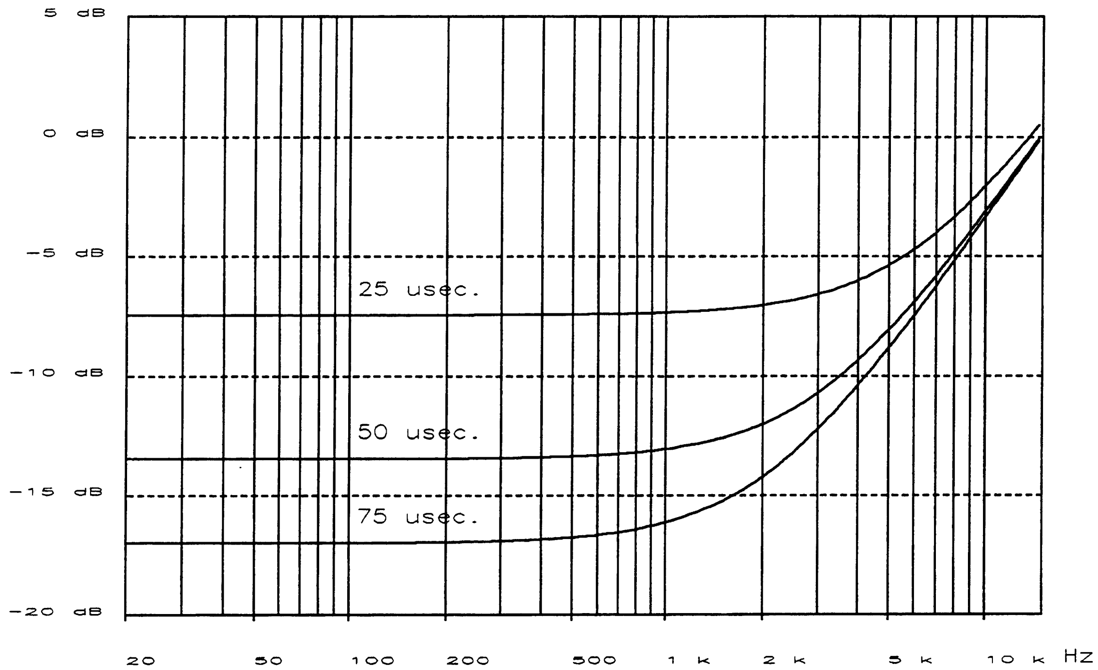

Fig. 2.6 - FM Pre-emphasis

3. DISMANTLING

This section describes how you get access to the individual printed circuit boards of the RE 204. Reassembling is not described, as it is the opposite of the dismantling operation.

Fig. 3.1 shows the location of the individual sections of the RE 204:

* Trafo Section
* Digital Section
* Analog Section
* Front Panel.

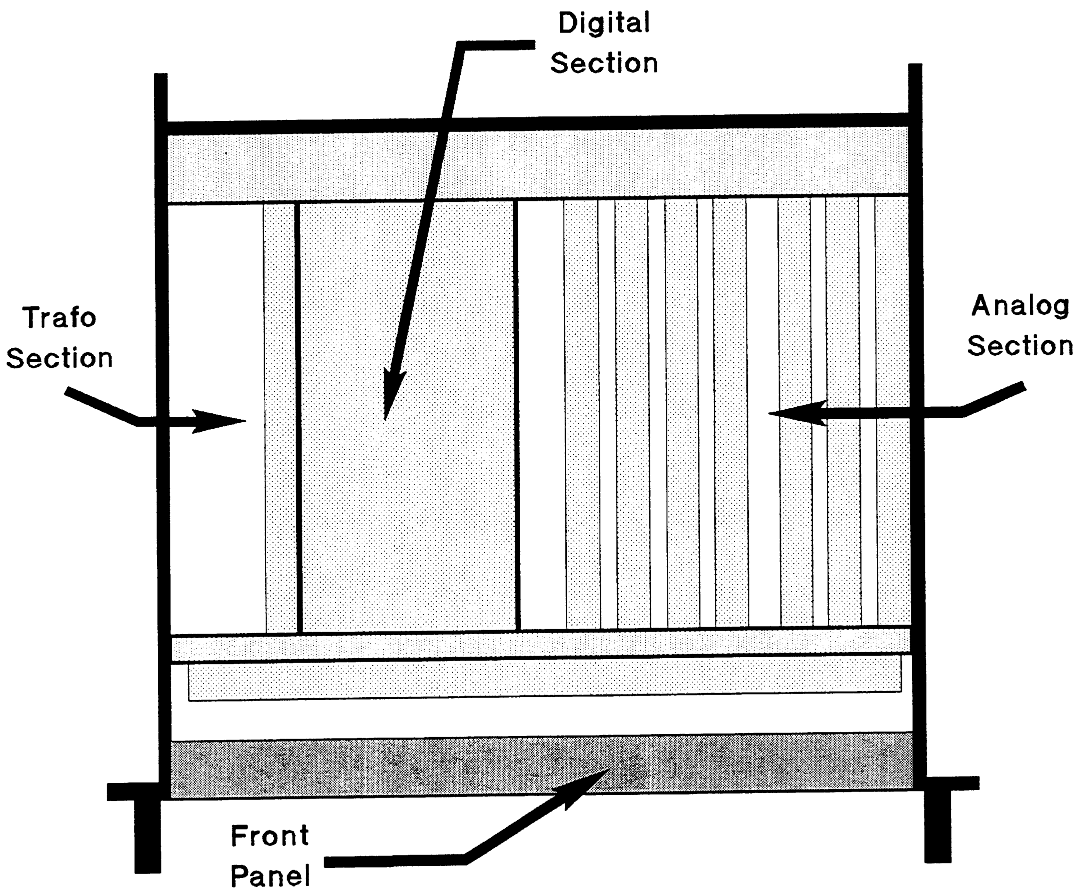

Fig. 3.1 - RE 204 Sections

The Trafo Unit contains the power-line inlet with fuses and line filter, the line transformer, and the +5 V Power Supply (901-844).

The Digital Section contains:

* 80C186 Main Computer (901-870)

* ADSP-2100A Signal Analyzing Processor (901-840)

* TMS320C10 Signal Processor constituting the Audio Generator Digital Board (901-867) (optional)

* Digital Motherboard (901-845).

The Analog Section contains all analog boards:

* Two Analog Frontend Boards (901-839) (one for the left channels and one for the right channels)

* A/D Converter Board (901-842)

* Audio Generator Analog Board (901-868) (optional)

* Analog Motherboard (901-841), which provides all interconnections between the individual sections of the instrument, and in addition holds the ±15 V and -5 V power supplies

* Stereo Generator (901-871) (optional).

In addition to these analog boards, a Wow & Flutter Board (901-840) may be installed on the Analog Frontend board for the right channel inputs.

The only circuitry contained in the Front Panel is the Meter Board (901-869).

3.1 Top and Bottom

The top and bottom plates are secured by two screws, located at the rear of the instrument. At the front, the plates are held by the Front Panel.

3.2 Front Panel Section

The Front Panel Section holds only one PCB assembly, the Meter Board.

To remove the Front Panel cover, unscrew the three screws indicated in Fig. 3.2. Note that the top and/or bottom plates do not need to be removed. Make sure that the cable for the Sub-D connector mounted in the cover plate is disconnected from the Meter Board during removal.

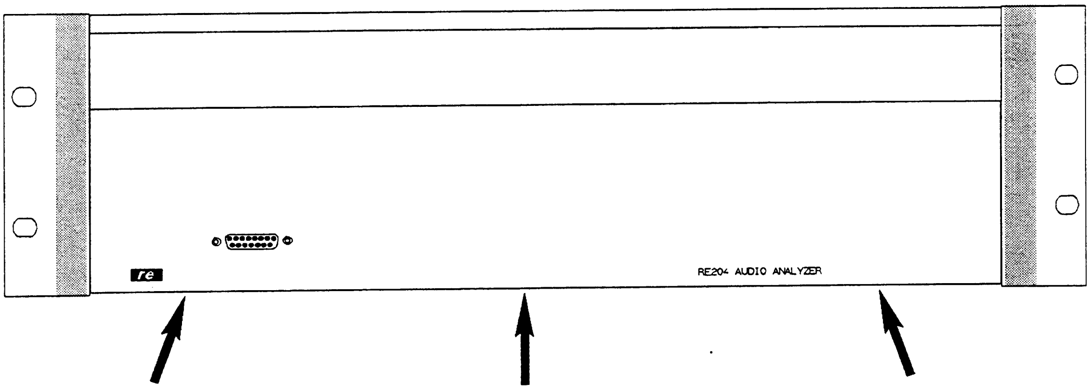

Fig. 3.2 - Removing the Front Panel Cover

In order to gain access to the Analog Motherboard, it is advantageous to remove the entire Front Panel.

To remove the entire Front Panel unscrew the two screws on each side of the instrument. The screws are located immediately behind the rack mounting flanges. When removing the Front Panel you must disconnect the flat cable connecting the Front Panel to the Analog Motherboard.

3.2.1 Meter Board

To remove the Meter Board, remove the Front Panel cover as previously described. Remove the top plate and disconnect the cable connecting the Meter Board to the Analog Motherboard at the motherboard. Yoy may then remove the board from the stands using a screwdriver.

3.3 Trafo Section

To remove the Trafo Section remove the screws indicated in Fig. 3.3. Insert a screwdriver into the slot between the rear panel and the chassis of the RE 204. You can then remove the transformer unit (transformer board, transformer and line plug).

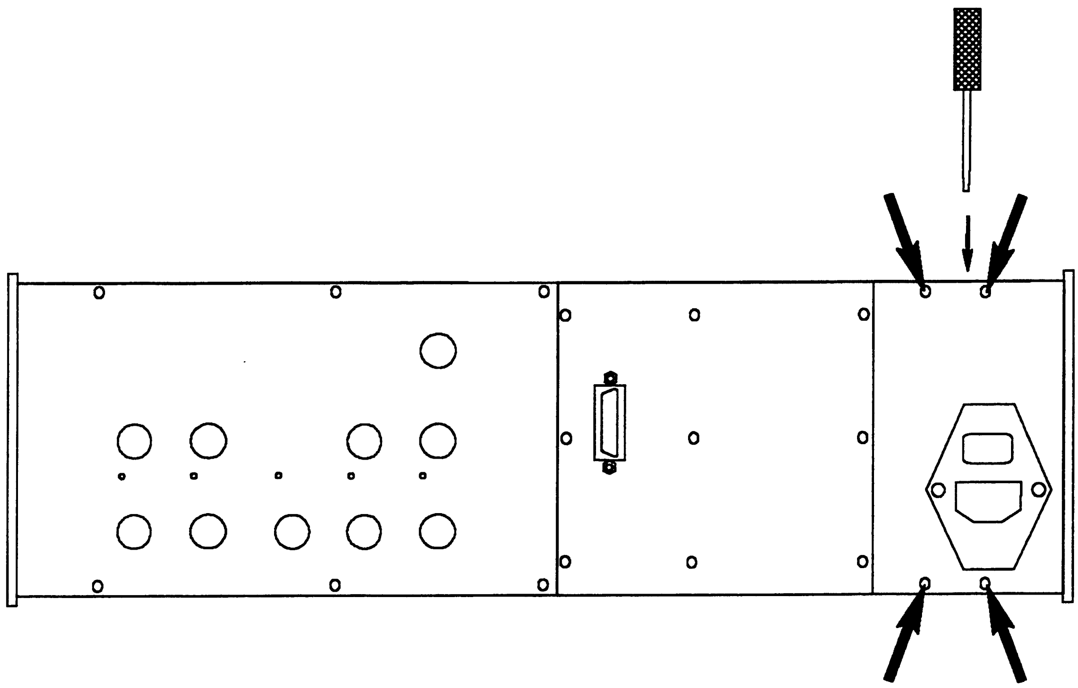

Fig. 3.3 - Removing the Trafo Unit

CAUTION The protective ground connection of the instrument is via the rear panel of the transformer unit. Therefore, if the transformer board is mounted on an extender board, it is mandatory that this connection is established using a wire or similar.

3.4 Digital Section

To disassemble the Digital Section remove the screws indicated in Fig. 3.4. Insert a screwdriver into the slot between the rear panel and the chassis of the RE 204. You can then remove the Main CPU Board and the rear panel of the Digital Section.

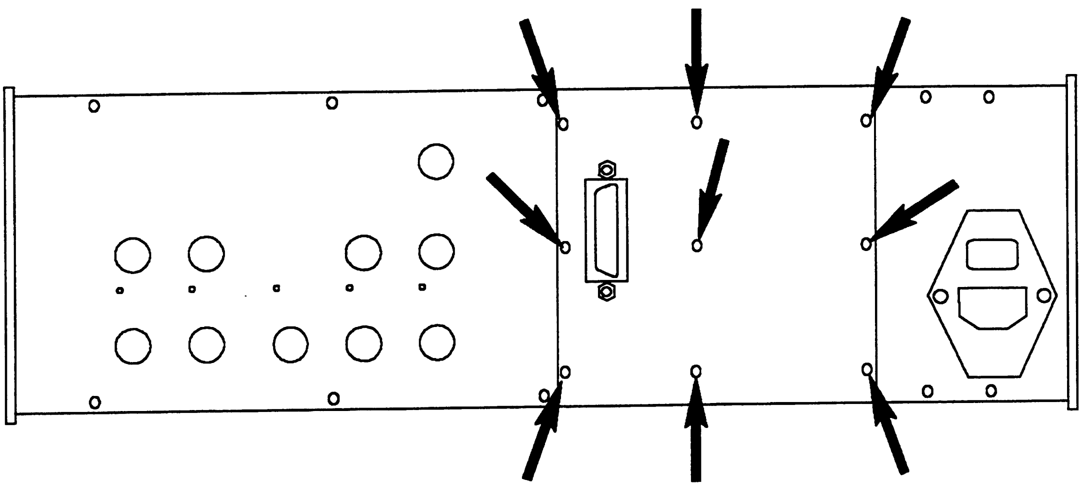

Fig. 3.4 - Dismantling the Digital Section

When you have removed the Main CPU Board, you have access to the two other digital boards: the Signal Analyzing Processor and the Audio Generator Signal Processor (if the Audio Generator Option is installed). If either of these two boards is to be mounted on an extender board, it is recommended that you remove the rear panel from the Main CPU Board. To do this, unscrew the screws shown in Fig. 3.5.

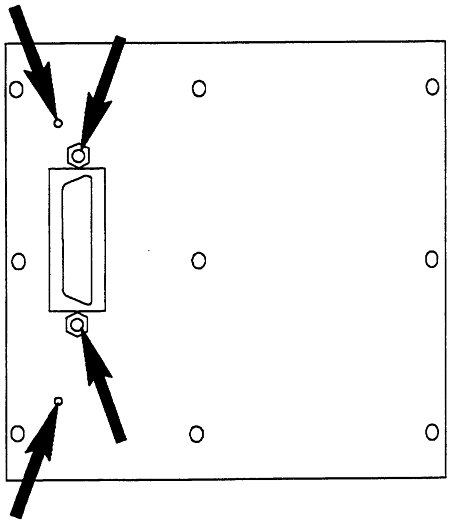

Fig. 3.5 - Removing the Rear Panel from the Main CPU

3.4.1 Digital Motherboard

To gain access to the Digital Motherboard, you must remove the shielding box of the Digital Section. First, remove the top and bottom plates (see section 3.1). Then disconnect the two flat cables connecting the Digital Section and the Analog Motherboard by unscrewing the screws securing them to the Digital Section.

When you have removed the four screws on the top and the four screws on the bottom of the shielding box, you may remove the entire box. It may be necessary to loosen some of the screws securing the card holders in the Analog Section in order to get the box out.

The Digital Motherboard is mounted on the cover plate. To remove it, unscrew the 6 screws and loosen the four hexagonal screws holding the two Sub-D connectors mounted in the cover plate.

3.5 Analog Section

To gain access to the boards in the Analog Section, remove the screws shown in Fig. 3.6. The location of the individual boards is shown in Fig. 3.7.

3.5.1 Analog Motherboard

To remove the Analog Motherboard:

1. Remove all printed circuit boards in the Analog Section.
2. Remove the entire Front Panel (see section 3.2).
3. Disconnect the two flat cables connecting the motherboard and the Digital Section by unscrewing the screws securing the cables to the Digital Section.
4. Remove the connector to the fan.
5. Unscrew the screws holding the motherboard (5 at the top, 6 at the bottom) and pull it out.

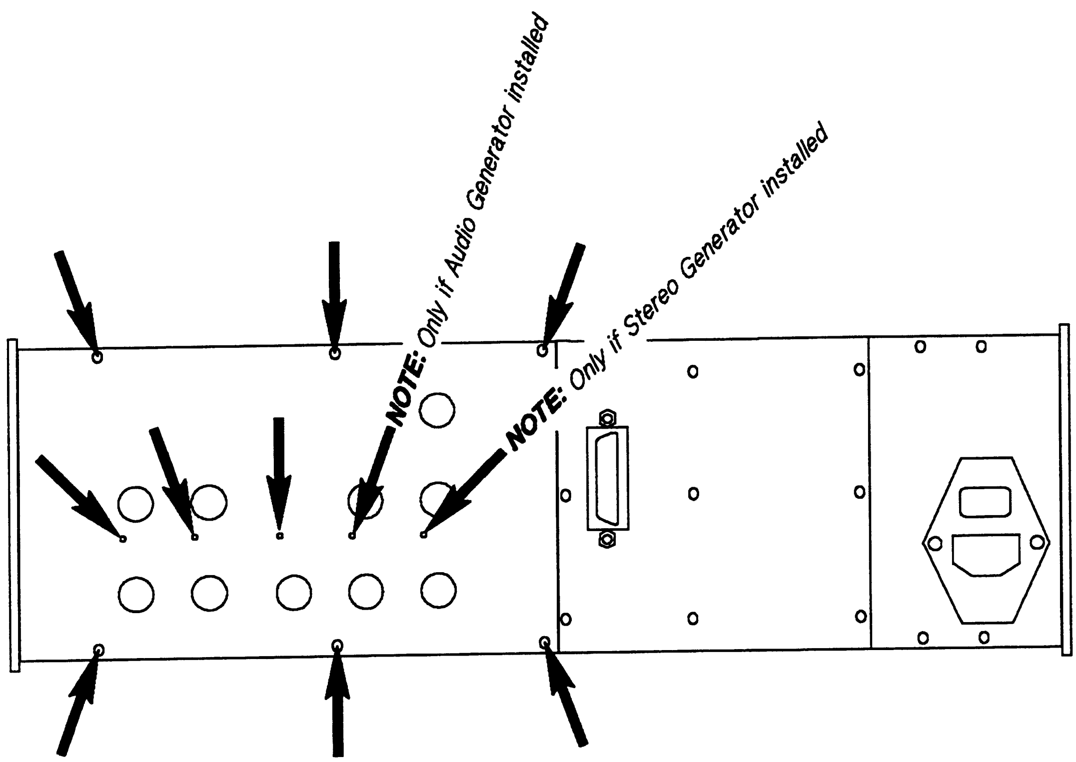

Fig. 3.6 - Removing the rear panel of the Analog Section

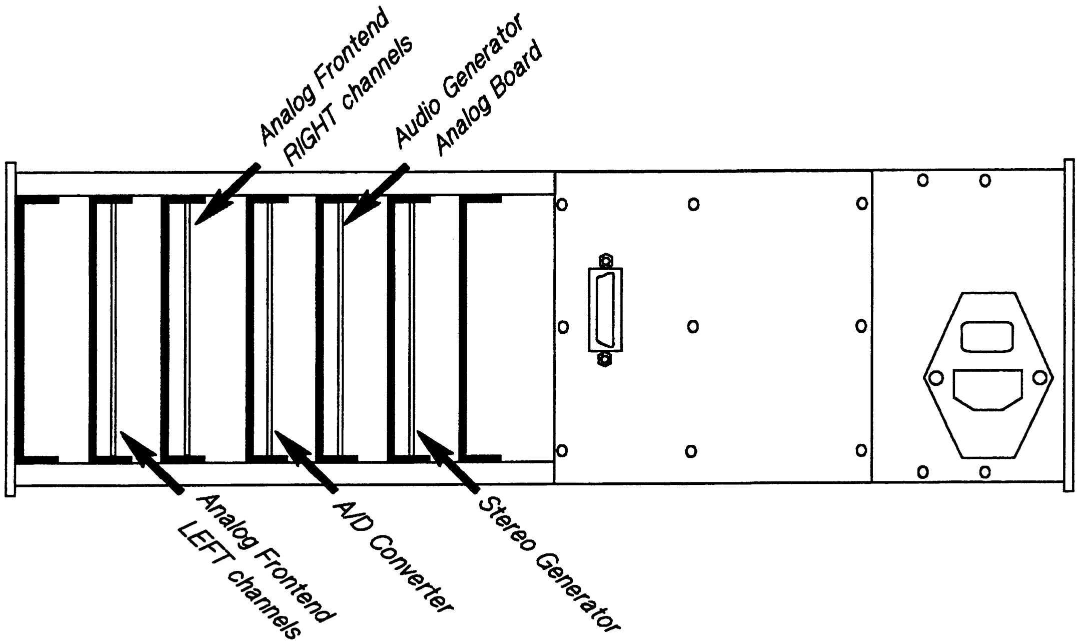

Fig. 3.7 - Analog Board Positioning

4. VERIFICATION AND MAINTENANCE

4.1 Performance Check

Before adjustments are made, the RE 204 must be allowed to warm-up for a period of at least one hour.

The procedures in this section test the electrical performance of the RE 204, using the specifications in section 17 as the performance standards. The performance tests are suitable for incoming inspection, troubleshooting, verification or preventive maintenance.

You require an IEEE 488 controller for practically all the tests. You should be able to output single commands, obtain measurement results from the RE 204 and display them. Before you perform any test, we recommend that you reset the RE 204 and switch on the calibration. You do this with the following command: "**RT CL,ON**"

Section 4.2 lists the equipment required for the performance tests.

After verification and maintenance we recommend that you reset the RE 204 Audio Analyzer with the following command: "**RT,CL,ON**"

4.2 Required Test Equipment

Instrument	Critical Specification	Recomm. Model
Audio Generator	50 Hz to 25 (60) kHz, SINAD <-80 dB	B&O TG 8 or RE 204 Audio Generator Option
DC Power Supply	0 to 30 V DC	
RMS Voltmeter	50 Hz to 100 kHz absolute accuracy: 0.1 % transfer accuracy: 0.01 %	HP 34401
Distortion Analyzer	THD <-110 dB SINAD <-80 dB	Audio Precision System One
Frequency Counter	accuracy: 0.1 Hz	HP 34401
DC Voltmeter	accuracy: 0.05 %	HP 34401
Stereo Analyzer	Stereo Separation ≥60 dB	R&S Modulation Analyzer FMAB
Oscilloscope	Capability of 40 dB over-drive without distortion of zero line and a sensitivity of 5 mV/div.	ADVANCE OS3000
Spectrum Analyzer	Freq. range 10 Hz to 1 MHz	HP 3588A

Table 4.1 - Required Test Equipment

4.3 Audio Generator

This section describes how to make a performance test of the Audio Generator of the RE 204. For further information about commands refer to the Operating Manual. Do not use the RE 204 as an analyzer for these tests, as some of the specifications are up to or better than the specifications of the RE 204 analyzer part.

4.3.1 Output Level

Equipment
RMS Voltmeter

Specification
Accuracy ±0.1 dB

Procedure

1. Connect the RMS voltmeter to the left output channel of the RE 204
2. Send the following command: "**AF,B,1000Hz**"
3. Check the Output Level accuracy according to Table 4.2
4. Repeat the measurements for the right channel.

Step	Attenuation	RE 204 Command	Measuring and Tolerance
1	-48 dB	"AL,B,10mVp"	7.071 mV_{rms} ±0.1 dB
2	-45 dB	"AL,B,16mVp"	11.31 mV_{rms} ±0.1 dB
3	-42 dB	"AL,B,25mVp"	17.68 mV_{rms} ±0.1 dB
4	-39 dB	"AL,B,35mVp"	24.75 mV_{rms} ±0.1 dB
5	-36 dB	"AL,B,50mVp"	35.36 mV_{rms} ±0.1 dB
6	-33 dB	"AL,B,70mVp"	49.50 mV_{rms} ±0.1 dB
7	-30 dB	"AL,B,100mVp"	70.71 mV_{rms} ±0.1 dB
8	-27 dB	"AL,B,135mVp"	95.46 mV_{rms} ±0.1 dB
9	-24 dB	"AL,B,190mVp"	134.4 mV_{rms} ±0.1 dB
10	-21 dB	"AL,B,270mVp"	190.9 mV_{rms} ±0.1 dB
11	-18 dB	"AL,B,375mVp"	265.2 mV_{rms} ±0.1 dB
12	-15 dB	"AL,B,530mVp"	374.8 mV_{rms} ±0.1 dB
13	-12 dB	"AL,B,750mVp"	530.3 mV_{rms} ±0.1 dB
14	-9 dB	"AL,B,1.100Vp"	777.8 mV_{rms} ±0.1 dB
15	-6 dB	"AL,B,1.500Vp"	1.060 V_{rms} ±0.1 dB
16	-3 dB	"AL,B,2.120Vp"	1.499 V_{rms} ±0.1 dB
17	0 dB	"AL,B,3.000Vp"	2.121 V_{rms} ±0.1 dB
18	3 dB	"AL,B,4.250Vp"	3.005 V_{rms} ±0.1 dB
19	6 dB	"AL,B,6.000Vp"	4.243 V_{rms} ±0.1 dB
20	9 dB	"AL,B,8.500Vp"	6.010 V_{rms} ±0.1 dB

Table 4.2 - Output Level Accuracy

Adjustments

Refer to section 12.2 for any relevant adjustments.

4.3.2 Frequency Response

Equipment
RMS Voltmeter

Specification

Accuracy	±0.05 dB	20 Hz to 10 kHz
	±0.1 dB	10 kHz to 25 kHz

Procedure

1. Send the following command to the RE 204: "`AL,B,1Vp AF,B,1000Hz`"
2. Connect the RMS Voltmeter to the Left Output BNC connector of the RE 204 and read the value. Store this value as a reference and check the level at the following frequencies:
   25Hz, 500Hz, 2kHz, 10kHz, 15kHz, and 25kHz
3. Repeat the measurements for right channel.

The permissible error is	±0.05 dB at	25 Hz, 500 Hz, 2 kHz and 10 kHz
	±0.1 dB at	15 kHz and 25 kHz

Adjustments
Refer to section 12.2 for relevant adjustments.

4.3.3 Total Harmonic Distortion (THD)

Equipment
Distortion Analyzer

Specification

THD	<-86 dB

Procedure

1. Connect the Distortion Analyzer to the Left Output BNC connector of the RE 204
2. Send the following command: "`AF,B,1000Hz AL,B,1Vp`"
3. Check, using the Distortion Analyzer, that the THD is within limits
4. Repeat the measurement for the right channel.

The permissible value is <-86 dB

Adjustments
Refer to section 12.2 for relevant adjustments.

4.3.4 SINAD

Equipment
Distortion Analyzer

Specification

SINAD	<-80 dB

Procedure

1. Connect the Distortion Analyzer to the Left Output BNC connector of the RE 204
2. Send the following command: "`AF,B,1000Hz AL,B,1Vp`"
3. Check, using the Distortion Analyzer, that the SINAD is within limits
4. Repeat the measurement for right channel.

The permissible value is <-80 dB

Adjustments
Refer to section 12.2 for any relevant adjustments.

4.3.5 Frequency Measurement

Equipment
Frequency Counter

Specification

Accuracy	±25ppm

Procedure

1. Send the following command: "`AL,B,1Vp AF,B,24000Hz`"
2. Connect the Frequency Counter to the Output Left BNC connector
3. Check, by connecting the frequency counter to the Output Left BNC connector of the RE 204, that the frequency is within limits
4 Repeat the measurement for the right channel.

The permissible value is 24000 Hz ±0.6 Hz.

Adjustments
No relevant adjustments.

4.4 Stereo Generator

This section describes how to make a performance test of the Stereo Generator. For further information about commands refer to the Operating Manual.

Check that the Audio Generator is present and verified before making the performance check of the Stereo Generator.

Before the performance check of the Stereo Generator, adjust the Comp Output level to 1 V_{rms} follows:

1. Issue the following command:
   "GE,FM AL,B,100 AF,B,1000 FC,MN PT,ON PV,0% CT,ON"
2. Adjust the Comp Output level with the LEVEL ADJ potentiometer located on the rear panel.

See section 4.4.6 for re-adjustment of the output level.

4.4.1 Pilot Frequency and Level

Equipment
Frequency Counter
RMS Voltmeter

Specification

Frequency	19000 Hz ±1 Hz
Level	775 mV_{rms}

Procedure

1. Connect the Frequency Counter to the 19 kHz sync BNC output of the RE 204
2. Check that the 19 kHz frequency is within limits
3. Exchange the Frequency Counter with the RMS Voltmeter and check the pilot level.

Permissible frequency 19000 Hz ±1 Hz.
Permissible level 775 mV_{rms} ±10 mV.

Adjustments
Refer to section 13.2 for any relevant adjustments.

4.4.2 Stereo Separation

Equipment
Oscilloscope
Overload Protection
(Stereo Analyzer)

Specification

Separation	>65 dB, 1 kHz
	>55 dB, 22 Hz to 15 kHz

Procedure

This test is difficult to perform with the recommended test instruments.

The R&S Stereo Analyzer specifies a stereo separation of 60 dB at 1 kHz and, therefore, if you are using this instrument for verification, please take note of this limit.

If you want to conform to specifications, follow the procedure described below.

If you find it difficult to locate the recommended oscilloscope, you can use the overload protection circuit described below.

1. Set the RE 204 using the following command:
   `GE,FM AF,L,1000Hz AL,L,100% FC,L PT,OFF CT,ON`
2. Connect the Comp Output BNC connector of the RE 204 to the Y-input of the oscilloscope, via the Overload Protection Circuit, and the left channel output from the Audio Generator to the Ext. Trigger input (see Fig. 4.2)
3. Set the Oscilloscope controls as follows:
   Ext. trigger
   DC Mode
   Volt/cm: When Switch S1 in Fig. 4.2 is open: 1 V/cm equals 1.4 Vp
   When Switch S1 in Fig. 2.4 is closed: 10 mV/cm

4. Check the stereo separation by measuring the voltages A and B shown in Fig. 4.1 and by using the equation: Stereo Separation 20*log (A/B).

Adjustments
Refer to section 13.2 for any relevant adjustments.

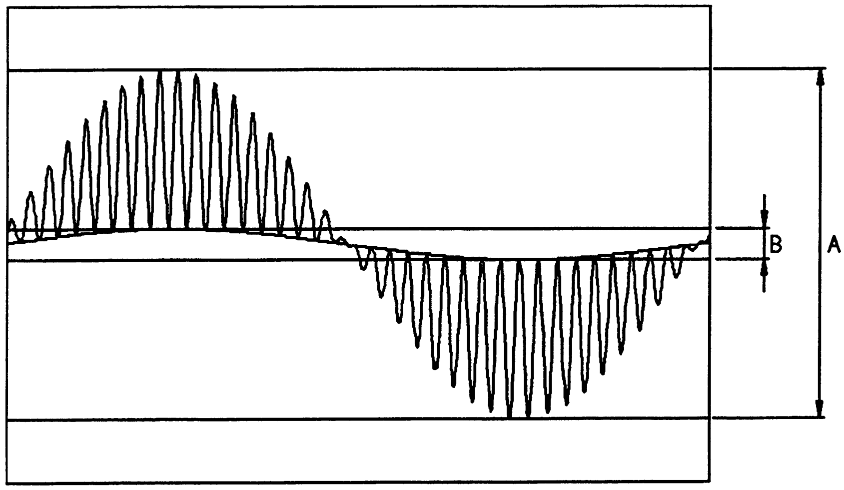

Fig. 4.1 - Stereo Separation

Overload Protection Circuit

To prevent the oscilloscope from overload, which can severely degrade the measurements, a simple circuit should be inserted between the Comp Output BNC connector and the oscilloscope, as shown in Fig. 4.2.

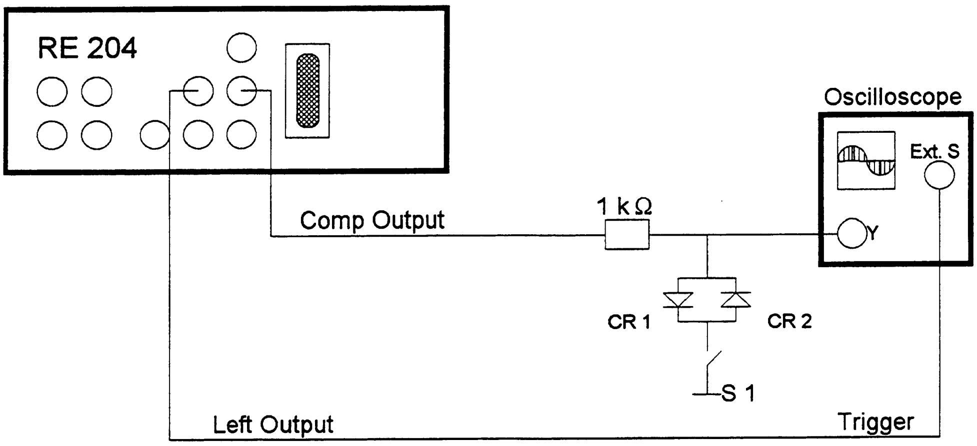

Fig. 4.2 - Overload Protection Unit

The diodes should be schottky diodes, for example Hewlett Packard type 5082-2812.

4.4.3 Comp Output Level, Stereo and Mono Mode, Pilot and AUX

Equipment
RMS Voltmeter
AF Generator (60 kHz)

Specification

Comp Output level, Stereo Mode	V_0
Comp Output level, Mono Mode	$V_0 \pm 0.1$ %
Comp Output level, Pilot 8 %	$0.08 \cdot V_0 \pm 0.5$ %
Comp Output level, Pilot 4 %	$0.04 \cdot V_0 \pm 0.5$ %
Comp Output level, Pilot 2 %	$0.02 \cdot V_0 \pm 1.0$ %
Comp Output level, Pilot 1 %	$0.01 \cdot V_0 \pm 1.0$ %
Comp Output level, Pilot 0.5 %	$0.05 \cdot V_0 \pm 1.0$ %
Comp Output level, AUX	

Procedure

1. Send the following command to select modulation level to 100 %, modulation frequency to 1000 Hz, pilot level to 0 %, and stereo mode to ST:
   "GE,FM AF,B,1000Hz AL,B,100% FC,ST PT,ON PV,0% CT,ON"
2. Connect the RMS Voltmeter to the Comp Output BNC connector measure the output level, V_0 (~1 V_{rms}).

To check the mono level:
1. Send the command "FC,MN" to switch to mono. Measure the Comp Output voltage, and check that it does not differ from V_0 by more than ±0.1 %.

To check the pilot level:
1. Send the following command: "GE,FM FC,OFF PT,ON PV,8% CT,ON"
2. Check, using the RMS Voltmeter, that the pilot level is within limits
3. Change the pilot level by issuing the command "PV,4%" and check the level
4. Repeat the measurements for 2 %, 1 % and 0.5 % pilot levels.

Permissible values, see the specifications above.

To verify the AUX input:
1. Send the following command to set modulation level to 0 %, pilot level to 0 %, stereo mode to ST and enable the AUX input by sending:
   "GE,FM AL,B,0% FC,ST PT,ON PV,0% AN,ON CT,ON"
2. Apply the following signal from the AF Generator: 57 kHz, 0.707 V_{rms} and connect it to the AUX Input of the RE 204. Check, using the RMS Voltmeter, that the Comp Output level is $V_0/10 \pm 1$ mV.

Adjustments
Refer to section 13.2 for any relevant adjustments.

NOTE Remember to switch off the AUX input with the command "AN,OFF".

4.4.4 Distortion

Equipment
Distortion Analyzer

Specification

Distortion in the 25 kHz bandwidth, THD	<0.02 %

Procedure

1. Send the following command to select modulation level to 100 %, modulation frequency to 1000 Hz, pilot level to 0 % and mode to stereo:
   `"GE,FM AF,B,1000Hz AL,B,100% FC,ST PT,ON PV,0% CT,ON"`
2. Connect the Distortion Analyzer to the Comp Output BNC connector of the RE 204 and check that distortion is within limits
3. Check mono mode with the following command "`FC,MN`".

The permissible limit is <0.02 %.

Adjustments
Refer to section 13.2 for any relevant adjustments.

4.4.5 Residual 38 kHz and spurious above 53 kHz

Equipment
Spectrum Analyzer

Specification

38 kHz residual	<-64 dB
Spurious above 53 kHz	<-60 dB

Procedure

1. Send the following command to the RE 204:
   `"GE,FM FC,ST AL,B,0% PT,ON PV,10% CT,ON"`
2. Connect the Spectrum Analyzer to the Comp. Output connectors and check the limits.

The permissible values are: <-64 dB at 38 kHz
<-60 dB above 53 kHz

Adjustments
Refer to section 13.2 for any relevant adjustments.

4.4.6 Re-adjustment of Comp Output Level

Equipment
RMS Voltmeter

Specification

Comp Output Level	530.3 mV_{rms} ±0.53 mV

Procedure

1. Send the following command to set the RE 204 to modulation 100 %, modulation frequency 1 kHz, pilot level to 0 % and mode to stereo:
   "GE,FM AF,B,1000Hz AL,B,100% FC,ST PT,ON PV,0% CT,ON"
2. Connect the RMS Voltmeter to the Comp Out BNC connector and adjust it to 530.3 mV using the Comp Output level potentiometer on the rear panel of the RE 204.

4.5 Wow & Flutter

This section describes how to make a performance test on the Wow and Flutter Option of the RE 204. For further information about commands refer to the Operating Manual.

4.5.1 Residual Wow & Flutter

Equipment
AF Generator

Specification

Residual Wow and Flutter	<0.001 %

Procedure

1. Apply a 3000 Hz 1.0 Vp signal to the Right Front Input of the RE 204
2. Check the residual wow and flutter with the following command:
   "CH,RF WD,DN,WT WF"

Note that it takes at least 8 seconds to complete the measurement and have the result ready.

The permissible value is: <0.001 %.

Adjustments
Refer to section 14.2 for any relevant adjustments.

4.6 Audio Analyzer

This section describes how to make a performance test on the analyzer part of the RE 204. For further information about commands refer to the Operating Manual.

Note that if the internal Audio Generator is used as signal source, it must be verified before you make the performance check of the analyzer part.

4.6.1 RMS Measurement

Equipment
Audio Generator
RMS Voltmeter

Specification
See Table 4.3.

Procedure

1. Connect the Audio Generator to all import channels of the RE 204 and to the RMS voltmeter
2. Send the command: "`CH,A AO,A,OFF`"
3. Follow the items in the Table 4.3 and check all channels that the RE 204 readings follow the voltmeter readings to within ±3 %.

Adjustments
Refer to sections 10.2 and 11.2 for any relevant adjustments.

Step	Voltage Applied to Input Channels	Set Range Command	Measurement Command
1	5 mV_{rms}, 1 kHz	"RE,A,11mVp"	"RS,1kHz"
2	10 mV_{rms}, 1 kHz	"RE,A,23mVp"	"RS,1kHz"
3	30 mV_{rms}, 1 kHz	"RE,A,46mVp"	"RS,1kHz"
4	60 mV_{rms}, 1 kHz	"RE,A,93mVp"	"RS,1kHz"
5	130 mV_{rms}, 1 kHz	"RE,A,187mVp"	"RS,1kHz"
6	260 mV_{rms}, 1 kHz	"RE,A,375mVp"	"RS,1kHz"
7	500 mV_{rms}, 1 kHz	"RE,A,750mVp"	"RS,1kHz"
8	1 V_{rms}, 1 kHz	"RE,A,1.5Vp"	"RS,1kHz"
9	2 V_{rms}, 1 kHz	"RE,A,3Vp"	"RS,1kHz"
10	4 V_{rms}, 1 kHz	"RE,A,6Vp"	"RS,1kHz"
11	6 V_{rms}, 1 kHz	"RE,A,12Vp"	"RS,1kHz"
12	6 V_{rms}, 1 kHz	"RE,A,24Vp"	"RS,1kHz"
13	6 V_{rms}, 1 kHz	"RE,A,30Vp"	"RS,1kHz"

Table 4.3 - Channel Range Commands

4.6.2 Residual Noise

Equipment
None.

Specification
Residual noise in 25 kHz bandwidth $<30\ \mu V_{rms}$

Procedure

1. Short-circuit the input connectors of the RE 204
2. Send the command: `CH,A AO,A,OFF RE,A,11mVp RS`
3. Get the residual noise value from the RE 204.

The permissible value is $<30\ \mu V_{rms}$.

Adjustments
No relevant adjustments.

4.6.3 Flatness

Equipment
Audio Generator

Specification
Flatness in 25 kHz bandwidth ±0.1 dB

Procedure

1. Apply 1 V_{rms} 1 kHz from the Audio Generator to the inputs of the RE 204
2. Send the following command: "**CH,A AO,A,OFF RE,A,1.5Vp RS**" and get the result
3. Use this value as a reference, and check the flatness at the following frequencies:
   25 Hz, 500 Hz, 2 kHz, 10 kHz, and 20 kHz by repeating the command: "**RS**"

The permissible value is 1 V_{rms} ±0.1 dB.

Adjustments
No relevant adjustments.

4.6.4 SINAD

Equipment
Audio Generator

Specification
SINAD at 1 kHz 3 Vp in 25 kHz bandwidth 0.03 %

Procedure

1. Apply 2.050 V_{rms} 1 kHz from the Audio Generator to the inputs of the RE 204
2. Issue the following command:
   CH,A AO,A,OFF RE,A,3.0Vp SD,100MS,F,1000Hz

The permissible value is <0.03 %.

Adjustments
Refer to sections 10.2 and 11.2 for any relevant adjustments.

4.6.5 Peak Measurement

Equipment
Audio Generator

Specification
Accuracy ±3 %

Procedure

1. Apply 1 V_{rms} 1 kHz from the Audio Generator to the inputs of the RE 204
2. Issue the command: "`CH,A AO,A,OFF RE,A,1.5Vp PK,1000Hz`"

The permissible value is 1.414 V ±3 %.

Adjustments
Refer to sections 10.2 and 11.2 for any relevant adjustments.

4.6.6 Frequency Measurement

Equipment
Audio Generator

Specification
Accuracy ±1 Hz

Procedure

1. Apply 1 V_{rms} 1 kHz from the Audio Generator to the inputs of the RE 204
2. Issue the command: "`CH,A AO,A,OFF RE,A,1.5Vp FQ`"

The permissible value is 1000 Hz ±1 Hz.

Adjustments
No relevant adjustments.

NOTE Do not use the internal Audio Generator for this measurement, because the clock synchronization for both units is the same.

4.6.7 DC Measurement

Equipment
DC Power Supply

Specification
Accuracy ±0.5% ±3 mV

Procedure

1. Apply 15 V from the DC power supply to the DC input of the RE 204
2. Issue the command: "`DL,HI,30V DC,HI`"
3. Change the DC voltage to 0.9 V for testing the low range
4. Issue the command: "`DL,LO,1V DC,LO`"

The permissible high range value is: 15 V ±78 mV
The permissible low range value is: 0.9 V ±7.5 mV

Adjustments
Refer to sections 11.2.6 to 11.2.9 for any relevant adjustments.

4.6.8 Meter Check

Equipment
Audio Generator

Specification
Resolution 10 dB

Procedure

1. Apply 1 V_{rms} 1 kHz from the Audio Generator to the inputs of the RE 204
2. Issue the command: "`CH,A MR,ON`"
3. Check the reading on the baragraph on the front panel of the RE 204.

Adjustments
No relevant adjustments.

5. DIGITAL MOTHERBOARD

5.1 Circuit Description

The Digital Motherboard connects the three boards in the Digital Section, and connects these boards and the Analog Section via connectors J4 and J5.

J4 carries the clock and data signals from the A/D converter to the two Audio Generator D/A converters. As these signals are too fast to be routed via a filtered connection, optocouplers located on the Analog Motherboard are used instead.

J5 is used for power and for the 2 Mbit/s serial interface. This connector is filtered.

5.2 Schematic Diagrams

The schematic diagram for the digital motherboard is shown in diagram number 985-314.

5.3 Component Locations

The component locations on the digital motherboard are shown in the following diagrams.

5.4 Parts List

A copy of the parts lists from the production documentation is shown in the following. The code number of the assembled PCB is 901-845.

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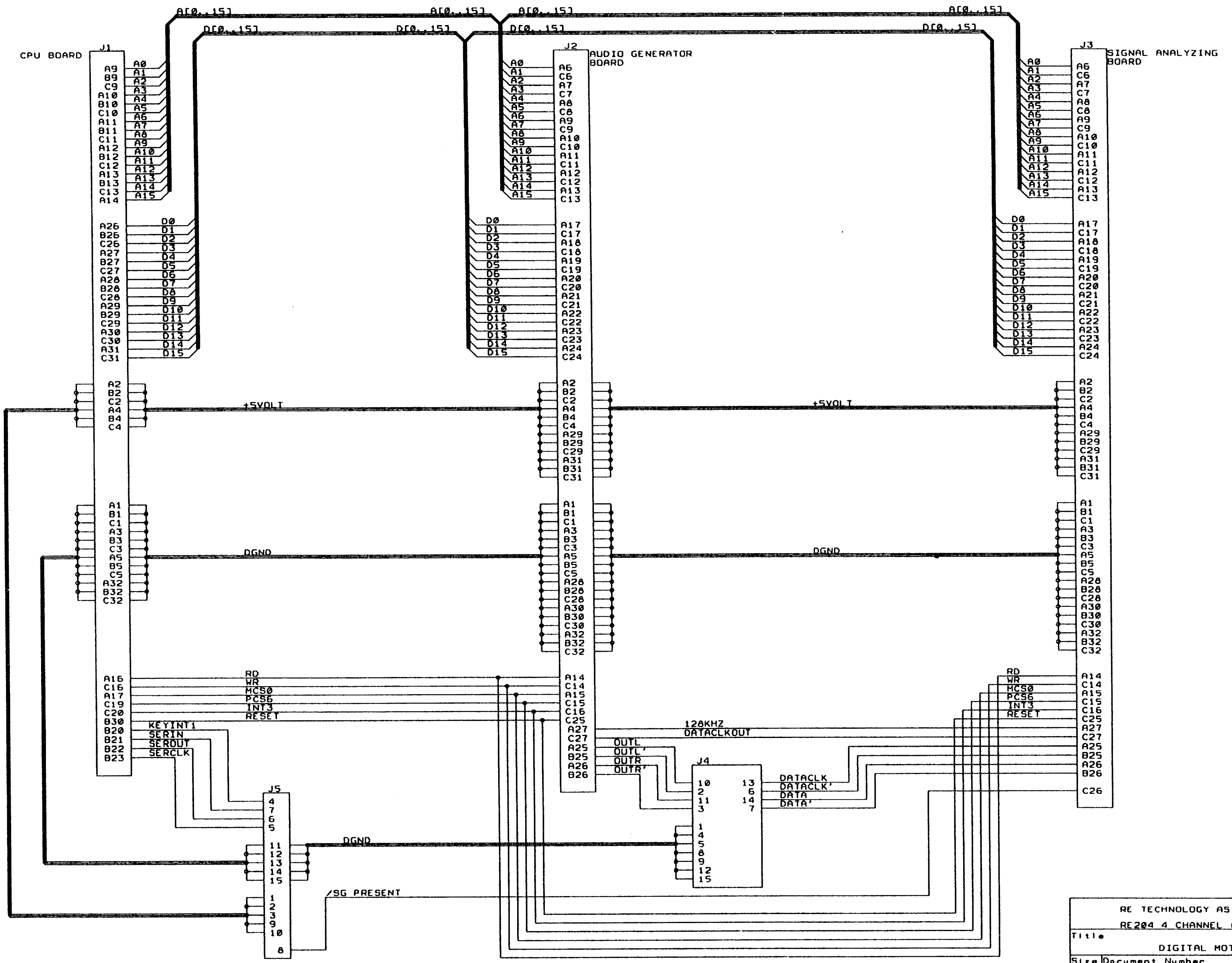
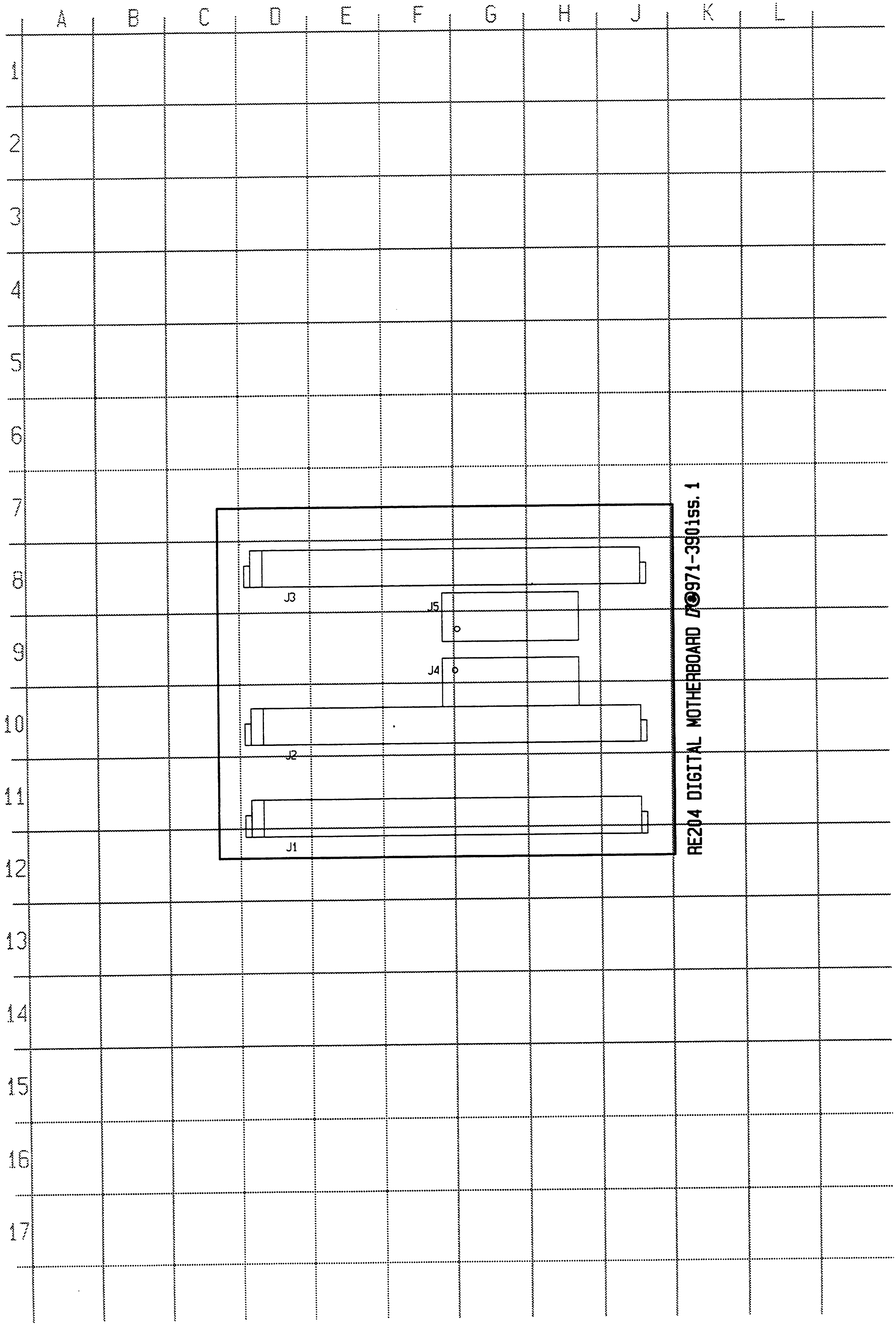


RE TECHNOLOGY AS			
RE204 4 CHANNEL AUDIO ANALYZER			
Title	DIGITAL MOTHERBOARD		
Size	Document Number		REV
A	901-845 971-390 985-314		1A
Date:	October 26, 1992	Sheet 1 of	1



A B C D E F G H J K L
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
J3
J5
J4
J2
J1
RE204 DIGITAL MOTHERBOARD
971-390iss.1

COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC
J1	D12																						
J2	D11																						
J3	D8																						
J4	F9																						
J5	F8																						

COMPONENT SIDE

PCB Assy Digital Motherboard (901-845)

CONNECTORS

J 1	DIN 41612 96 pol female straight, C class II	805-925
J 2	DIN 41612 96 pol female straight, C class II	805-925
J 3	DIN 41612 96 pol female straight, C class II	805-925
J 4	D-Sub 15 pol female straight for PCB, with UN4-40	805-982
J 5	D-Sub 15 pol male straight for PCB, UN4-40 and filte	806-017

MISCELLANEOUS

	PCB For RE204 Digital Motherboard	971-390

6. ANALOG MOTHERBOARD

6.1 Circuit Description

The Analog Motherboard connects the Trafo Unit, the Digital Section, the Analog Section, and the Front Panel. Furthermore, this board holds the ±15 V and the -5 V Power Supplies for the analog circuitry.

To use low-voltage drop regulators, which only are available as positive regulators, the ±15 V supplies are configured as two positive voltage supplies in series. QA1 directly provides the +15 V supply from the +20 V and Analog GND. The output of the regulator QA2 is connected to Analog GND, thus establishing the -15 V supply as the return path. The -5 V supply is generated from the -15 V.

The interface to the Digital Section is provided by J4, which carries the data/clock signals from the A/D Converter and the data signals to the Audio Generator Analog Board, and by J5, which carries the Serial Bus and the +5 V power. The optocouplers used for the signals for J4 are located as close to J4 as possible to minimize possible EMI from these high-speed lines. To further reduce the EMI, the signals are routed in coaxial cables, thus establishing a very well-defined return path.

J1 provides +5 V for the fan located in the Trafo Section, see section 3.

J3 connects to the Front Panel, which uses the Serial Bus from the Main Computer, and +5 V power supply.

The +5 V and the Digital GND (return) are routed separately from the +5 V Power Supply (J10) to the Digital Section and to the Analog Section to minimize interference.

6.2 Schematic Diagrams

The schematic diagram for the analog motherboard is shown in diagram number 985-311.

6.3 Component Locations

The component locations on the analog motherboard are shown in the following diagram.

6.4 Parts List

A copy of the parts lists from the production documentation is shown in the following. The code number of the assembled PCB is 901-841.

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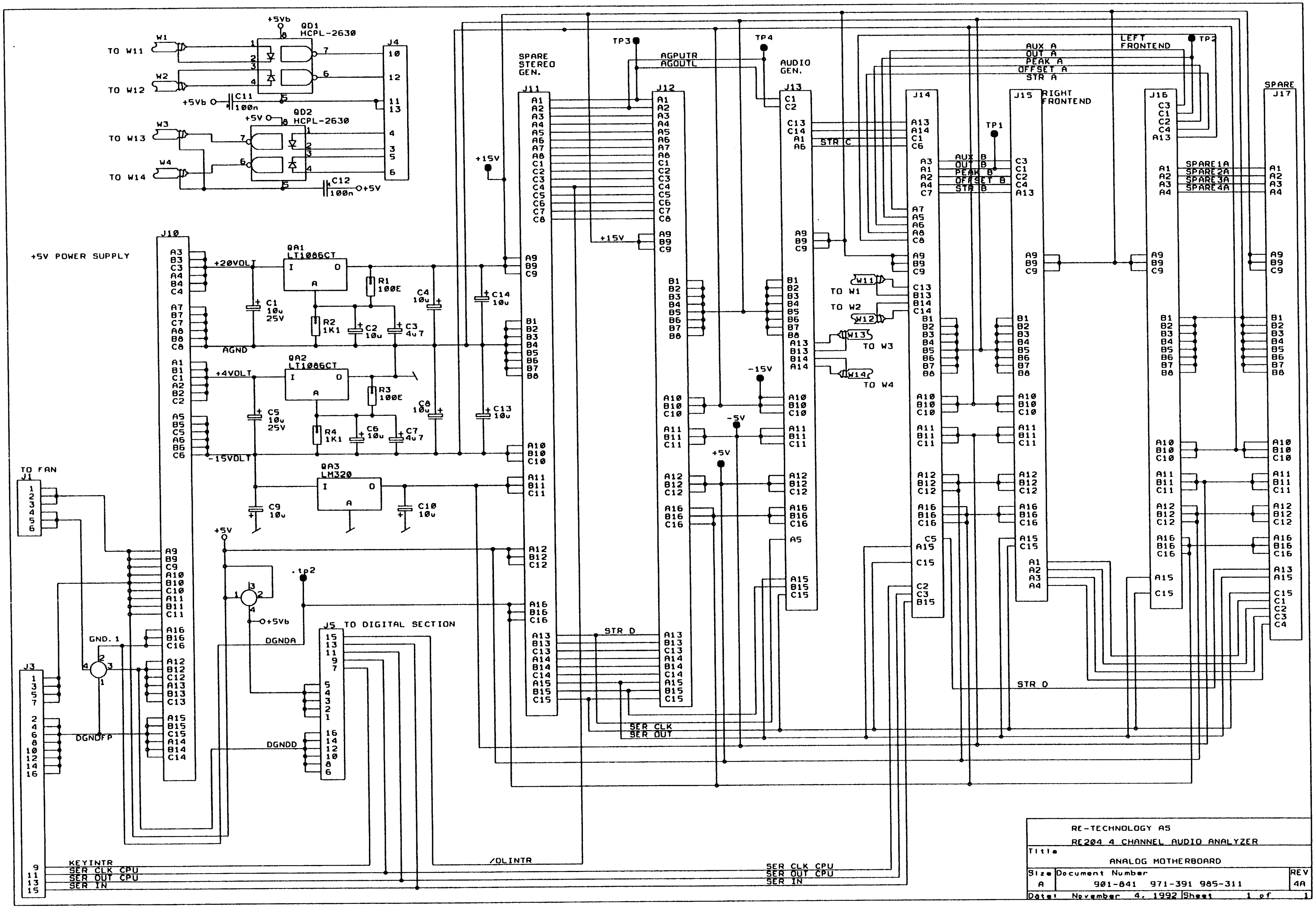
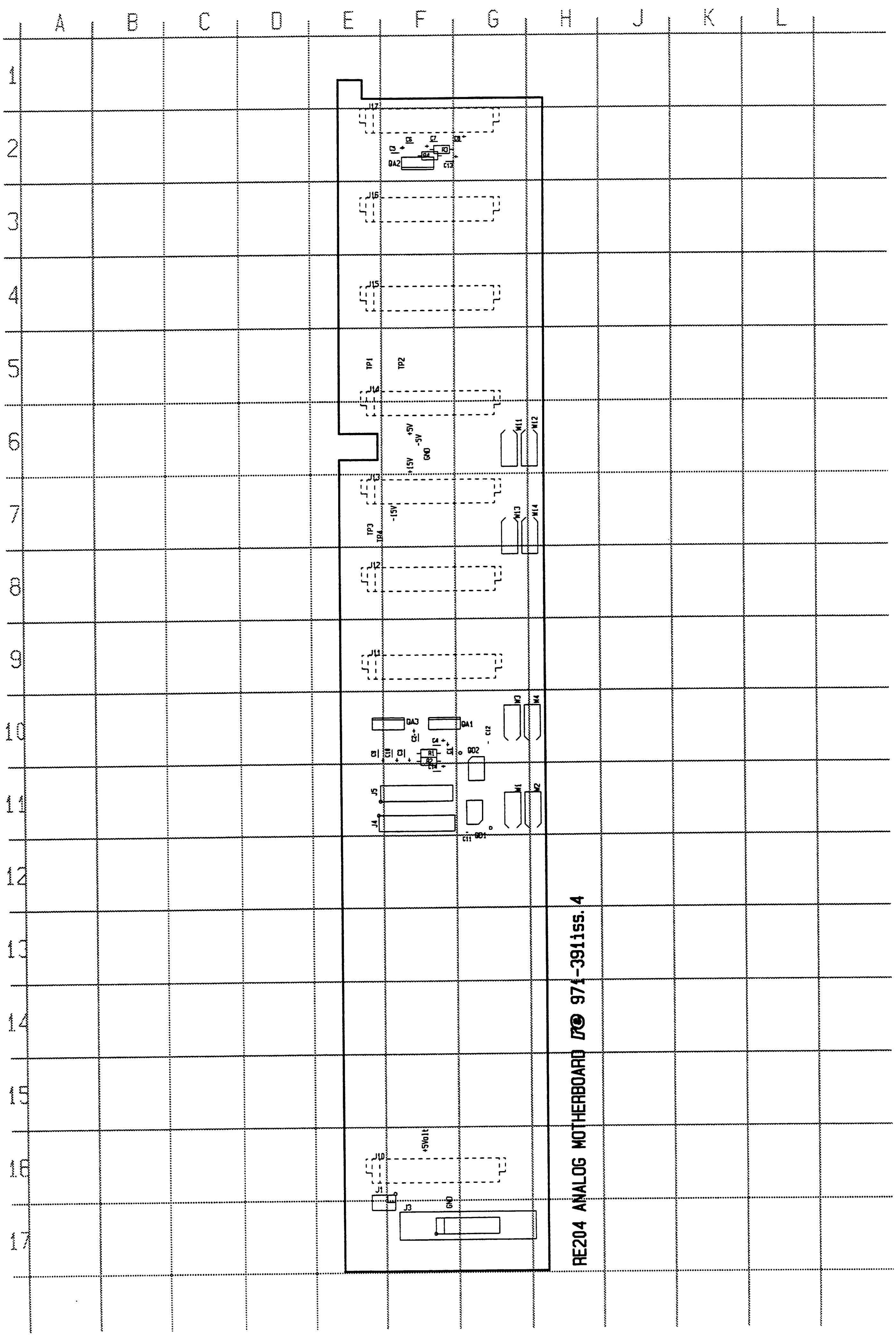

RE-TECHNOLOGY AS
RE204 4 CHANNEL AUDIO ANALYZER
Title
ANALOG MOTHERBOARD
Size A
Document Number
901-841 971-391 985-311
REV 4A
Date: November 4, 1992 Sheet 1 of 1
+5V POWER SUPPLY
J10
J11 SPARE STEREO GEN.
J12
J13 AUDIO GEN.
J14
J15 RIGHT FRONTEND
J16 LEFT FRONTEND
J17 SPARE
J4
J5 TO DIGITAL SECTION
J1 TO FAN
J3
QD1 HCPL-2630
QD2 HCPL-2630
QA1 LT1086CT
QA2 LT1086CT
QA3 LM320
TO W11
TO W12
TO W13
TO W14
TO W1
TO W2
TO W3
TO W4
+20VOLT
AGND
+4VOLT
-15VOLT
AGPUTR
AGOUTL
AUX A
OUT A
PEAK A
OFFSET A
STR A
AUX B
OUT B
PEAK B
OFFSET B
STR B
STR C
STR D
SPARE1A
SPARE2A
SPARE3A
SPARE4A
SER CLK
SER OUT
SER CLK CPU
SER OUT CPU
SER IN
KEYINTR
/OLINTR
DGNDA
DGNDD
DGNDFP
GND.1
TP1
TP2
TP3
TP4
.tp2


RE204 ANALOG MOTHERBOARD 971-391iss. 4
A B C D E F G H J K L
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
J17
QA2
J16
J15
TP1
TP2
J14
+5V
-5V
GND
+15V
W11
W12
J13
-15V
TP3
TP4
W13
W14
J12
J11
QA3
QA1
W3
W4
GD2
J5
J4
W1
W2
GD1
+5Volt
J10
J1
J3
GND

COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC
+5V	F6																						
+5Volt	F16																						
+15V	F6																						
-5V	F6																						
-15V	F7																						
C1	F10																						
C2	F10																						
C3	F10																						
C4	F10																						
C5	F2																						
C6	F2																						
C7	F2																						
C8	G2																						
C9	E10																						
C10	F10																						
C11	G12																						
C12	G10																						
C13	F2																						
C14	F11																						
GND	F6																						
GND	F17																						
J1	E16																						
J3	F17																						
J4	E11																						
J5	E11																						
J10	E16																						
J11	E9																						
J12	E8																						
J13	E7																						
J14	E5																						
J15	E4																						
J16	E3																						
J17	E2																						
QA1	G10																						
QA2	F2																						
QA3	F10																						
QD1	G12																						
QD2	G10																						
R1	F10																						
R2	F11																						
R3	F2																						
R4	F2																						
TP1	E5																						
TP2	F5																						
TP3	E7																						
TP4	F7																						
W1	G11																						
W2	H11																						
W3	G10																						
W4	H10																						
W11	G6																						
W12	H6																						
W13	G7																						
W14	H7																						

COMPONENT SIDE

PCB Assy Analog Motherboard (901-841)

CAPACITORS

C 1	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 2	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 3	C Solid alu 4u7 20% 25V	265-000
C 4	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 5	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 6	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 7	C Solid alu 4u7 20% 25V	265-000
C 8	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 9	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 10	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 11	C Ceramic 100n 20% 50V	213-401
C 12	C Ceramic 100n 20% 50V	213-401
C 13	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 14	C Solid Aluminium 10u 20% 25V Short Type	265-110

CONNECTORS

J 1	Connector 2X3 pole DUBOX PCB male	805-985
J 3	Conn.Header w/lock 16 -pol straight f/PCB	805-965
J 5	Conn Miniature 16 pin Socket	806-050
J 10	DIN 41612 48 pol female straight, C/2 class II	805-959
J 11	DIN 41612 48 pol female straight, C/2 class II	805-959
J 12	DIN 41612 48 pol female straight, C/2 class II	805-959
J 13	DIN 41612 48 pol female straight, C/2 class II	805-959
J 14	DIN 41612 48 pol female straight, C/2 class II	805-959
J 15	DIN 41612 48 pol female straight, C/2 class II	805-959
J 16	DIN 41612 48 pol female straight, C/2 class II	805-959
J 17	DIN 41612 48 pol female straight, C/2 class II	805-959

INTEGRATED ANALOG CIRCUITS

QA 1	IC LT1086CT Regulator 1.5Amp	364-879
QA 2	IC LT1086CT Regulator 1.5Amp	364-879
QA 3	IC LM320T-5 -5V REG. TO220	364-880

INTEGRATED DIGITAL CIRCUITS

QD 1	Optocoupler 2630, Dual high speed	360-218
QD 2	Optocoupler 2630, Dual high speed	360-218

RESISTORS

R 1	R Metal Film 100E 1% 0.5W TC50	113-100
R 2	R Metal Film 1K10 1% 0.5W TC50	114-110
R 3	R Metal Film 100E 1% 0.5W TC50	113-100
R 4	R Metal Film 1K10 1% 0.5W TC50	114-110

MISCELLANEOUS

	Screw pozidriv panhead M3x8	008-308
	Screw Pozidrive Pan Head M3,5X10	008-310
	Screw pozidriv countersunk M3x8	009-308
	Lock washer D3,2/5,5x0,45	046-405
	Lock washer D3,2/5,5x0,45	046-405
	Tubular rivet D2,5x6	060-260
	79mm Coax Cable For RE204 Analog Mother Board	616-205
	135mm Coax Cable For RE204 Analog Mother Board	616-206
	55mm Flat Cable For RE204 Analog Mother Board	617-926
	42mm Flat Cable For RE204 Analog Mother Board	617-927
	Wire Electrical Black AWG 24	634-000
	Term. strip 50pol mod 2	806-072
	Mounting Acc. for TO-220	816-163
	Rectangular Washer F. TO220	816-178
	Insulation Bushing F. TO-220	816-214
	Heat sink for RE204	816-290
	Solder Terminal 0.1 O2	823-303
	PCB For RE204 Analog Motherboard	971-391
QDS1	8 Pin Dil Socket	816-132
QDS2	8 Pin Dil Socket	816-132

7. TRAFO UNIT

7.1 Circuit Description

The +5 V Power Supply for all digital circuitries is located in the Trafo Unit. Furthermore, this board holds the rectifier and filtering circuitry for the ±15 V regulators, which are located on the Analog Motherboard; see section 6 for a description of these supplies.

7.2 Schematic Diagrams

The schematic diagram for the trafo unit is shown in diagram number 985-313.

7.3 Component Locations

The component locations on the trafo unit are shown in the following diagram.

7.4 Parts List

A copy of the parts lists from the production documentation is shown in the following. The code number of the assembled PCB is 901-844.

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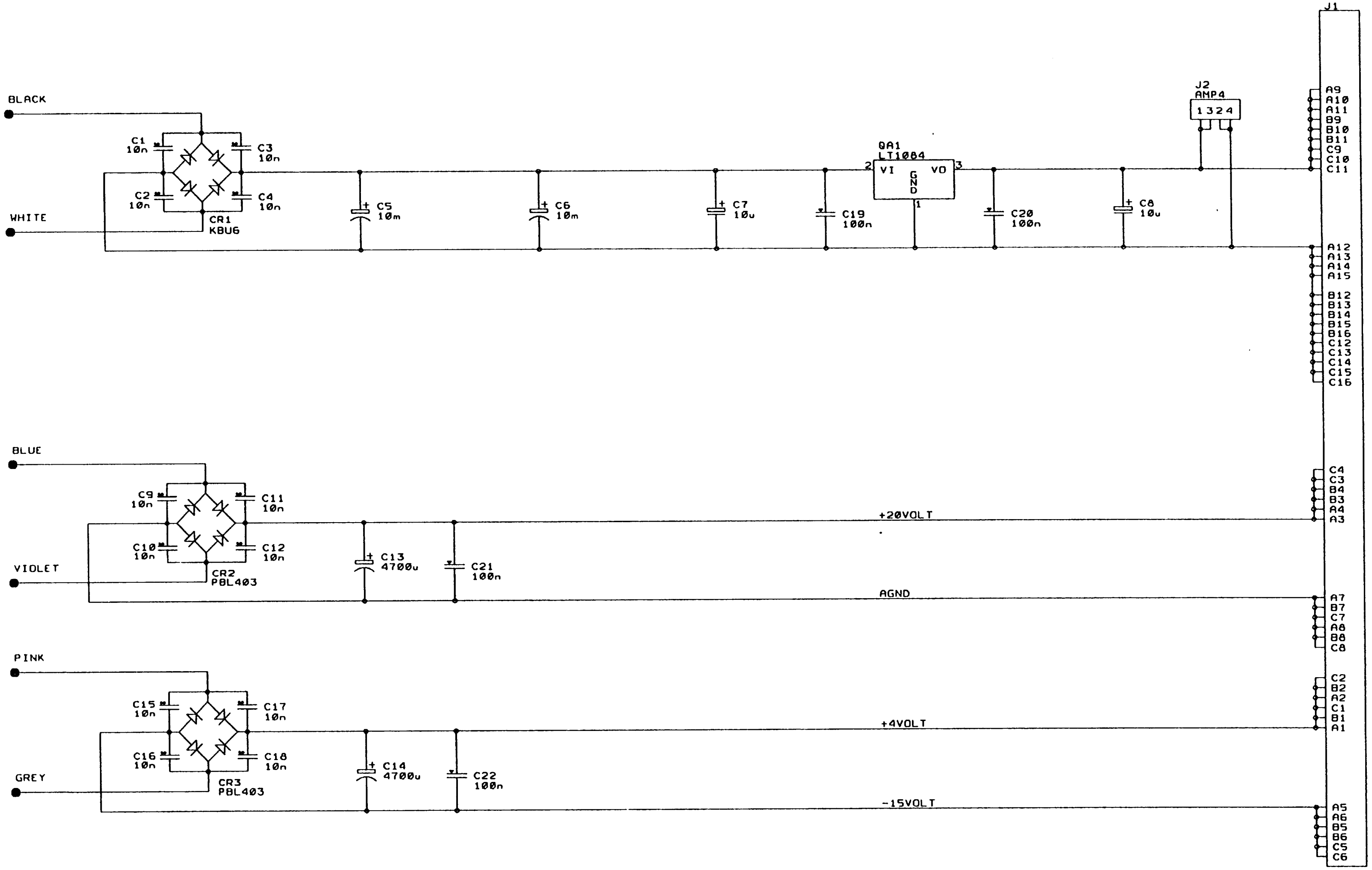
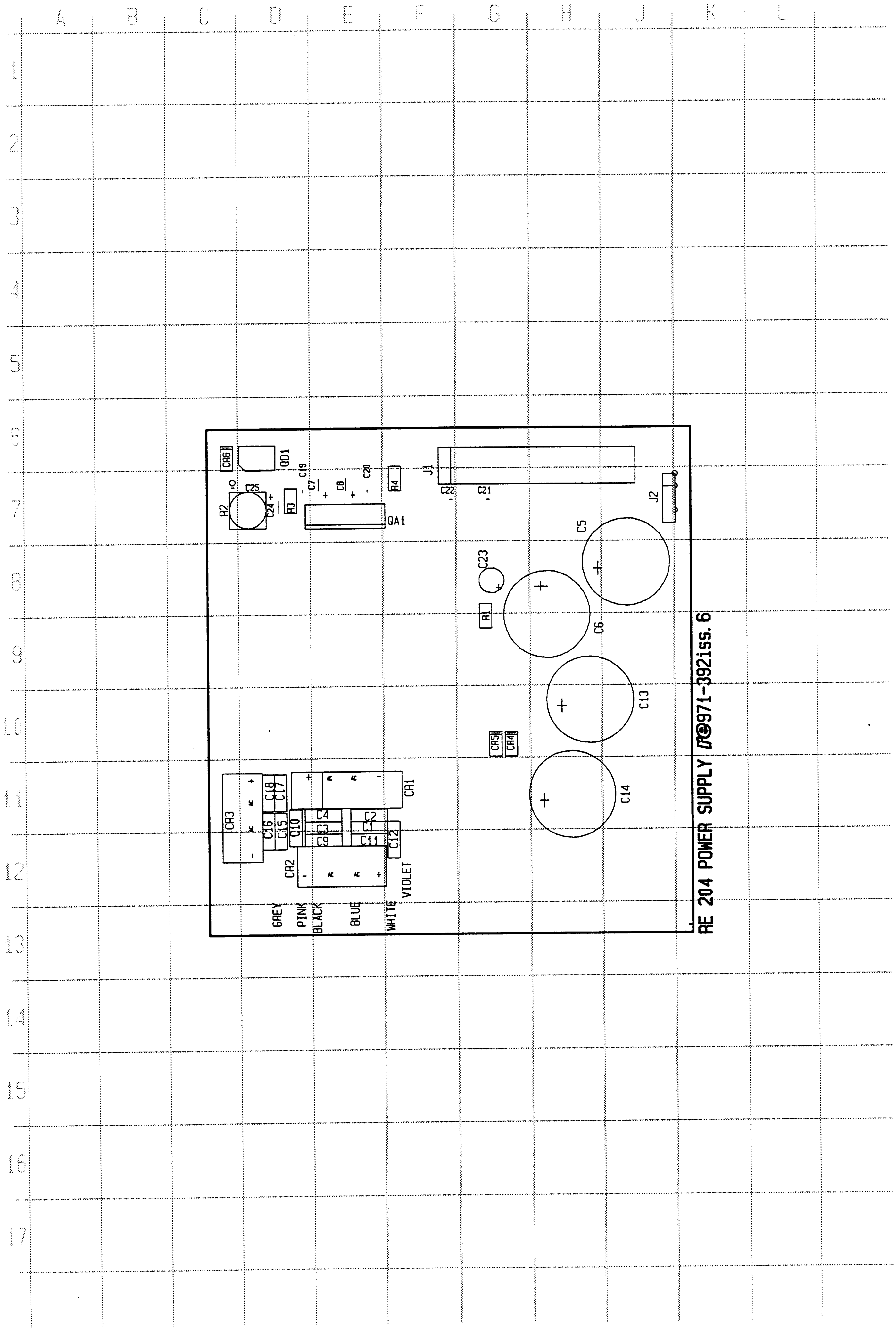


RE TECHNOLOGY AS			
RE204 4 CHANNEL AUDIO ANALYZER			
Title	+5V POWER SUPPLY		
Size	Document Number		REV
A	901-844 971-392 985-313		6A
Date:	October 24, 1992	Sheet 1 of 1	


A B C D E F G H J K L
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
RE 204 POWER SUPPLY 971-392iss. 6
CR6
QD1
C19
C7
C8
C20
R4
J1
C25
C24
R2
R3
QA1
C22
C21
J2
C5
C23
C6
R1
C13
CR5
CR4
C14
CR3
C18
C17
C16
C15
C10
C4
C3
C9
C2
C1
C11
C12
CR1
CR2
VIOLET
GREY
PINK
BLACK
BLUE
WHITE

COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC
BLACK	E13																						
BLUE	E13																						
CR1	F11																						
CR2	D12																						
CR3	C11																						
CR4	G10																						
CR5	G10																						
CR6	C6																						
C1	E12																						
C2	E11																						
C3	E11																						
C4	E11																						
C5	H7																						
C6	J9																						
C7	E7																						
C8	E7																						
C9	E12																						
C10	D12																						
C11	E12																						
C12	F12																						
C13	J10																						
C14	J11																						
C15	D11																						
C16	D12																						
C17	D11																						
C18	D11																						
C19	D7																						
C20	E7																						
C21	G7																						
C22	F7																						
C23	G8																						
C24	D7																						
C25	D7																						
GREY	D13																						
J1	F7																						
J2	J7																						
PINK	D13																						
QA1	F7																						
QD1	D6																						
R1	G8																						
R2	C7																						
R3	D7																						
R4	F7																						
VIOLET	F12																						
WHITE	F13																						

COMPONENT SIDE

PCB Assy Trafo Unit (901-844)

CAPACITORS

C 1	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 2	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 3	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 4	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 5	Electrolytic 10000/16, 2000h/105°, R:18*40, RM3	261-095
C 6	Electrolytic 10000/16, 2000h/105°, R:18*40, RM3	261-095
C 7	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 8	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 9	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 10	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 11	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 12	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 13	Electrolytic 4700/35, 2000h/105°, R:18*40, RM3	261-096
C 14	Electrolytic 4700/35, 2000h/105°, R:18*40, RM3	261-096
C 15	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 16	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 17	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 18	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 19	C Ceramic 100n 20% 50V	213-401
C 20	C Ceramic 100n 20% 50V	213-401
C 21	C Ceramic 100n 20% 50V	213-401
C 22	C Ceramic 100n 20% 50V	213-401

DIODES

CR 1	Bridges Rectifier Vin:140 Io:6A	340-212
CR 2	Bridge Rectifier Vin:140V Io:1.9A	340-208

CONNECTORS

J 1	DIN 41612 64 pol male 90°, C/2 class II	805-958

INTEGRATED ANALOG CIRCUITS

QA 1	IC LT1084CP 5V Regulator 5A	364-878

MISCELLANEOUS

	Screw pozidriv panhead M3x8	008-308
	Screw Pozidrive Pan Head M3,5X10	008-310
	Screw pozidriv panhead M3*12	008-312
	Nut hexagon M3	031-302
	Washer 3mm	042-315
	Lock washer D3,2/5,5x0,45	046-405
	Heat Sink For RE204	816-291
	Mica Insulator Sot-93	816-297
	PCB For RE204 +5 V Power Supply	971-392

8. MAIN CPU BOARD

8.1 Circuit Description

The main components of the CPU board are:

* The CPU itself with RAMs and EPROMs
* 2 Mbits/s Serial Interface Circuit
* IEEE 488 Interface Circuit
* Address and Mode Switch Circuit
* Battery Back-up Circuit.

8.1.1 CPU with RAMs and EPROMs

The CPU is a 16-bit 80C186, which interfaces to the RAMs (QD12 and QD13) and to the EPROMs (QD14 and QD15) via the address latches QD7, QD8 and QD9, which store the address during memory cycles. QD4 and QD5 buffer the 16 data bits. A PLD (QD19) handles address decoding for all devices except the EPROMs.

8.1.2 2 Mbits/s Serial Interface

The Main Computer communicates with boards outside the digital section via a specialized 3-wire 2 Mbit/s serial interface. The 2 MHz clock is derived from the 8 MHz output clock from the 80C186. To transmit or receive a 16-bit message, the Main Computer transmits 25 bits serially on SER OUT, clocked by SER CLK. Incoming data is received on the line SER IN. A PLD (QD25) controls the serial interface; the shift registers QD29, QD30 and QD31 receive or transmit data and addresses. Q3, Q4, Q5, and Q6 buffer the data and clock signals, while QD17C buffers received data.

Fig. 8.1 shows the general format for the communication via the serial interface.

A6 A5 ... A2 A1	W/R	1	D15 D14 ... D1 D0	0

Fig. 8.1 - Format of Serial Data

A6 to A1 constitute a 6-bit address originally stored in QD31. This address is received and decoded locally on the individual boards connected to the serial interface. A6 is transmitted first.

W/R identifies whether the operation is a write (W/R = 1) or a read (W/R = 0) operation. This bit originates from QD25, pin 15.

The following bit ("1") provides slack for delays in the transmitter chain during transmission of data to the Main Computer.

D15 to D0 are the 16 data bits from QD29 and QD30. The last bit ("0") is used for synchronization.

If the 80C186 wants to read information via the serial interface, it first transmits an address indicating who should send data to the computer. A W/R bit equal to 0 follows indicating that this is a read operation. Finally, the "1" bit, 16 dummy data bits and the sync bit follow. As soon as a PLD on one of the boards has found that the transmitted address equals its internal address, while the W/R bit indicates a read operation, it issues a latch pulse to load data into a local parallel-in-serial-out register, enables SER CLK to clock data out of the register, and activates SER IN which normally is tri-stated. 16 bits of data are then sent back to the main CPU from the addressed board.

During write operations, the local PLD recognizes its address as above, followed by a W/R bit equal to 1 to indicate a write operation. The PLD then counts 17 SER CLK pulses before issuing a latch pulse for an external serial-in-parallel-out register which has been receiving the 16 data bits, clocked by SER CLK.

At regular intervals, the 80C186 computer transmits a synchronization word consisting of 24 "1" bits followed by the "0" sync bit. This ensures that all internal counters etc. in the PLDs are reset to a well-defined initial state even if errors occur on the SER CLK line.

8.1.3 IEEE 488 Interface

The IEEE 488 interface is built around three ICs (QD1, QD2 and QD3). QD1 and QD2 are special-purpose IEEE 488 buffers, while QD3 is the IEEE 488 interface chip which handles all data transfer via the IEEE 488 bus.

8.1.4 Address and Mode Switch

The switch S1 sets up the IEEE 488 address, and indicates different configurations of the RE 204, for example installation of the Wow & Flutter Option. The switch is read via QD23, enabled by a chip select signal from the address decoding PLD QD19.

8.1.5 Battery Back-up

BT1 is a 3.6 V Lithium battery which provides power for the RAMs QD12 and QD13 during periods of power-down. The circuit Q10 ensures that the RAMs are deselected as soon as a power fail occurs. To keep CS1/ high the battery also powers the address decoding circuit QD21.

8.2 Schematic Diagrams

The schematic diagram for the main CPU is shown in diagram number 985-254.

8.3 Component Locations

The component locations on the main CPU are shown in the following diagram.

8.4 Parts List

A copy of the parts lists from the production documentation is shown in the following. The code number of the assembled PCB is 901-870.

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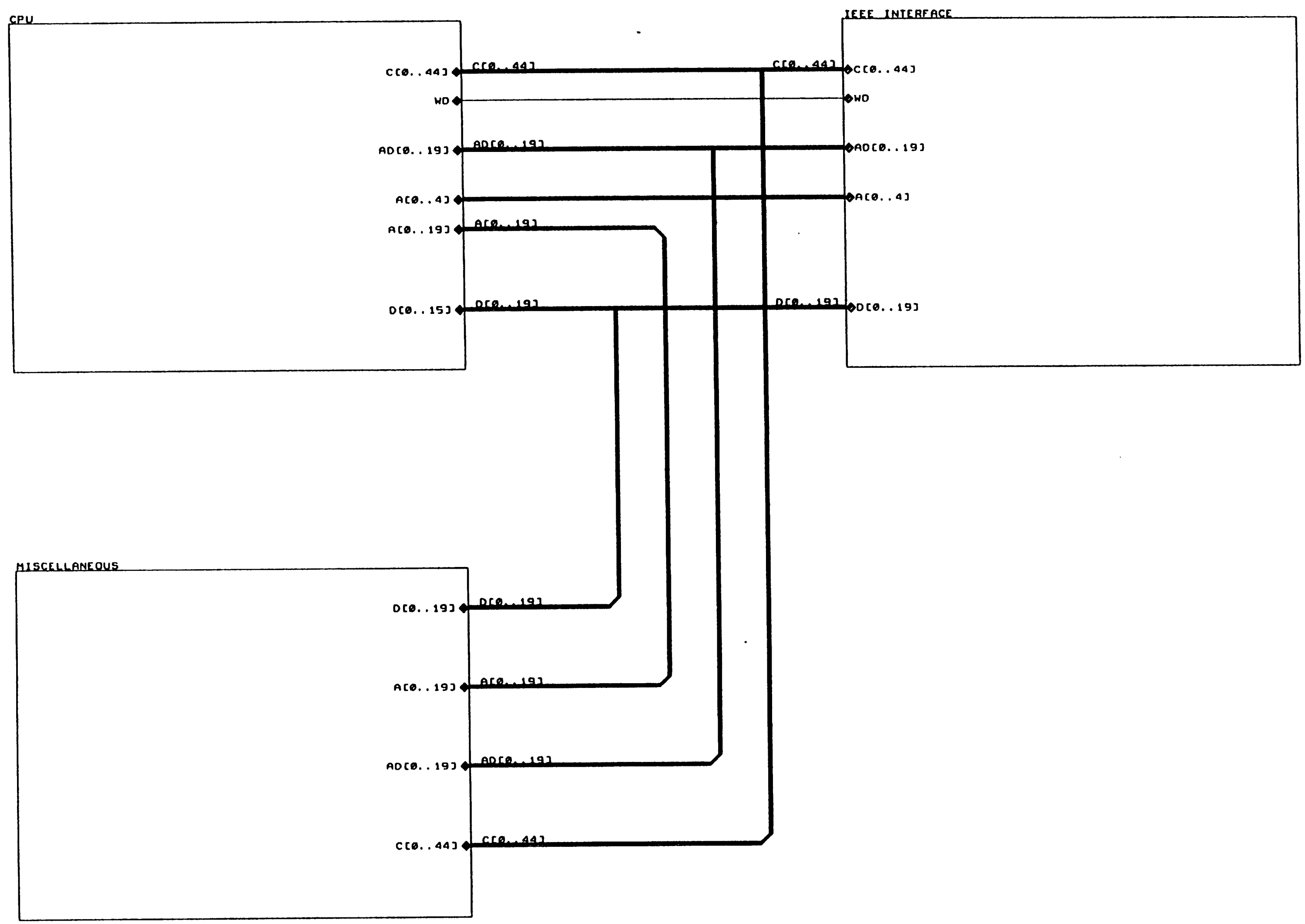

RE TECHNOLOGY AS RE530 CPU BOARD		
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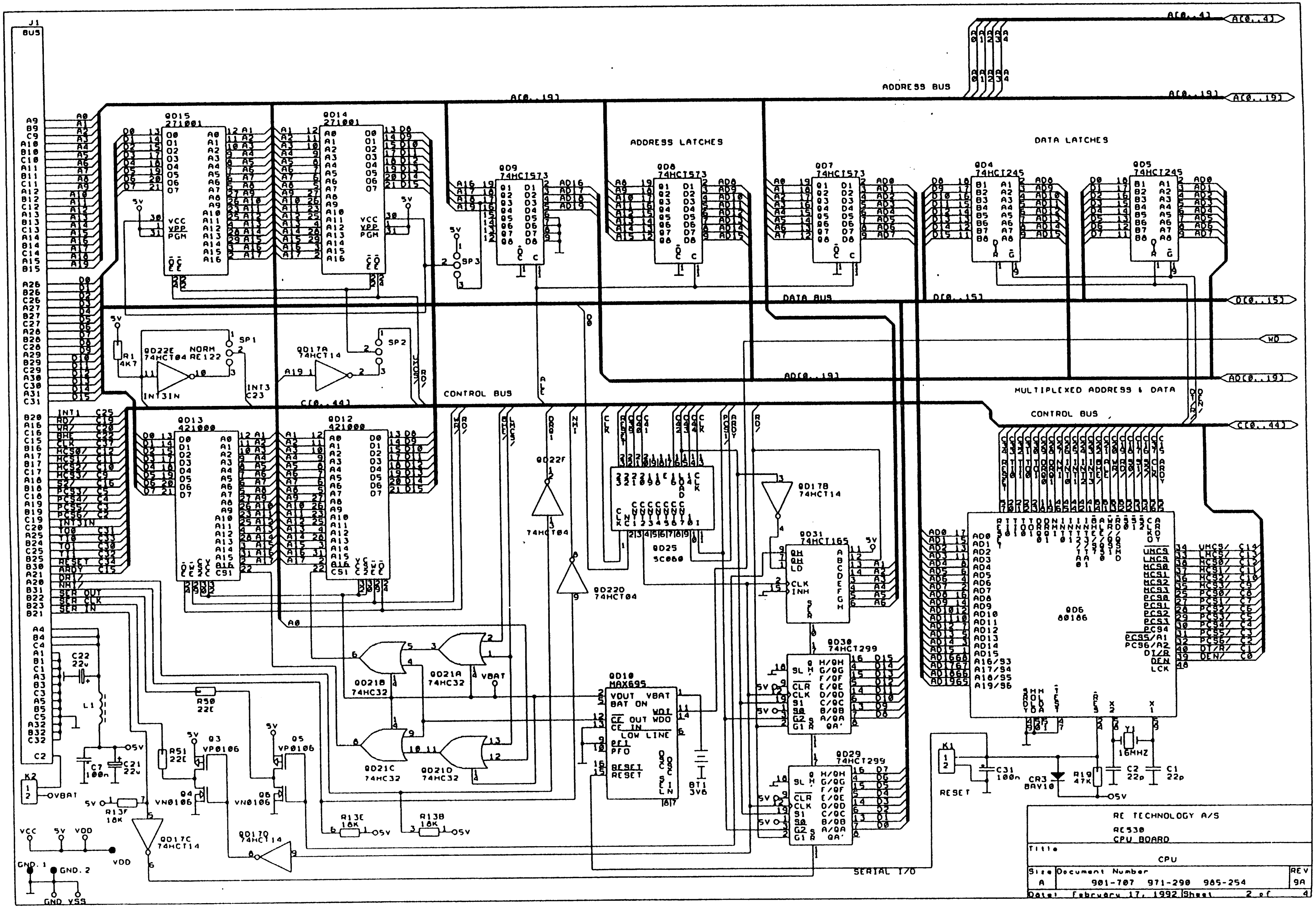
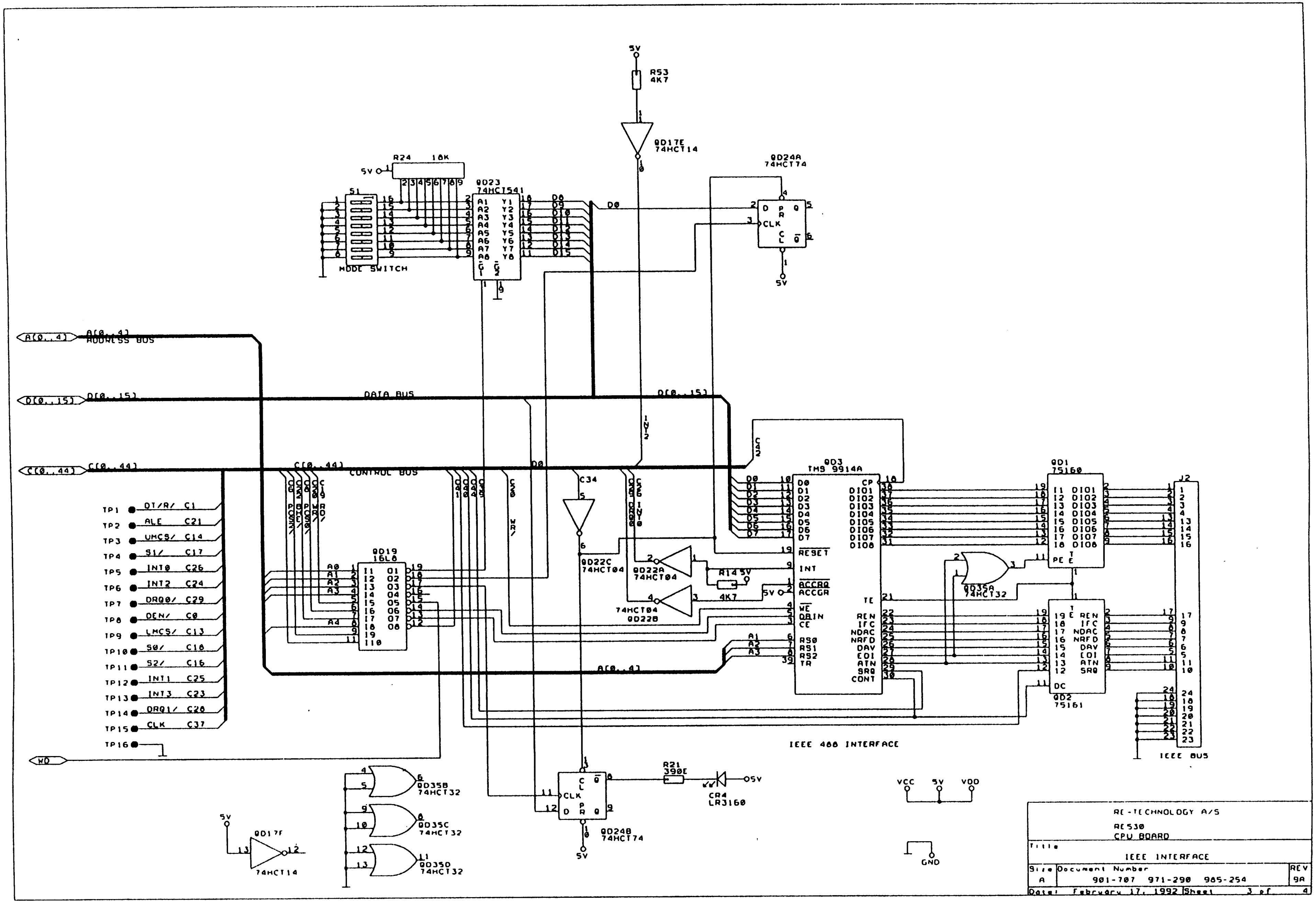
Size: A	Document Number: 901-707 971-290 985-254	REV: 9A
Date: February 17, 1992	Sheet 1 of 4	


ADDRESS BUS
ADDRESS LATCHES
DATA LATCHES
DATA BUS
MULTIPLEXED ADDRESS & DATA
CONTROL BUS
SERIAL I/O
RESET
RE TECHNOLOGY A/S
RC530
CPU BOARD
Title
CPU
Size A
Document Number 901-707 971-290 985-254
REV 9A
Date: February 17, 1992 Sheet 2 of 4

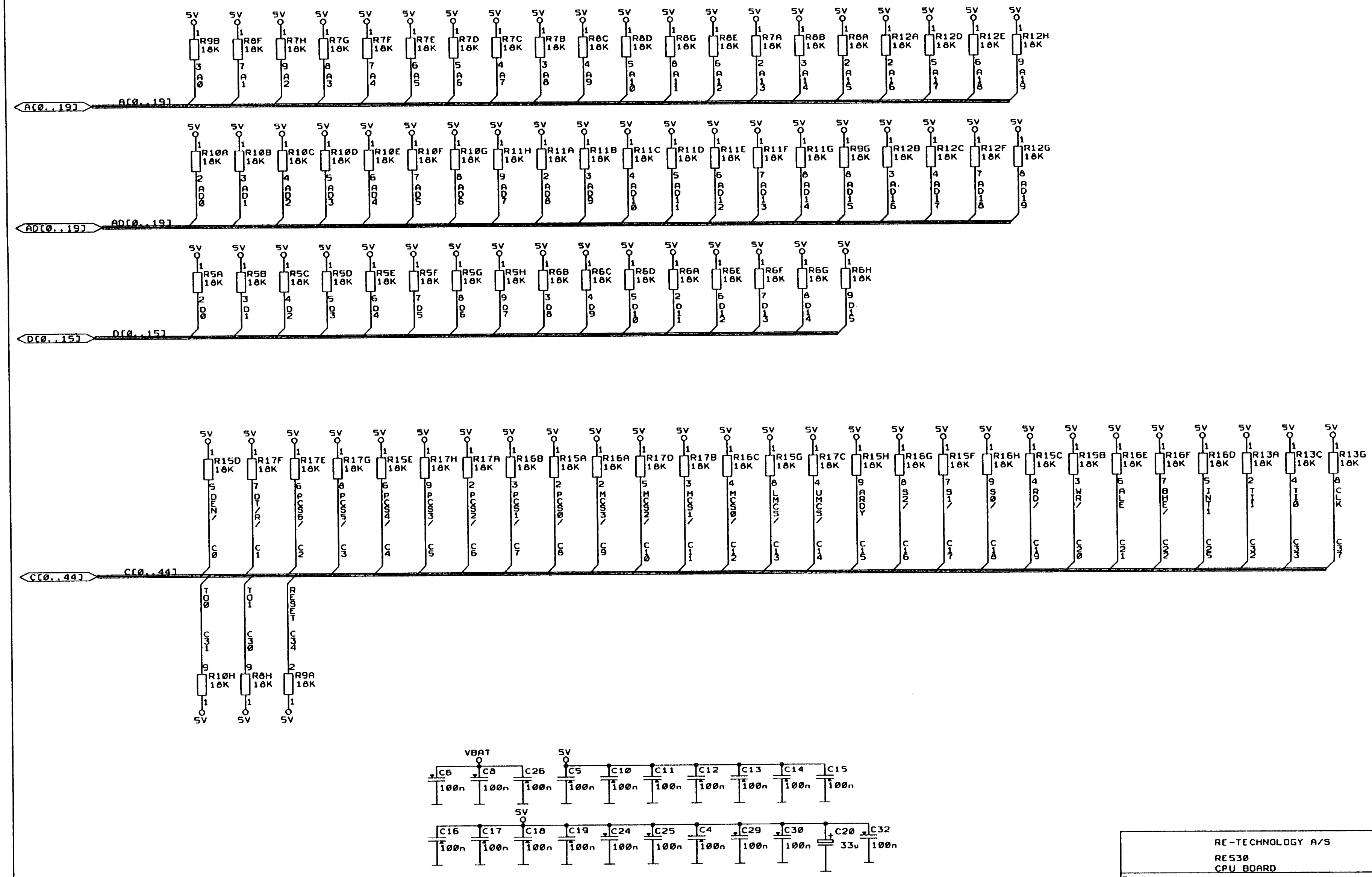


RE-TECHNOLOGY A/S
RE530
CPU BOARD

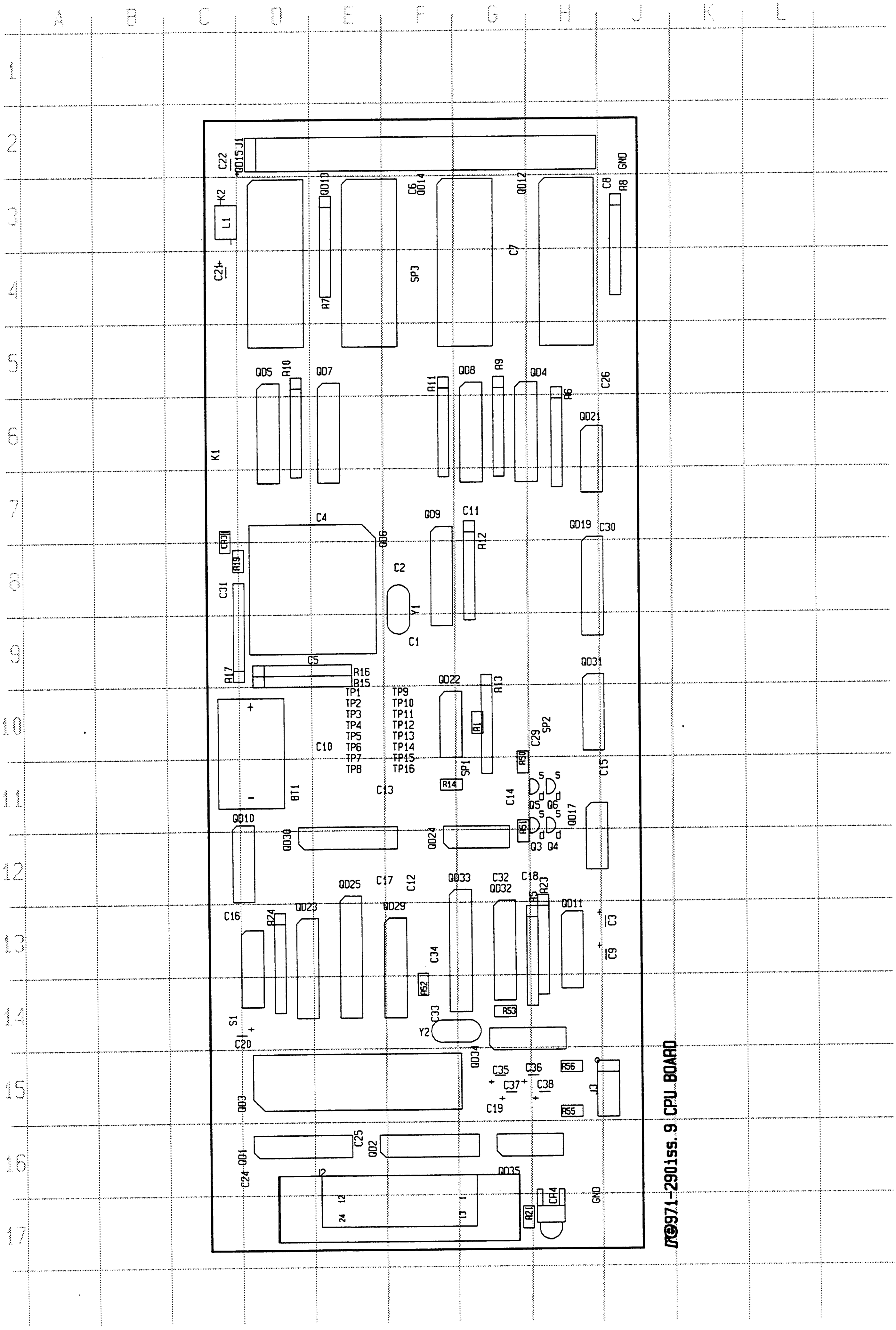
Title: IEEE INTERFACE

Size	Document Number	REV
A	901-707 971-290 985-254	9A

Date: February 17, 1992 Sheet 3 of 4



RE-TECHNOLOGY A/S RE530 CPU BOARD		
Title MISCELLANEOUS		
Size A	Document Number 901-707 971-290 985-254	REV 9A
Date: February 17, 1992	Sheet 4 of 4	


971-290iss.9 CPU BOARD
A B C D E F G H J K L
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC
BT1	D11	Q3	H12																				
CR3	C8	Q4	H12																				
CR4	H17	Q5	H11																				
C1	F9	Q6	H11																				
C2	F8	R1	G10																				
C3	J13	R5	H13																				
C4	E7	R6	H6																				
C5	D9	R7	E4																				
C6	F3	R8	J3																				
C7	G4	R9	G5																				
C8	J3	R10	D5																				
C9	J13	R11	F5																				
C10	E10	R12	G8																				
C11	G7	R13	G10																				
C12	F12	R14	F11																				
C13	E11	R15	E10																				
C14	G11	R16	E9																				
C15	J11	R17	C9																				
C16	C13	R19	D8																				
C17	E12	R21	G17																				
C18	G12	R23	H12																				
C19	G15	R24	D13																				
C20	C14	R50	G11																				
C21	C4	R51	G12																				
C22	C2	R52	F14																				
C24	D16	R53	G14																				
C25	E16	R55	H15																				
C26	J5	R56	H15																				
C29	H10	SP1	G11																				
C30	J7	SP2	H10																				
C31	C8	SP3	F4																				
C32	G12	S1	C14																				
C33	F14	TP1	E10																				
C34	F13	TP2	E10																				
C35	G15	TP3	E10																				
C36	G15	TP4	E10																				
C37	G15	TP5	E10																				
C38	H15	TP6	E10																				
GND	H17	TP7	E11																				
GND	J2	TP8	E11																				
J1	D2	TP9	F10																				
J2	D16	TP10	F10																				
J3	H15	TP11	F10																				
K1	C6	TP12	F10																				
K2	C3	TP13	F10																				
L1	C3	TP14	F10																				
QD1	D16	TP15	F11																				
QD2	E16	TP16	F11																				
QD3	D15	Y1	F9																				
QD4	H5	Y2	F14																				
QD5	D5																						
QD6	F8																						
QD7	E5																						
QD8	G5																						
QD9	F7																						
QD10	C11																						
QD11	H13																						
QD12	G3																						
QD13	E3																						
QD14	F3																						
QD15	C2																						
QD17	H11																						
QD19	H7																						
QD21	H6																						
QD22	F9																						
QD23	D13																						
QD24	F12																						
QD25	E12																						
QD29	E13																						
QD30	D12																						
QD31	H9																						
QD32	G12																						
QD33	F12																						
QD34	G15																						
QD35	G16																						

COMPONENT SIDE

Main CPU Board (901-870)

BATTERIES

BT 1	Battery Lithium 3V/0.9AH dxl 14.5x25, PCB Version	431-005

CAPACITORS

C 1	C Ceramic 22p0 2% 100V NP0	213-206
C 2	C Ceramic 22p0 2% 100V NP0	213-206
C 4	C Ceramic 100n 20% 50V	213-401
C 5	C Ceramic 100n 20% 50V	213-401
C 6	C Ceramic 100n 20% 50V	213-401
C 7	C Ceramic 100n 20% 50V	213-401
C 8	C Ceramic 100n 20% 50V	213-401
C 10	C Ceramic 100n 20% 50V	213-401
C 11	C Ceramic 100n 20% 50V	213-401
C 12	C Ceramic 100n 20% 50V	213-401
C 13	C Ceramic 100n 20% 50V	213-401
C 14	C Ceramic 100n 20% 50V	213-401
C 15	C Ceramic 100n 20% 50V	213-401
C 16	C Ceramic 100n 20% 50V	213-401
C 17	C Ceramic 100n 20% 50V	213-401
C 18	C Ceramic 100n 20% 50V	213-401
C 19	C Ceramic 100n 20% 50V	213-401
C 20	C Solid Aluminium 33u 20% 10V Short Type	265-105
C 21	C Solid Aluminium 22u 20% 6v3 Short Type	265-109
C 22	C Solid Aluminium 22u 20% 6v3 Short Type	265-109
C 24	C Ceramic 100n 20% 50V	213-401
C 25	C Ceramic 100n 20% 50V	213-401
C 26	C Ceramic 100n 20% 50V	213-401
C 29	C Ceramic 100n 20% 50V	213-401
C 30	C Ceramic 100n 20% 50V	213-401
C 31	C Ceramic 100n 20% 50V	213-401
C 32	C Ceramic 100n 20% 50V	213-401

DIODES

CR 3	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 4	LED Indicator 90° HP-HLMP5000	350-803

CONNECTORS

J 1	DIN 41612 96 pol male 90°, C class II	805-923
J 2	Connector Champ Angled 24 pins	805-943

CHOKES

L 1	RF-choke six-hole core green	731-204

TRANSISTORS

Q 3	Transistor VP0106N3 Power Mos P-CH	360-244
Q 4	Transistor VN0106N3 Power Mos N-CH	360-245
Q 5	Transistor VP0106N3 Power Mos P-CH	360-244
Q 6	Transistor VN0106N3 Power Mos N-CH	360-245

INTEGRATED DIGITAL CIRCUITS

QD 1	IC SN75160A Octal IEEE-488 TR	364-576
QD 2	IC SN75161N Octal bus transceivers	364-455
QD 3	IC TMS9914ANL P-VER.Gen.Pur Interface bus	364-454
QD 4	IC 74HCT245 oct bus tx/rx	364-667
QD 5	IC 74HCT245 oct bus tx/rx	364-667
QD 6	IC 80C186-8 PLCC 16-Bit Microprocessor	365-114
QD 7	IC 74HCT573 Octal Latch	364-762
QD 8	IC 74HCT573 Octal Latch	364-762
QD 9	IC 74HCT573 Octal Latch	364-762
QD 10	IC MAX 695 Microprocessor supervisory Circuits	365-045
QD 12	IC 55257/51256 CMOS RAM 32KX8	364-759
QD 13	IC 55257/51256 CMOS RAM 32KX8	364-759
QD 14	RE204 Prog E-PROM 901-870 QD14	368-375
QD 15	RE204 Prog E-PROM 901-870 QD15	368-376
QD 17	IC 74HCT14 Hex inverter with Schmitt trigger	364-699
QD 19	RExxx Main Cpu 901-707 iss5 QD19 16L8	369-330
QD 21	IC 74HC32 Quad 2-Input OR Gate	364-756
QD 22	IC 74HCT04 HEX inv	364-700
QD 23	IC 74HC541 Octal buffer/line driver	364-781
QD 24	IC 74HCT74 dual D ff	364-686
QD 25	RExxx Main Cpu QD25 For 971-290 Iss5 or Newer	369-361
QD 29	IC 74HCT299 8-bit Shift register	364-782
QD 30	IC 74HCT299 8-bit Shift register	364-782
QD 31	IC 74HCT165 8-bit PISO	364-695
QD 35	IC 74HCT32 quad OR gate	364-698

RESISTORS

R 1	R Metal film 4K70 5% 0.2W TC250	107-447
R 5	R Thick film Sil 8*18K	146-008
R 6	R Thick film Sil 8*18K	146-008
R 7	R Thick film Sil 8*18K	146-008
R 8	R Thick film Sil 8*18K	146-008
R 9	R Thick film Sil 8*18K	146-008
R 10	R Thick film Sil 8*18K	146-008
R 11	R Thick film Sil 8*18K	146-008
R 12	R Thick film Sil 8*18K	146-008
R 13	R Thick film Sil 8*18K	146-008
R 14	R Metal film 4K70 5% 0.2W TC250	107-447
R 15	R Thick film Sil 8*18K	146-008
R 16	R Thick film Sil 8*18K	146-008
R 17	R Thick film Sil 8*18K	146-008
R 19	R Metal film 47K0 5% 0.2W TC250	107-547
R 21	R Metal film 390E 5% 0.2W TC250	107-339
R 24	R Thick film Sil 8*18K	146-008

R 50	R Metal film 22E0 5% 0.2W TC250	107-222
R 51	R Metal film 22E0 5% 0.2W TC250	107-222
R 53	R Metal film 4K70 5% 0.2W TC250	107-447

SWITCHES

S 1	DIL Switch 8x1-Pol	547-003

CRYSTALS

Y 1	Quartz Crystal 16MHZ +-50ppm	910-202

MISCELLANEOUS

	Screw pozidriv panhead M2.5x8	008-208
	Hexagon Cylinder Screw M2.5x8 Rustproof	010-208
	Lock washer D2,7/4,8x0,45	046-404
	Tubular Rivet 2.5X10	060-310
	Female Plug	805-718
	Locknipple F. Multiplug Champ Short version 90	805-967
	Isolating Plate F.Crystal	816-287
	L-piece for PCB	857-041
	PCB For RExxx General Purpose Computer	971-290
	Rear Plate For 2 Comp. RE204 SUB DWG 933-074	978-279
	Single Coater Foam Tape	992-125
GND1	Solder Terminal 0.1 O2	823-303
GND2	Solder Terminal 0.1 O2	823-303
QDS1	20 Pin DIL Socket	816-184
QDS2	20 Pin DIL Socket	816-184
QDS3	40 pin DIL Socket	816-179
QDS6	PLCC 68 pol socket	816-305
QDS12	Dual In Line Socket 32 Pin 6 Modul Spacing	816-296
QDS13	Dual In Line Socket 32 Pin 6 Modul Spacing	816-296
QDS14	Dual In Line Socket 32 Pin 6 Modul Spacing	816-296
QDS15	Dual In Line Socket 32 Pin 6 Modul Spacing	816-296
QDS19	20 Pin DIL Socket	816-184
QDS25	24 Pin DIL Socket w. 3 modul spacing	816-274

9. SIGNAL ANALYZING PROCESSOR

9.1 Circuit Description

The Signal Analyzing Processor is responsible for all measuring, including filtering and RMS/average/quasi-peak detection (but excluding the analog peak detectors and the meter updating; see section 2, **Principle of Operation**).

9.1.1 Data Sample Input

Data, A/D Data, and the associated clock signal, Data Clk, from the A/D Converter Board are routed to the Signal Analyzing Processor. The data format, as shown in Fig. 9.1, consists of 17 data bits per sample, the first one indicates whether this sample is from the left or right channel.

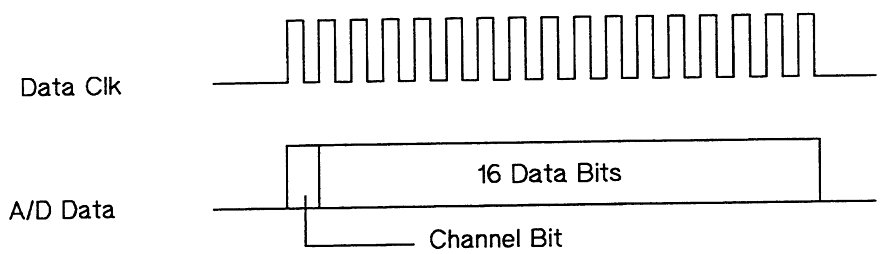


Fig. 9.1 - A/D Data Format

The serial data enters the serial-in-parallel-out shift register QD24/QD25. As data from the A/D converter is updated on the rising edge of the clock, this shift register is clocked on the trailing edge. On the last clock pulse the shift register holds the 16 data bits, while QD33B holds the channel-indication bit.

The output from the shift register is transferred to a FIFO (First-In-First-Out) register (QD12,QD13,QD14,QD15) to provide some slack for the signal processor when fetching data samples. The signal 128K, which is generated by the counter QD26, controls the transfer. The counter acts as a "digital one-shot"; it is reset by any Data Clk pulse and allowed to run out (TC, pin 15 goes high) when the clock pulse train ceases. The Audio Generator Signal Processor also uses this signal.

9.1.2 Main Computer Interface

The 80C186 Main Computer tells the Signal Analyzing Processor which measurement is going to be made and transfers filter data and the various measurement parameters.

The Main Computer has access to various control signals via the hardware control register QD23. After power up, the Main Computer gains control over the program memory busses (address and data busses) by asserting Bus Request (pin 2 of QD23). The signal processor responds by asserting Bus Grant and tri-stating the busses. The Main Computer then transfers the signal processor program code from the EPROMs on the Main Computer board to the 24-bit signal processor program memory RAM (QD3,QD4,QD5). This is done in two steps, as the 80C186 bus is only 16-bits wide. Upon completion of the transfer, Reset and Bus Request are released and the signal processor starts execution.

When a measurement is going to be performed, the Main Computer gains access to the program memory busses as described above. The measurement command and associated parameters such as measurement time, filter coefficients etc. are then written in a specific message area of the program memory. After releasing the busses, the signal processor is provoked to start the measurement by assertion of an interrupt (pin 3 of QD23).

A 16-word FIFO (First-In-First-Out) buffer (QD8,QD9,QD10,QD11) delivers the measurement result to the Main Computer. When the signal processor transfers the 16th word to the FIFO, DIR (Data Input Ready) goes low, because the FIFO is full. This signal interrupts the Main Computer, indicating that a measurement result is ready. When the Main Computer reads the first word from the FIFO, DIR goes high because the FIFO no longer is full, thus releasing the interrupt.

9.2 Schematic Diagrams

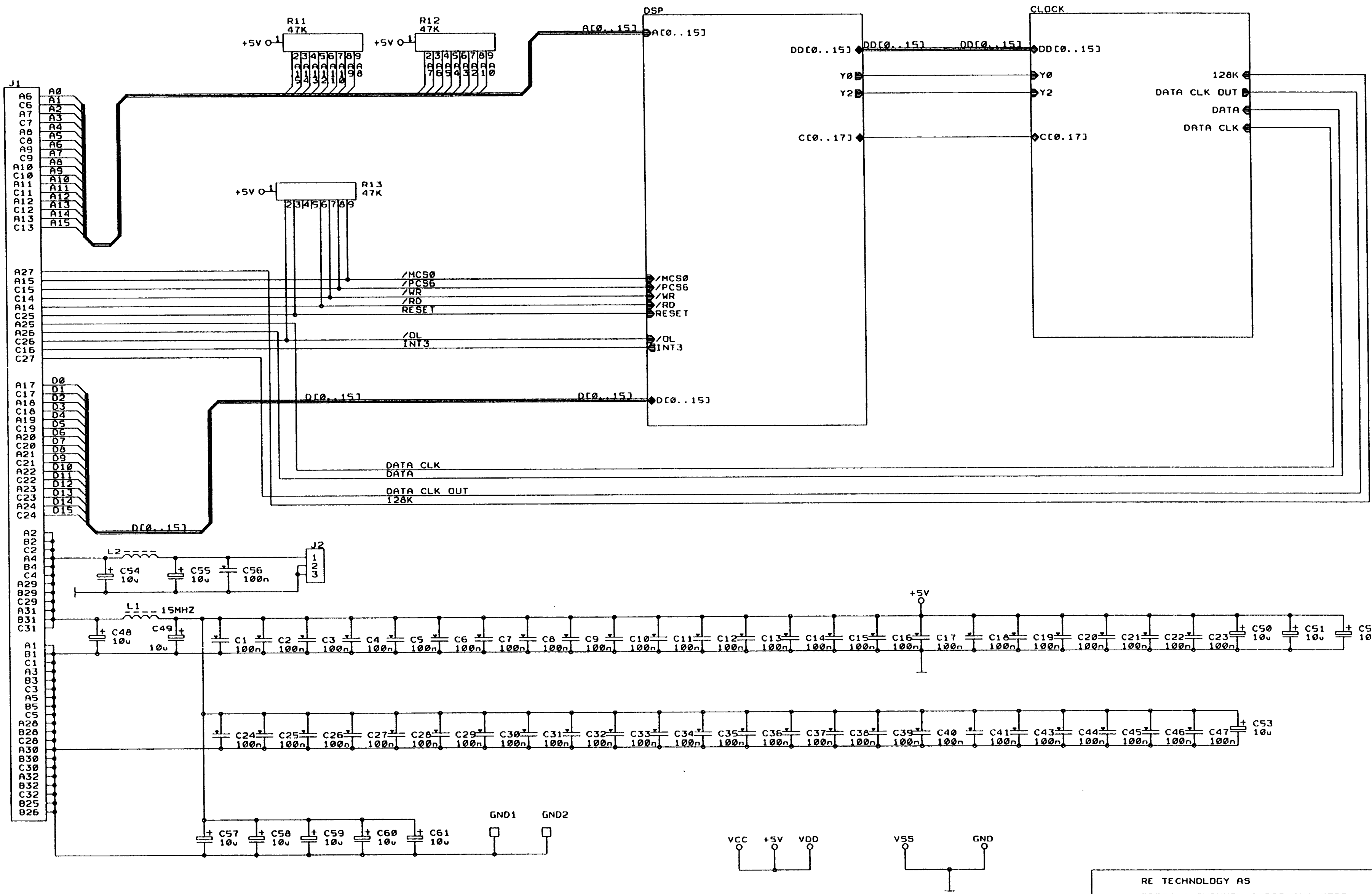
The schematic diagram for the signal analyzing processor is shown in diagram number 985-310.

9.3 Component Locations

The component locations on the signal analyzing processor are shown in the following diagram.

9.4 Parts List

A copy of the parts lists from the production documentation is located in the following. The code number of the assembled PCB is 901-840.



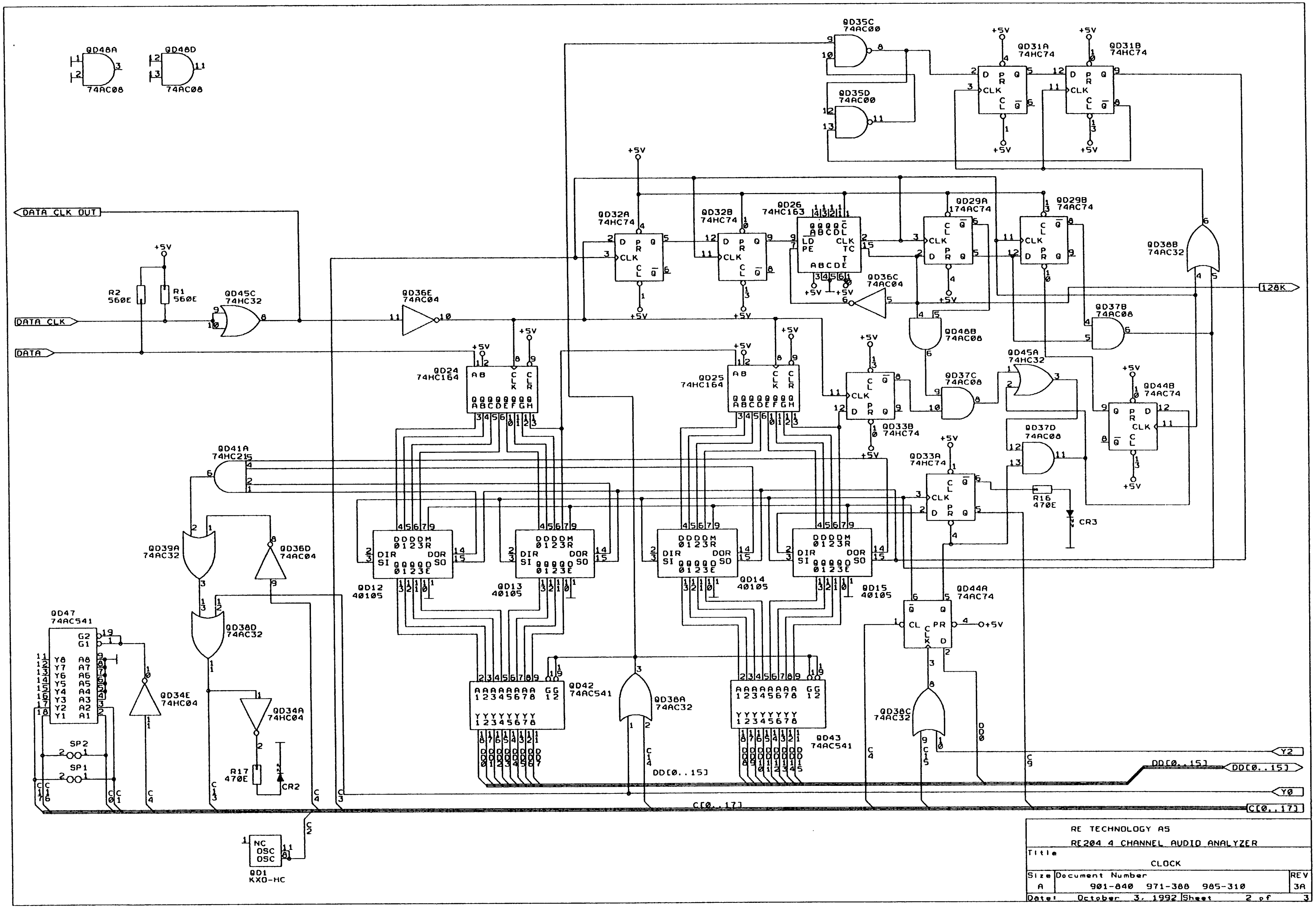
RE TECHNOLOGY AS

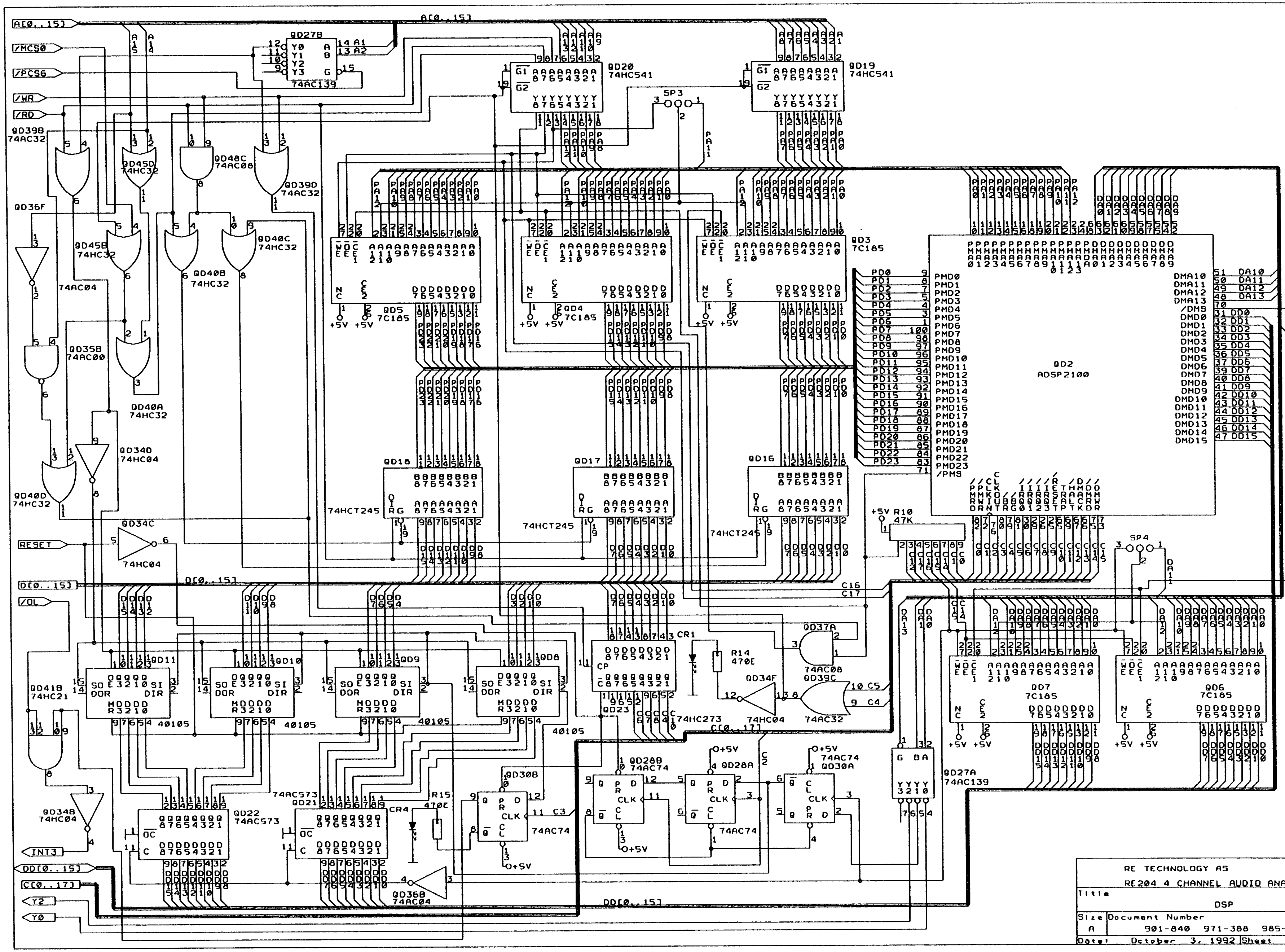
RE204 4 CHANNEL AUDIO ANALYZER
SIGNAL ANALYZING BOARD

Title: ROOT SHEET

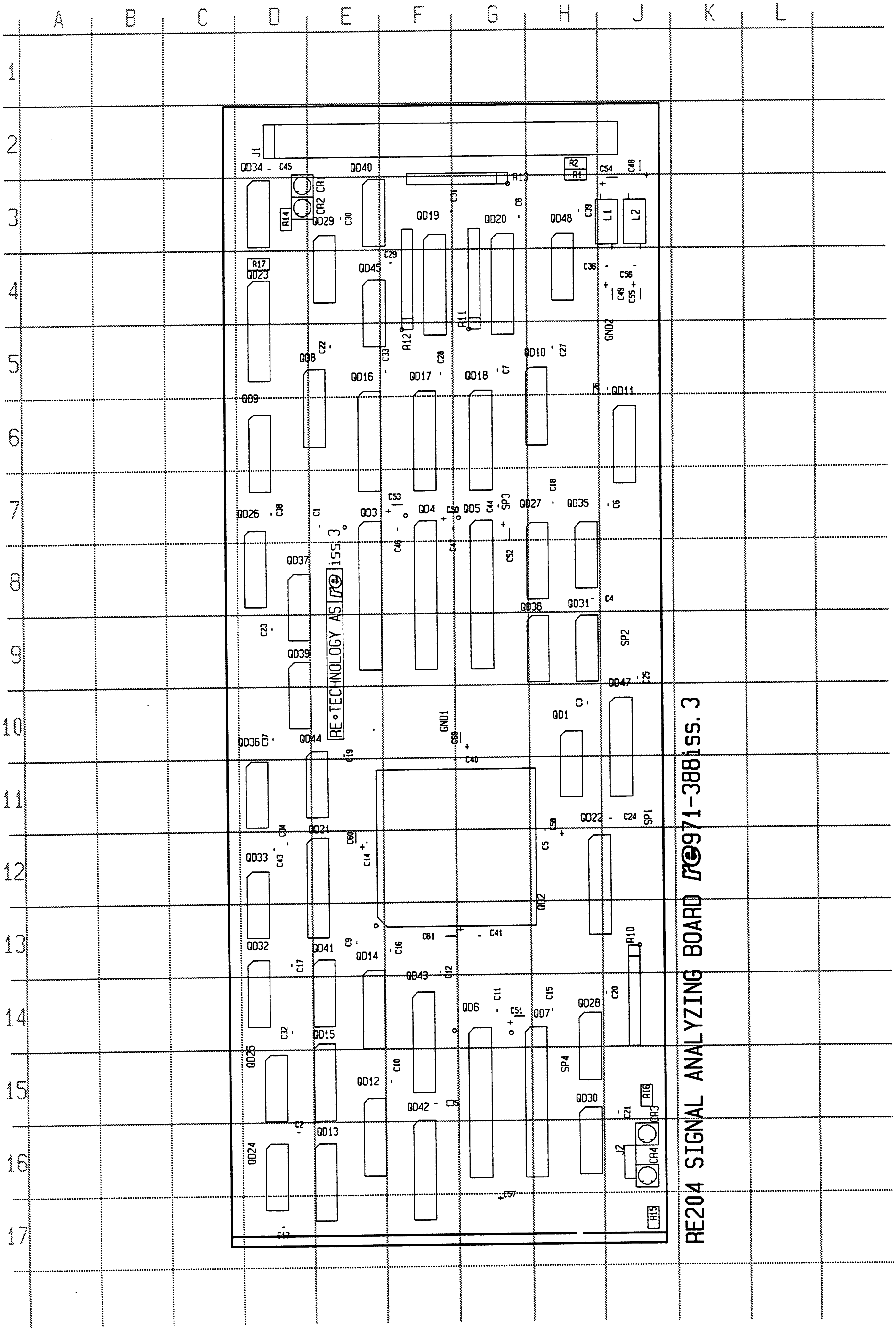
Size	Document Number	REV
A	901-840 971-388 985-310	3A

Date: October 3, 1992 Sheet 1 of 3


RE TECHNOLOGY AS
RE204 4 CHANNEL AUDIO ANALYZER
Title
CLOCK
Size A
Document Number 901-840 971-388 985-310
REV 3A
Date: October 3, 1992
Sheet 2 of 3
DATA CLK OUT
DATA CLK
DATA
128K
Y2
DD[0..15]
Y0
C[0..17]
QD48A 74AC08
QD48D 74AC08
QD35C 74AC00
QD35D 74AC00
QD31A 74HC74
QD31B 74HC74
QD32A 74HC74
QD32B 74HC74
QD26 74HC163
QD29A 174AC74
QD29B 74AC74
QD38B 74AC32
QD36C 74AC04
QD36E 74AC04
QD45C 74HC32
R1 560E
R2 560E
QD24 74HC164
QD25 74HC164
QD48B 74AC08
QD37B 74AC08
QD37C 74AC08
QD45A 74HC32
QD44B 74AC74
QD33B 74HC74
QD37D 74AC08
QD33A 74HC74
R16 470E
CR3
QD41A 74HC21
QD39A 74AC32
QD36D 74AC04
QD12 40105
QD13 40105
QD14 40105
QD15 40105
QD44A 74AC74
QD47 74AC541
QD34E 74HC04
QD38D 74AC32
QD34A 74HC04
R17 470E
CR2
QD42 74AC541
QD38A 74AC32
QD43 74AC541
QD38C 74AC32
SP1
SP2
QD1 KXO-HC



RE TECHNOLOGY AS		
RE204 4 CHANNEL AUDIO ANALYZER		
Title	DSP	
Size	Document Number	REV
A	901-840 971-388 985-310	3A
Date: October 3, 1992	Sheet 3 of 3	


RE204 SIGNAL ANALYZING BOARD 971-388 iss. 3
RE • TECHNOLOGY AS iss. 3

COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC
CR1	E3	QD6	G14																				
CR2	E3	QD7	H14																				
CR3	J16	QD8	D5																				
CR4	J16	QD9	D6																				
C1	E7	QD10	G5																				
C2	D16	QD11	J6																				
C3	H10	QD12	E15																				
C4	J8	QD13	E16																				
C5	H12	QD14	E13																				
C6	J7	QD15	E14																				
C7	G5	QD16	E5																				
C8	G3	QD17	F5																				
C9	E13	QD18	G5																				
C10	F15	QD19	F3																				
C11	G14	QD20	G3																				
C12	F14	QD21	D12																				
C13	D17	QD22	H11																				
C14	E12	QD23	D4																				
C15	H14	QD24	D16																				
C16	F13	QD25	D15																				
C17	D13	QD26	D7																				
C18	H7	QD27	G7																				
C19	E11	QD28	H14																				
C20	J14	QD29	E3																				
C21	J15	QD30	H15																				
C22	E5	QD31	H8																				
C23	D9	QD32	D13																				
C24	J11	QD33	D12																				
C25	J10	QD34	D2																				
C26	J6	QD35	H7																				
C27	H5	QD36	C10																				
C28	F5	QD37	D8																				
C29	F4	QD38	G8																				
C30	E3	QD39	D9																				
C31	G3	QD40	E2																				
C32	D14	QD41	E13																				
C33	F5	QD42	F15																				
C34	D12	QD43	F14																				
C35	F15	QD44	D10																				
C36	H4	QD45	E4																				
C37	D10	QD47	J10																				
C38	D7	QD48	H3																				
C39	H3	R1	H3																				
C40	G11	R2	H2																				
C41	G13	R10	J13																				
C43	D12	R11	G5																				
C44	G7	R12	F5																				
C45	D2	R13	G3																				
C46	F8	R14	D3																				
C47	G8	R15	J17																				
C48	J2	R16	J15																				
C49	J4	R17	D4																				
C50	F7	SP1	J11																				
C51	G14	SP2	J9																				
C52	G8	SP3	G7																				
C53	F7	SP4	H15																				
C54	J2	3	E7																				
C55	J4																						
C56	J4																						
C57	G17																						
C58	H12																						
C59	G10																						
C60	E12																						
C61	F13																						
GND1	F10																						
GND2	J5																						
J1	D2																						
J2	J16																						
L1	J3																						
L2	J3																						
QD1	H10																						
QD2	H13																						
QD3	E7																						
QD4	F7																						
QD5	G7																						

COMPONENT SIDE

PCB Assy Signal Analyzing Processor (901-840)

CAPACITORS

C 1	C Ceramic 100n 20% 50V	213-401
C 2	C Ceramic 100n 20% 50V	213-401
C 3	C Ceramic 100n 20% 50V	213-401
C 4	C Ceramic 100n 20% 50V	213-401
C 5	C Ceramic 100n 20% 50V	213-401
C 6	C Ceramic 100n 20% 50V	213-401
C 7	C Ceramic 100n 20% 50V	213-401
C 8	C Ceramic 100n 20% 50V	213-401
C 9	C Ceramic 100n 20% 50V	213-401
C 10	C Ceramic 100n 20% 50V	213-401
C 11	C Ceramic 100n 20% 50V	213-401
C 12	C Ceramic 100n 20% 50V	213-401
C 13	C Ceramic 100n 20% 50V	213-401
C 14	C Ceramic 100n 20% 50V	213-401
C 15	C Ceramic 100n 20% 50V	213-401
C 16	C Ceramic 100n 20% 50V	213-401
C 17	C Ceramic 100n 20% 50V	213-401
C 18	C Ceramic 100n 20% 50V	213-401
C 19	C Ceramic 100n 20% 50V	213-401
C 20	C Ceramic 100n 20% 50V	213-401
C 21	C Ceramic 100n 20% 50V	213-401
C 22	C Ceramic 100n 20% 50V	213-401
C 23	C Ceramic 100n 20% 50V	213-401
C 24	C Ceramic 100n 20% 50V	213-401
C 25	C Ceramic 100n 20% 50V	213-401
C 26	C Ceramic 100n 20% 50V	213-401
C 27	C Ceramic 100n 20% 50V	213-401
C 28	C Ceramic 100n 20% 50V	213-401
C 29	C Ceramic 100n 20% 50V	213-401
C 30	C Ceramic 100n 20% 50V	213-401
C 31	C Ceramic 100n 20% 50V	213-401
C 32	C Ceramic 100n 20% 50V	213-401
C 33	C Ceramic 100n 20% 50V	213-401
C 34	C Ceramic 100n 20% 50V	213-401
C 35	C Ceramic 100n 20% 50V	213-401
C 36	C Ceramic 100n 20% 50V	213-401
C 37	C Ceramic 100n 20% 50V	213-401
C 38	C Ceramic 100n 20% 50V	213-401
C 39	C Ceramic 100n 20% 50V	213-401
C 40	C Ceramic 100n 20% 50V	213-401
C 41	C Ceramic 100n 20% 50V	213-401
C 43	C Ceramic 100n 20% 50V	213-401
C 44	C Ceramic 100n 20% 50V	213-401
C 45	C Ceramic 100n 20% 50V	213-401
C 46	C Ceramic 100n 20% 50V	213-401
C 47	C Ceramic 100n 20% 50V	213-401
C 48	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 49	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 50	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 51	C Solid Aluminium 10u 20% 16V Short Type	265-108

C 52	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 53	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 54	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 55	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 56	C Ceramic 100n 20% 50V	213-401
C 57	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 58	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 59	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 60	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 61	C Solid Aluminium 10u 20% 16V Short Type	265-108

DIODES

CR 1	LED 3mm red	350-043
CR 4	LED 3mm red	350-043

CONNECTORS

J 1	DIN 41612 96 pol male 90°, C class II	805-923
J 2	Conn 3 Pole Dubox Angle PCB male	805-975

CHOKES

L 1	RF-choke six-hole core green	731-204
L 2	RF-choke six-hole core green	731-204

INTEGRATED DIGITAL CIRCUITS

QD 1	Hybrid Clock Oscillator 40MHz TTl 100ppm	910-214
QD 2	IC Digial Signal Proc. ADSP2100AJG (PGA 10MHz)	364-885
QD 3	IC Cmos Static Ram 2Kx8 30nsec.	364-868
QD 4	IC Cmos Static Ram 2Kx8 30nsec.	364-868
QD 5	IC Cmos Static Ram 2Kx8 30nsec.	364-868
QD 6	IC Cmos Static Ram 2Kx8 30nsec.	364-868
QD 7	IC Cmos Static Ram 2Kx8 30nsec.	364-868
QD 8	IC 74HC40105 4-BitsX16 Words FiFo Register	364-802
QD 9	IC 74HC40105 4-BitsX16 Words FiFo Register	364-802
QD 10	IC 74HC40105 4-BitsX16 Words FiFo Register	364-802
QD 11	IC 74HC40105 4-BitsX16 Words FiFo Register	364-802
QD 12	IC 74HC40105 4-BitsX16 Words FiFo Register	364-802
QD 13	IC 74HC40105 4-BitsX16 Words FiFo Register	364-802
QD 14	IC 74HC40105 4-BitsX16 Words FiFo Register	364-802
QD 15	IC 74HC40105 4-BitsX16 Words FiFo Register	364-802
QD 16	IC 74HCT245 oct bus tx/rx	364-667
QD 17	IC 74HCT245 oct bus tx/rx	364-667
QD 18	IC 74HCT245 oct bus tx/rx	364-667
QD 19	IC 74HC541 Octal buffer/line driver	364-781
QD 20	IC 74HC541 Octal buffer/line driver	364-781
QD 21	IC 74ACT573 Octal Transparent Latch W.Tri State	364-863
QD 22	IC 74ACT573 Octal Transparent Latch W.Tri State	364-863
QD 23	IC 74HC273 Octal D-FF.	364-574
QD 24	IC 74HCT164 8b shift reg.	364-676
QD 25	IC 74HCT164 8b shift reg.	364-676
QD 26	IC 74HC163P 4-bit binary counter	364-814

QD 27	IC 74AC139 Dual 1-OF-4 Decoder/Demultiplexer	364-805
QD 28	IC 74ACT74 Dual d-Type FF With Set And Reset	364-865
QD 29	IC 74AC74 dual D ff	364-795
QD 30	IC 74AC74 dual D ff	364-795
QD 31	IC 74HC74P dual d ff	364-755
QD 32	IC 74HC74P dual d ff	364-755
QD 33	IC 74HC74P dual d ff	364-755
QD 34	IC 74HC04 HEX INV	364-757
QD 35	IC 74AC00 quad NAND gate	364-819
QD 36	IC 74AC04 Hex Inverter	364-861
QD 37	IC 74AC08 Quad 2-Input And	364-860
QD 38	IC 74AC32 quad OR gate	364-864
QD 39	IC 74AC32 quad OR gate	364-864
QD 40	IC 74HC32 Quad 2-Input OR Gate	364-756
QD 41	IC 74HC21 and gate	364-812
QD 42	IC 74AC541 Octal Buffer/Line Driver	364-818
QD 43	IC 74AC541 Octal Buffer/Line Driver	364-818
QD 44	IC 74AC74 dual D ff	364-795
QD 45	IC 74HC32 Quad 2-Input OR Gate	364-756
QD 48	IC 74AC08 Quad 2-Input And	364-860

RESISTORS

R 1	R Metal film 560E 5% 0.2W TC250	107-356
R 2	R Metal film 560E 5% 0.2W TC250	107-356
R 10	R Thick film Sil 8*47K	146-005
R 11	R Thick film Sil 8*47K	146-005
R 12	R Thick film Sil 8*47K	146-005
R 13	R Thick film Sil 8*47K	146-005
R 16	R Metal film 470E 5% 0.2W TC250	107-347
R 17	R Metal film 470E 5% 0.2W TC250	107-347

MISCELLANEOUS

	Solder Terminal 0.1 O2	823-303
	Handle for PCB	854-315
	PCB For RE204 Signal Analyzing Board	971-388
QDS2	PGA Socket 13X13 101 Pins	816-295
QDS3	14 Pin Dil Socket	816-131
QDS4	14 Pin Dil Socket	816-131
QDS5	14 Pin Dil Socket	816-131
QDS6	14 Pin Dil Socket	816-131
QDS7	14 Pin Dil Socket	816-131

10. ANALOG FRONTEND

10.1 Circuit Description

Fig. 10.1 shows the block diagram.

The main purpose of the Analog Frontend is to condition the analog input signal before it is digitized. This conditioning involves amplification/attenuation and frequency limiting. Furthermore, the Analog Frontend includes a peak detector and an AUX channel, used during meter updating.

10.1.1 Balanced Input Amplifiers

Refer to sheet 2 of the schematic diagram.

Each frontend board handles two inputs, front and rear, having individual input stages. Each input stage is composed of a relay attenuator, followed by an instrumentation amplifier providing differential-to-single-ended conversion. The diodes CR1-2, CR9-10 (CR11-CR12, CR19-CR20) ensure input protection for peak amplitudes of up to 50 V.

The relays K3 and K8 are used to disconnect the external input and short-circuit the inputs to the instrumentation amplifiers. This feature is used for self-calibration.

Mount the jumpers K4, K5, K9 and K10 during calibration of the CMRR input.

10.1.2 Gain Section

Refer to sheet 3 of the schematic diagram.

This section comprises the input selector used to shift between the front and the rear input (Q16 and Q19). The input which is *not* selected, is using Q15 and Q18 routed to the AUX channel programmable amplifier QA128, providing either 0 dB or 30 dB gain. During meter updates, this channel is used for measuring the rear input, while the front input is routed through the normal signal path, as described in section 2.9.

Following the input selector, the offset voltage correction is added. This voltage originates from a D/A converter located on the A/D Converter Board (see section 11) and uses R95/R91 further divided, yielding a resolution of approximately 40 μV.

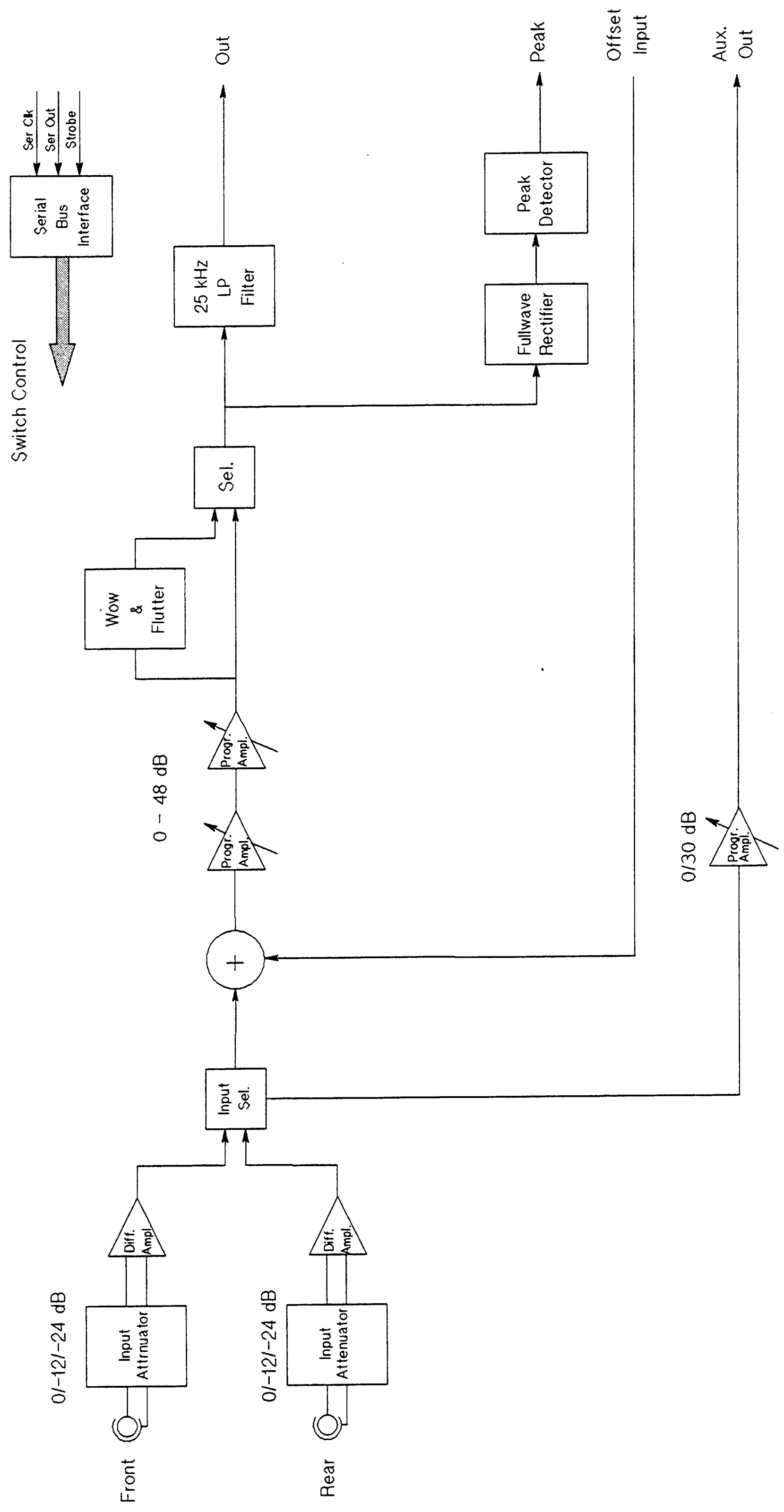


Fig. 10.1 - Analog Frontend Block Diagram

The programmable amplifier has two sections, one (QA7) offering 0 dB, 6 dB, 12 dB, 18 dB and 24 dB gain, the other (QA16B) 0 dB, 12 dB and 24 dB gain. Gain is always set at QA7 before QA16B.

10.1.3 Clipper and Peak Detector

Refer to sheet 4 of the schematic diagram.

From the output of the gain section, the signal is routed to the (optional) Wow & Flutter Board. The switches Q33/Q32 select between the normal signal and the output from the Wow & Flutter Board.

QA8 constitutes a clipper ensuring that the voltage from this point never exceeds 3.2 Vpeak. This ensures that the antialiasing filter is never saturated.

The peak detector (QA14/QA15) is used for supervision of input signals during measurements, and for auto ranging. A fullwave rectifier (QA17) precedes it to ensure that both positive and negative peak voltages are accounted for. 1 V DC voltage at the peak output corresponds to 1 Vpeak AC input voltage.

10.1.4 Antialiasing Filter

Refer to sheet 5 of the schematic diagram.

The antialiasing filter attenuates possible signal components which could cause aliasing in the digital domain, that is any frequencies above 39 kHz. The filter is a 9th order elliptical low-pass filter with a ripple of 0.1 dB, which attenuats 85 dB at 41 kHz. The filter has been implemented using FDNRs (Frequency Dependent Negative Resistances) to eliminate problems related with conventional inductors, such as large size, low Q, non-linearity, etc.

The diodes, CR48-CR51, in conjunction with the zener diode, CR47, protect against latch-up during power up. Q36, C141 and R183 ensure proper power-up conditions.

10.1.5 Serial Bus Interface

Refer to sheet 6 of the schematic diagram.

The 80C186 Main Computer is able to set up the Analog Frontend via the Serial Bus described in section 8. 15 bits are used, latched in the serial-in-parallel-out register consisting of QD1/QD2. The strobe pulse used to latch serial data into this register originates from the A/D Converter Board. As the two frontend boards are identical, they are distinguished by the routing in the Analog Motherboard of two different strobe pulses from the A/D Converter Board (Strobe A and Strobe B for left and right, respectively, see section 11).

The interpretation of the various control bits is given in Table 10.1.

Input Attenuator, Front Channel	Ch1,C0		Ch1,C1		
	0		0		-12 dB
	0		1		0 dB
	1		0		-24 dB
Input Attenuator, Rear Channel	Ch2,C0		Ch2, C1		
	0		0		-12 dB
	0		1		0 dB
	1		0		-24 dB
Gain at QA7	B3	B2	B1	B0	
	0	0	0	0	0 dB
	0	0	0	1	6 dB
	0	0	1	1	12 dB
	0	1	1	1	18 dB
	1	1	1	1	24 dB
Gain at QA16B	B5		B4		
	0		0		0 dB
	0		1		12 dB
	1		1		24 dB
Channel Select	Ch1/Ch2				
	0				Front Ch.
	1				Rear Ch.
Wow & Flutter Enable	Norm/W&F				
	0				W&F Selected
	1				Normal Selected
Peak Detector Discharge	Peak Discharge				
	0				Peak Discharge
	1				Peak Enable
Input Short-circuit (K3/K8)	Input S/C				
	0				S/C Off
	1				S/C On
Aux. Channel Gain	Aux. Gain				
	0				0 dB
	1				30 dB

Table 10.1 - Analog Frontend Setup

10.2 Adjustments

The adjustment procedures are identical for left and right Frontend Boards. Adjustment of the following items are described:

* Input offset in front channel
* Offset in gain section
* Input offset in rear channel
* Output offset
* Offset in AUX channel
* CMRR at 0 dB, -12 dB and -24 dB in front channel
* CMRR at 0 dB, -12 dB and -24 dB in rear channel
* Gain in antialiasing filter
* Peak detectors.

We recommend that you make all the adjustments and in the order stated. This is particularly important for the first three offset adjustments. All voltage measurements should be made using a high precision (0.1 % or better) digital voltmeter.

10.2.1 Offset, Input and Gain Section

Input Offset in Front Channel: Send the command "**CAL,OFF CAL,CLR AO,A,OFF**". Short-circuit Front input.

Adjust the DC voltage measured at TP1 to 0.0 mV ±0.5 mV using R11.

Gain Section Offset: Send the command "**RE,A,3VP CH,F**".

Adjust the DC voltage measured at TP4 to 0.0 mV ±0.5 mV using R86.

Input Offset in Rear Channel: Short-circuit Rear input.

Send the command "**CH,R**".

Adjust the DC voltage measured at TP4 to 0.0 mV ±0.5 mV using R50.

10.2.2 Output Offset

Short-circuit both inputs. Place the Frontend Board directly in the motherboard slot without using an extender board. Measure on the Motherboard TP1 for right and TP2 for left. Use the ground terminal nearby. Adjust the DC voltage to 0.0 mV ±0.5 mV using R141.

10.2.3 Offset in AUX Channel

Short-circuit both inputs. Send the command "**MR,ON**".

Use R81 to adjust the DC voltage at TP3 to 0.0 mV ±0.5 mV.

10.2.4 CMRR in Front Channel

Short-circuit the front input and apply a 1 kHz, 2.00 V_{rms} test signal between the short and ground (chassis).

Adjust CMRR at 0 dB:	Send the command "**CH,F RE,F,3**". Adjust using R5 to obtain a minimum AC reading on TP1 (<0.3 mV).
Adjust CMRR at -12 dB:	Mount short-circuits at K4 and K5. Send the command "**RE,F,12**". Adjust using R22 to minimum AC reading at TP1 (<0.3 mV).
Adjust CMRR at -24 dB:	Remove the short-circuits at K4 and K5. Send the command "**RE,F,24**". Adjust using R17 to minimum AC reading at TP1 (<0.3 mV).

10.2.5 CMRR in Rear Channel

Short-circuit the rear input and apply a 1 kHz, 2.00 V_{rms} test signal between the short and ground (chassis).

Adjust CMRR at 0 dB:	Send the command "**CH,R RE,R,3**". Adjust using R44 to minimum AC reading on TP2 (<0.3 mV).
Adjust CMRR at -12 dB:	Mount short-circuits at K9 and K10. Send the command "**RE,R,12**". Adjust using R62 to minimum AC reading at TP2 (<0.3 mV).
Adjust CMRR at -24 dB:	Remove the short-circuits at K9 and K10. Send the command "**RE,R,24**". Adjust using R56 to minimum AC reading at TP2 (<0.3 mV).

10.2.6 Gain in Antialiasing Filter

Apply a 1 kHz, 2.00 V_{rms} test signal to the front input. Send the command "**CH,LF**" (use "**CH,RF**" when adjusting the right Frontend board). Measure "RMS,500" continuously, or use an AC voltmeter connected to TP8 (J4, pin c1).

Adjust using R169 until the reading corresponds to the actual input level within 0.1 %.

Change the input frequency to 20 Hz and repeat while adjusting using R168.

Repeat the adjustment at 1 kHz and the adjustment at 20 Hz until no further improvements are obtained.

10.2.7 Peak Detectors

Apply a 2 Vrms (2.82 Vpeak), 1 kHz test signal to front input. Measure "PK,250" continuously, or measure the DC voltage at TP6.

Adjust using R130 until the reading is accurate to within ±0.01 V.

Send the command "**CAL,ON CAL**"

10.3 Schematic Diagrams

The schematic diagram for the analog frontend is shown in diagram number 985-309.

10.4 Component Locations

The component locations on the analog frontend are shown in the following diagram.

10.5 Parts List

A copy of the parts lists from the production documentation is shown in the following. The code number of the assembled PCB is 901-839.

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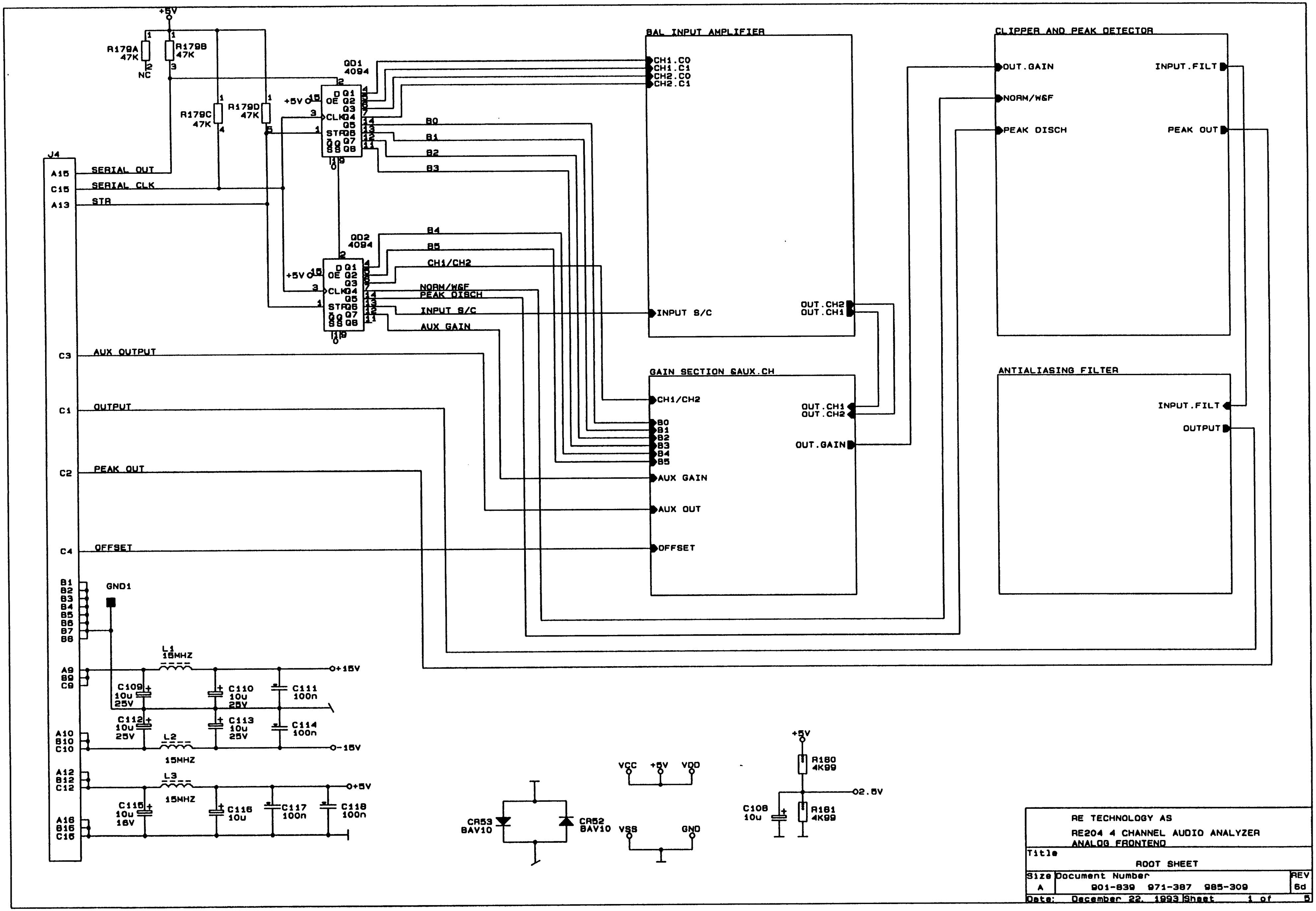
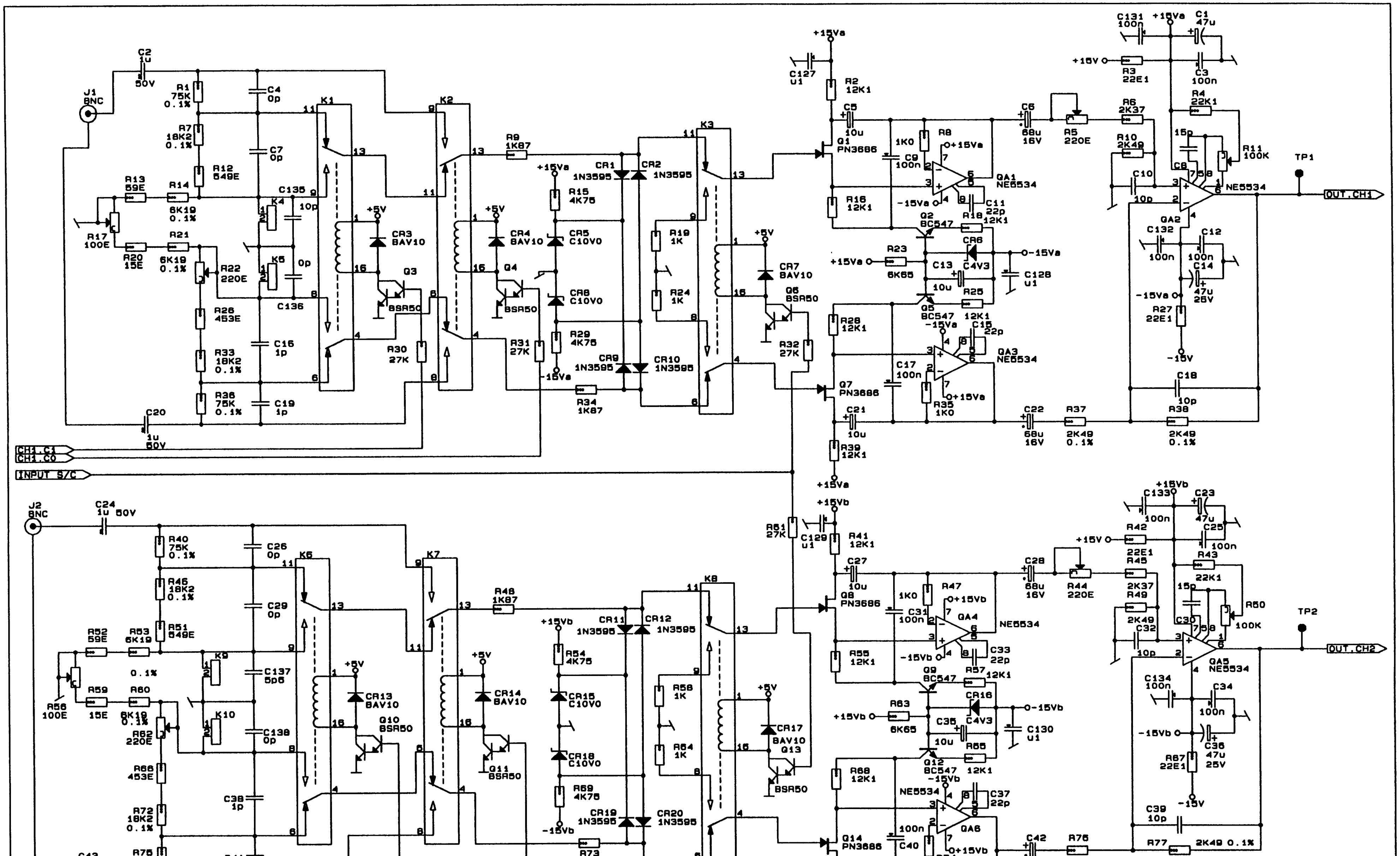


J4
A15 SERIAL OUT
C15 SERIAL CLK
A13 STR
C3 AUX OUTPUT
C1 OUTPUT
C2 PEAK OUT
C4 OFFSET
B1 B2 B3 B4 B5 B6 B7 B8
A9 B9 C9
A10 B10 C10
A12 B12 C12
A16 B16 C16
GND1
+5V
R179A 47K
R179B 47K
NC
R179C 47K
R179D 47K
QD1 4094
QD2 4094
D Q1 OE Q2 Q3 CLK Q4 Q5 STR Q6 Q7 SS Q8
B0 B1 B2 B3 B4 B5
CH1/CH2
NORM/W&F
PEAK DISCH
INPUT S/C
AUX GAIN
BAL INPUT AMPLIFIER
CH1.C0 CH1.C1 CH2.C0 CH2.C1
INPUT S/C
OUT.CH2 OUT.CH1
GAIN SECTION &AUX.CH
CH1/CH2
B0 B1 B2 B3 B4 B5
AUX GAIN
AUX OUT
OFFSET
OUT.CH1 OUT.CH2
OUT.GAIN
CLIPPER AND PEAK DETECTOR
OUT.GAIN
NORM/W&F
PEAK DISCH
INPUT.FILT
PEAK OUT
ANTIALIASING FILTER
INPUT.FILT
OUTPUT
L1 15MHZ
L2 15MHZ
L3 15MHZ
C109 10u 25V
C110 10u 25V
C111 100n
C112 10u 25V
C113 10u 25V
C114 100n
C115 10u 16V
C116 10u
C117 100n
C118 100n
+15V
-15V
+5V
CR53 BAV10
CR52 BAV10
VCC +5V VDD
VSS GND
R180 4K99
R181 4K99
C108 10u
2.5V
RE TECHNOLOGY AS
RE204 4 CHANNEL AUDIO ANALYZER
ANALOG FRONTEND
Title
ROOT SHEET
Size A
Document Number 901-839 971-387 985-309
REV 6d
Date: December 22, 1993
Sheet 1 of 5



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RE204 4 CHANNEL AUDIO ANALYZER

ANALOG FRONTEND

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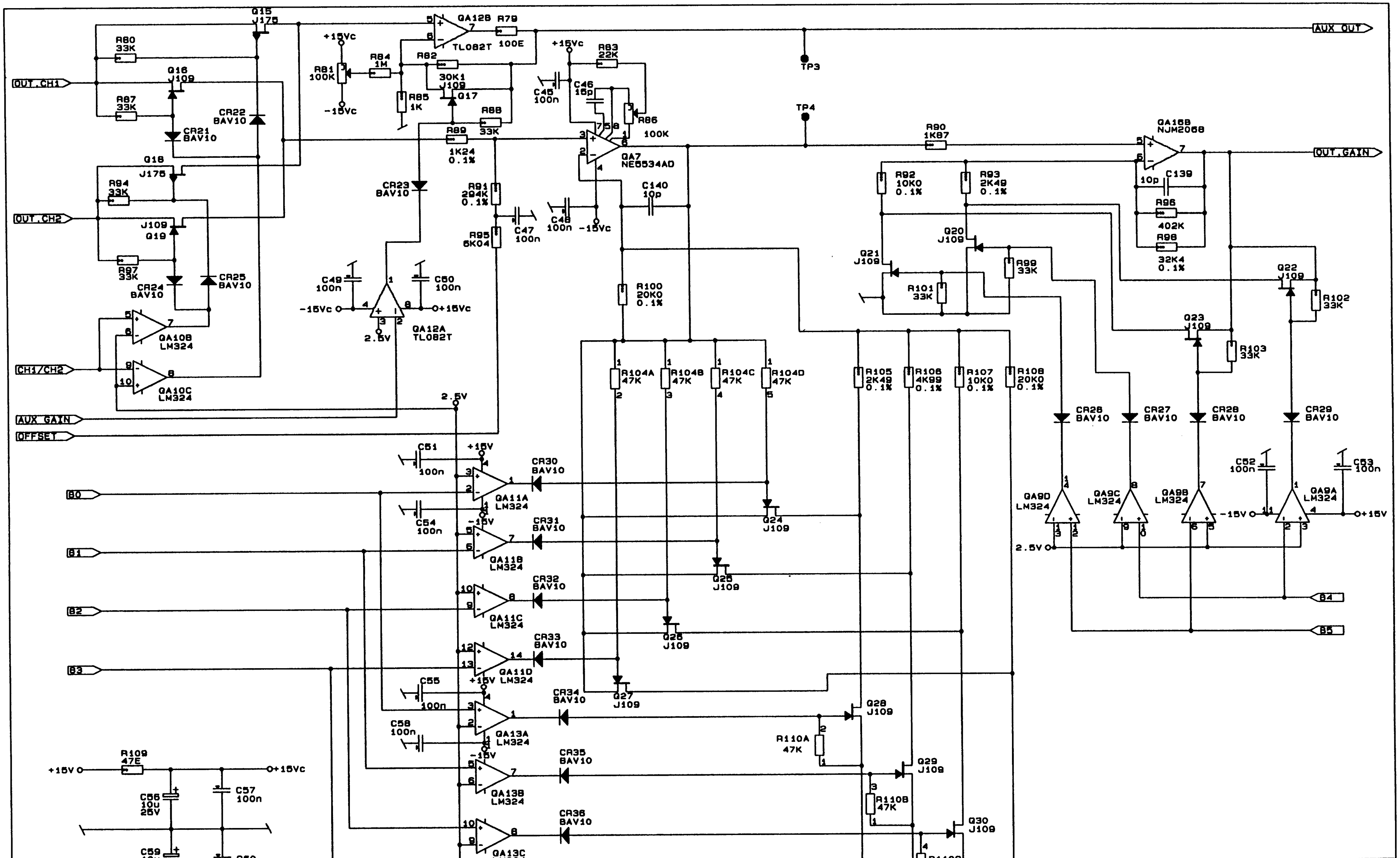
Size: A	Document Number: 901-839 971-387 985-309	REV: 6d
Date: December 22, 1993	Sheet 2 of 5	



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RE204 4 CHANNEL AUDIO ANALYZER			
ANALOG FRONTEND			
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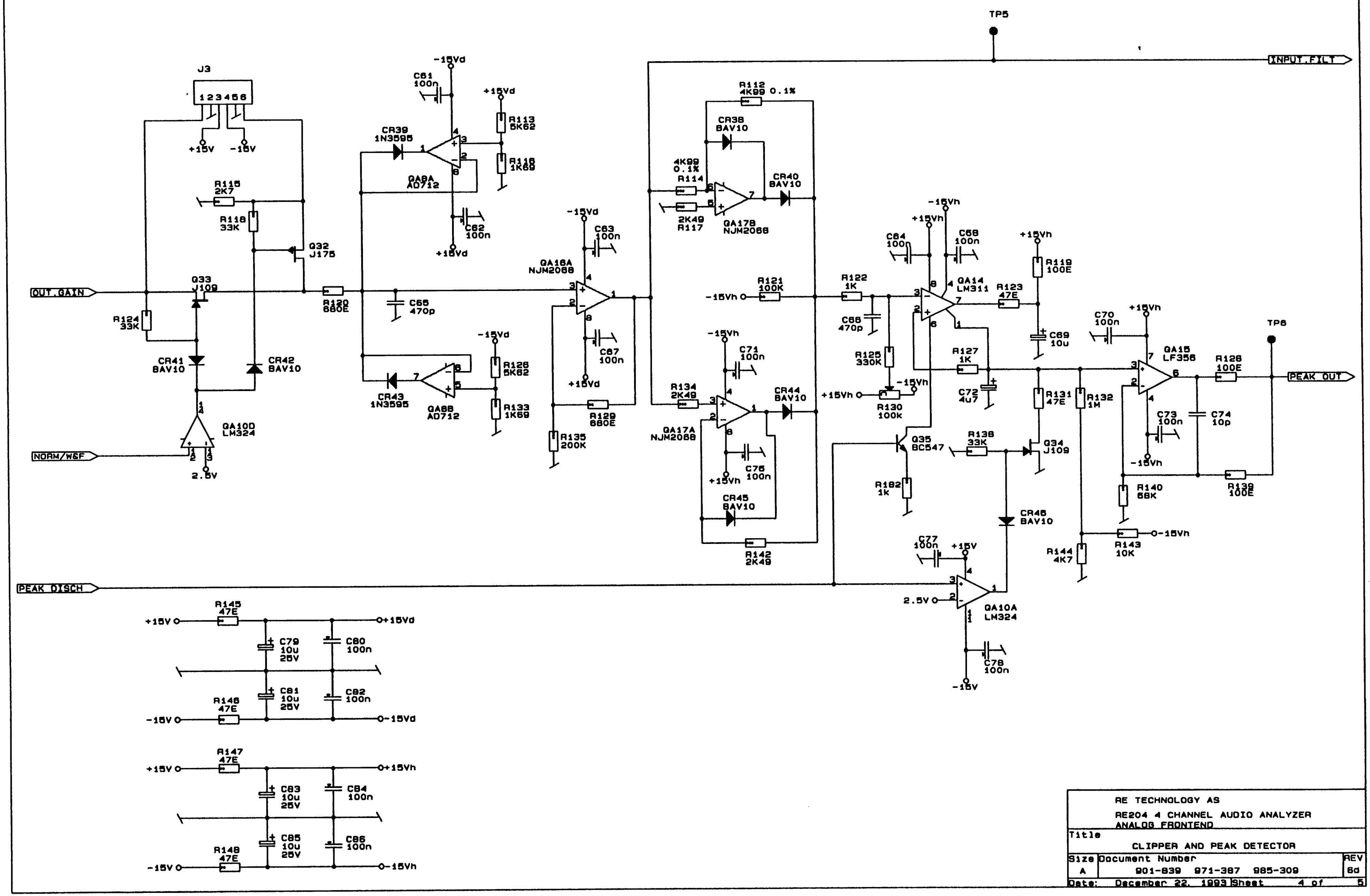
Size	Document Number		REV
A	901-839 971-387 985-309		6d
Date:	December 22, 1993	Sheet 3 of	5



RE TECHNOLOGY AS RE204 4 CHANNEL AUDIO ANALYZER ANALOG FRONTEND		
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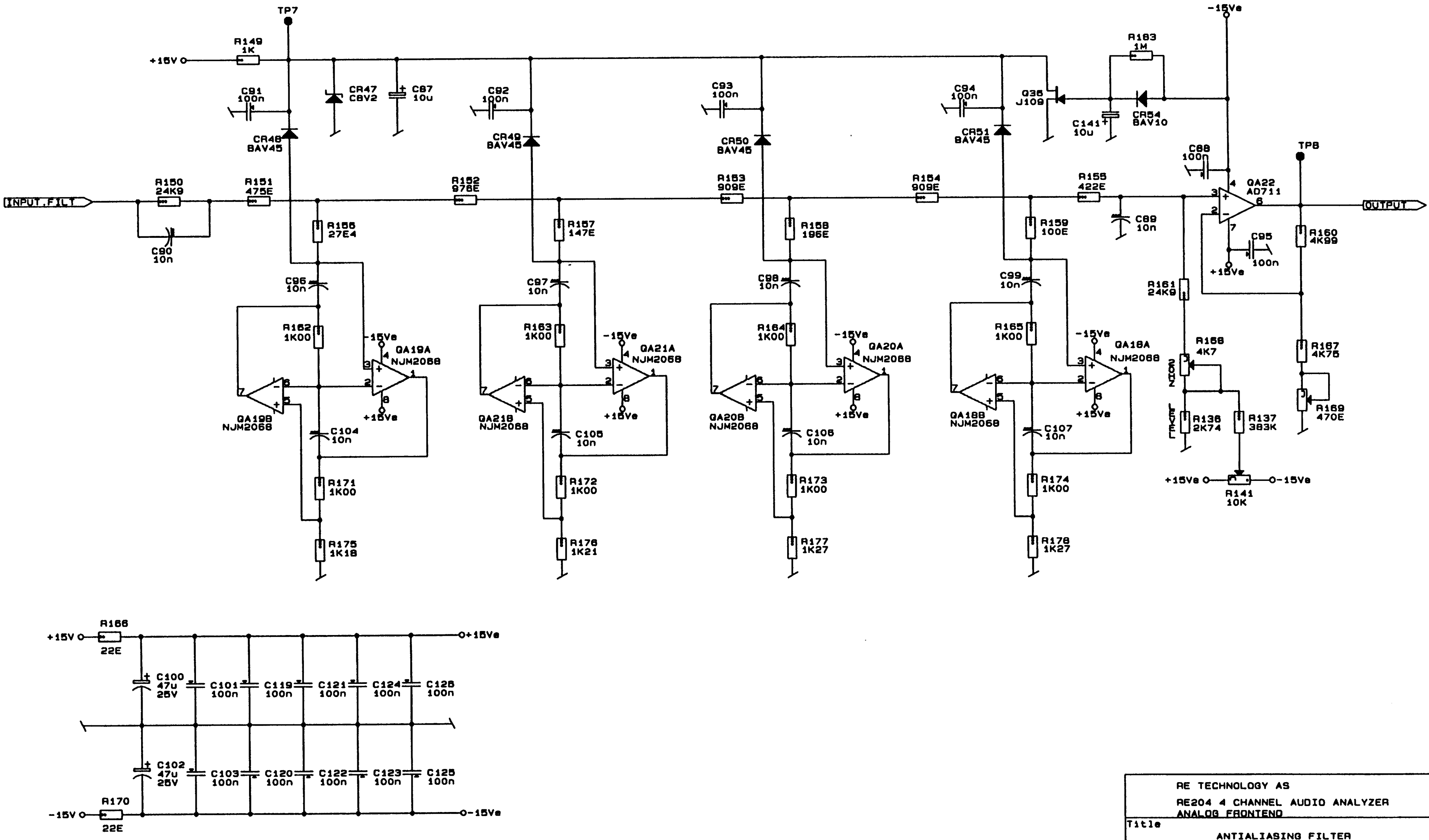
Size A	Document Number 901-839 971-387 985-309	REV 6d
Date:	December 22, 1993 Sheet 4 of	5



RE TECHNOLOGY AS RE204 4 CHANNEL AUDIO ANALYZER ANALOG FRONTEND		
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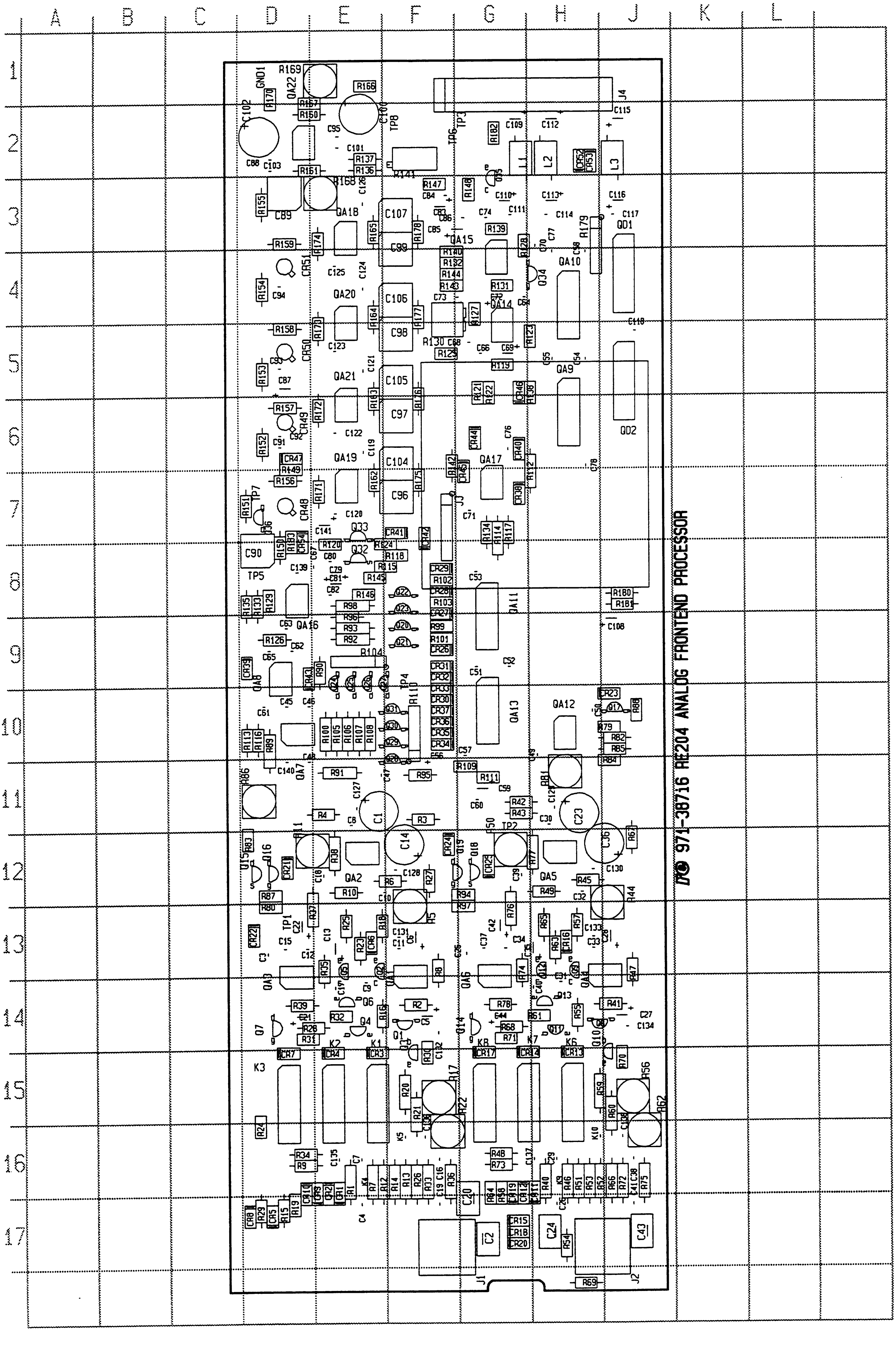
Size A	Document Number 901-839 971-387 985-309	REV 6d
Date: December 22, 1993	Sheet 5 of 5	


971-38716 RE204 ANALOG FRONTEND PROCESSOR

COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC
CR1	E17	C22	D13	C98	F5	QA14	G4	R29	D17	R104	E9	R179	H3										
CR2	E17	C23	H11	C99	F4	QA15	F3	R30	F15	R105	E10	R180	J8										
CR3	E15	C24	H17	C100	F2	QA16	D9	R31	D14	R106	E10	R181	J8										
CR4	E15	C25	G13	C101	E2	QA17	G6	R32	E14	R107	E10	R182	G2										
CR5	D17	C26	H17	C102	D2	QA18	E3	R33	F16	R108	E10	R183	D8										
CR6	E13	C27	J14	C103	D2	QA19	E6	R34	D16	R109	G11	TP1	D13										
CR7	D15	C28	J13	C104	F6	QA20	E4	R35	E13	R110	F10	TP2	G12										
CR8	D17	C29	H16	C105	F5	QA21	E5	R36	F16	R111	G11	TP3	G2										
CR9	E17	C30	H11	C106	F4	QA22	D1	R37	E13	R112	H7	TP4	F10										
CR10	D17	C31	H14	C107	F3	QD1	J3	R38	E12	R113	D10	TP5	D8										
CR11	H17	C32	H12	C108	J9	QD2	J6	R39	D14	R114	G8	TP6	G2										
CR12	G17	C33	H13	C109	G2	Q1	F14	R40	H16	R115	E8	TP7	D7										
CR13	H15	C34	G13	C110	G3	Q2	E13	R41	J14	R116	D10	TP8	F2										
CR14	G15	C35	G13	C111	G3	Q3	F15	R42	G11	R117	G8												
CR15	G17	C36	J12	C112	H2	Q4	E14	R43	G11	R118	F8												
CR16	H13	C37	G13	C113	H3	Q5	E13	R44	J13	R119	G5												
CR17	G15	C38	J16	C114	H3	Q6	E14	R45	H12	R120	E8												
CR18	G17	C39	G12	C115	J2	Q7	D14	R46	H16	R121	G6												
CR19	G17	C40	H14	C116	J3	Q8	H14	R47	J14	R122	G6												
CR20	G17	C41	J17	C117	J3	Q9	H13	R48	G16	R123	H5												
CR21	D12	C42	G13	C118	J5	Q10	H14	R49	H12	R124	E8												
CR22	D13	C43	J17	C119	E6	Q11	H14	R50	G12	R125	F5												
CR23	H10	C44	G14	C120	E7	Q12	H14	R51	H16	R126	D9												
CR24	F12	C45	D10	C121	E5	Q13	H14	R52	H16	R127	G5												
CR25	G12	C46	D10	C122	E6	Q14	G14	R53	H16	R128	H4												
CR26	F9	C47	F11	C123	E5	Q15	D12	R54	H17	R129	D8												
CR27	F9	C48	D11	C124	E4	Q16	D12	R55	H14	R130	F5												
CR28	F8	C49	H11	C125	E4	Q17	J10	R56	J15	R131	G4												
CR29	F8	C50	H10	C126	E3	Q18	G12	R57	H13	R132	F4												
CR30	F10	C51	G9	C127	E11	Q19	G12	R58	G17	R133	D9												
CR31	F9	C52	G9	C128	F12	Q20	F9	R59	J15	R134	G8												
CR32	F9	C53	G8	C129	H11	Q21	F9	R60	J15	R135	D9												
CR33	F10	C54	H5	C130	J12	Q22	F8	R61	G14	R136	E2												
CR34	F10	C55	H5	C131	F13	Q23	F8	R62	J15	R137	E2												
CR35	F10	C56	F11	C132	F15	Q24	E10	R63	H13	R138	H6												
CR36	F10	C57	G10	C133	H13	Q25	E10	R64	G17	R139	G3												
CR37	F10	C58	H4	C134	J14	Q26	E10	R65	H13	R140	F4												
CR38	G7	C59	G11	C135	E16	Q27	F10	R66	J16	R141	F2												
CR39	D9	C60	G11	C136	F16	Q28	F11	R67	J12	R142	F7												
CR40	G6	C61	D10	C137	G16	Q29	F10	R68	G14	R143	F4												
CR41	F7	C62	D9	C138	J16	Q30	F10	R69	H18	R144	F4												
CR42	F8	C63	D9	C139	D8	Q31	F10	R70	J15	R145	E8												
CR43	D10	C64	G4	C140	D11	Q32	E8	R71	G14	R146	E8												
CR44	G6	C65	D9	C141	E7	Q33	E7	R72	J16	R147	F3												
CR45	G7	C66	G5	GND1	D1	Q34	H4	R73	G16	R148	G3												
CR46	G6	C67	E8	J1	G18	Q35	G3	R74	G14	R149	D7												
CR47	D6	C68	F5	J2	J18	Q36	D7	R75	J16	R150	D8												
CR48	D7	C69	G5	J3	G7	R1	E16	R76	G13	R151	D7												
CR49	D6	C70	H4	J4	J1	R2	F14	R77	H12	R152	D6												
CR50	D5	C71	G7	K1	E14	R3	F11	R78	G14	R153	D5												
CR51	D4	C72	G4	K2	E14	R4	E11	R79	H10	R154	D4												
CR52	H2	C73	F4	K3	D15	R5	F13	R80	D13	R155	D3												
CR53	H2	C74	G3	K4	E16	R6	F12	R81	H11	R156	D7												
CR54	D7	C76	G6	K5	F16	R7	E16	R82	J10	R157	D6												
C1	E11	C77	H3	K6	H14	R8	F14	R83	D12	R158	D5												
C2	G17	C78	H7	K7	G14	R9	D16	R84	J11	R159	D3												
C3	D13	C79	E8	K8	G14	R10	E12	R85	J10	R160	D2												
C4	E17	C80	E8	K9	H16	R11	D12	R86	D11	R161	D2												
C5	F14	C81	E8	K10	H16	R12	E16	R87	D12	R162	E7												
C6	F13	C82	E8	L1	G2	R13	F16	R88	J10	R163	E6												
C7	E16	C83	F3	L2	H2	R14	F16	R89	D10	R164	E5												
C8	E11	C84	F3	L3	J2	R15	D17	R90	E9	R165	E3												
C9	E14	C85	F3	QA1	F14	R16	E14	R91	E11	R166	E1												
C10	E12	C86	F3	QA2	E12	R17	F15	R92	E9	R167	D2												
C11	F13	C87	D5	QA3	D14	R18	E13	R93	E9	R168	E3												
C12	D13	C88	D2	QA4	H14	R19	D17	R94	F12	R169	D1												
C13	E13	C89	D3	QA5	H12	R20	F15	R95	F11	R170	D2												
C14	F12	C90	D8	QA6	G14	R21	F15	R96	E9	R171	E7												
C15	D13	C91	D6	QA7	D11	R22	G15	R97	F13	R172	E6												
C16	F16	C92	D6	QA8	D10	R23	E13	R98	E8	R173	E5												
C17	E14	C93	D5	QA9	H5	R24	D16	R99	F9	R174	E4												
C18	E12	C94	D4	QA10	H4	R25	E13	R100	E10	R175	F7												
C19	F17	C95	E2	QA11	G9	R26	F16	R101	F9	R176	F6												
C20	G17	C96	F7	QA12	H10	R27	F12	R102	F8	R177	F5												
C21	D14	C97	F6	QA13	G10	R28	D14	R103	F8	R178	F3												

COMPONENT SIDE

971-38716

PCB Assy Analog Frontend (901-839)

CAPACITORS

C 1	Electrolytic 47/25, 2000h/85°, R:5*11, RM2	261-085
C 2	MKT, 4x1u Select 50V,	241-086
C 3	C Ceramic 100n 20% 50V	213-401
C 5	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 6	C Tantal 4x 68uF Select 16V	267-021
C 8	C Ceramic 15p0 2% 100V NPO	213-216
C 9	C Ceramic 100n 20% 50V	213-401
C 10	C Ceramic 10p0 2% 100V NPO	213-205
C 11	C Ceramic 22p0 2% 100V NPO	213-206
C 12	C Ceramic 100n 20% 50V	213-401
C 13	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 14	Electrolytic 47/25, 2000h/85°, R:5*11, RM2	261-085
C 15	C Ceramic 22p0 2% 100V NPO	213-206
C 16	C Ceramic 1p +-P25 100V P100	213-220
C 17	C Ceramic 100n 20% 50V	213-401
C 18	C Ceramic 10p0 2% 100V NPO	213-205
C 19	C Ceramic 1p +-P25 100V P100	213-220
C 20	MKT, 4x1u Select 50V,	241-086
C 21	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 22	C Tantal 4x 68uF Select 16V	267-021
C 23	Electrolytic 47/25, 2000h/85°, R:5*11, RM2	261-085
C 24	MKT, 4x1u Select 50V,	241-086
C 25	C Ceramic 100n 20% 50V	213-401
C 27	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 28	C Tantal 4x 68uF Select 16V	267-021
C 30	C Ceramic 15p0 2% 100V NPO	213-216
C 31	C Ceramic 100n 20% 50V	213-401
C 32	C Ceramic 10p0 2% 100V NPO	213-205
C 33	C Ceramic 22p0 2% 100V NPO	213-206
C 34	C Ceramic 100n 20% 50V	213-401
C 35	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 36	Electrolytic 47/25, 2000h/85°, R:5*11, RM2	261-085
C 37	C Ceramic 22p0 2% 100V NPO	213-206
C 38	C Ceramic 1p +-P25 100V P100	213-220
C 39	C Ceramic 10p0 2% 100V NPO	213-205
C 40	C Ceramic 100n 20% 50V	213-401
C 41	C Ceramic 1p +-P25 100V P100	213-220
C 42	C Tantal 4x 68uF Select 16V	267-021
C 43	MKT, 4x1u Select 50V,	241-086
C 44	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 45	C Ceramic 100n 20% 50V	213-401
C 46	C Ceramic 15p0 2% 100V NPO	213-216
C 47	C Ceramic 100n 20% 50V	213-401
C 48	C Ceramic 100n 20% 50V	213-401
C 49	C Ceramic 100n 20% 50V	213-401
C 50	C Ceramic 100n 20% 50V	213-401
C 51	C Ceramic 100n 20% 50V	213-401
C 52	C Ceramic 100n 20% 50V	213-401
C 53	C Ceramic 100n 20% 50V	213-401
C 54	C Ceramic 100n 20% 50V	213-401

C	55	C Ceramic 100n 20% 50V	213-401
C	56	C Solid Aluminium 10u 20% 25V Short Type	265-110
C	57	C Ceramic 100n 20% 50V	213-401
C	58	C Ceramic 100n 20% 50V	213-401
C	59	C Solid alu 10u 20% 25V	265-010
C	60	C Ceramic 100n 20% 50V	213-401
C	61	C Ceramic 100n 20% 50V	213-401
C	62	C Ceramic 100n 20% 50V	213-401
C	63	C Ceramic 100n 20% 50V	213-401
C	64	C Ceramic 100n 20% 50V	213-401
C	65	C Ceramic 470p 20% 100V	213-014
C	66	C Ceramic 470p 20% 100V	213-014
C	67	C Ceramic 100n 20% 50V	213-401
C	68	C Ceramic 100n 20% 50V	213-401
C	69	C Solid Aluminium 10u 20% 16V Short Type	265-108
C	70	C Ceramic 100n 20% 50V	213-401
C	71	C Ceramic 100n 20% 50V	213-401
C	72	C Solid Aluminium 4u7 20% 25V Short Type	265-100
C	73	C Ceramic 100n 20% 50V	213-401
C	74	C Ceramic 10p0 2% 100V NP0	213-205
C	76	C Ceramic 100n 20% 50V	213-401
C	77	C Ceramic 100n 20% 50V	213-401
C	78	C Ceramic 100n 20% 50V	213-401
C	79	C Solid Aluminium 10u 20% 25V Short Type	265-110
C	80	C Ceramic 100n 20% 50V	213-401
C	81	C Solid Aluminium 10u 20% 25V Short Type	265-110
C	82	C Ceramic 100n 20% 50V	213-401
C	83	C Solid Aluminium 10u 20% 25V Short Type	265-110
C	84	C Ceramic 100n 20% 50V	213-401
C	85	C Solid Aluminium 10u 20% 25V Short Type	265-110
C	86	C Ceramic 100n 20% 50V	213-401
C	87	C Solid Aluminium 10u 20% 16V Short Type	265-108
C	88	C Ceramic 100n 20% 50V	213-401
C	89	C Polyst 10n0 1% 63V	243-302
C	90	C Polyst 10n0 1% 63V	243-302
C	91	C Ceramic 100n 20% 50V	213-401
C	92	C Ceramic 100n 20% 50V	213-401
C	93	C Ceramic 100n 20% 50V	213-401
C	94	C Ceramic 100n 20% 50V	213-401
C	95	C Ceramic 100n 20% 50V	213-401
C	96	C Polyst 10n0 1% 63V	243-302
C	97	C Polyst 10n0 1% 63V	243-302
C	98	C Polyst 10n0 1% 63V	243-302
C	99	C Polyst 10n0 1% 63V	243-302
C	100	Electrolytic 47/25, 2000h/85°, R:5*11, RM2	261-085
C	101	C Ceramic 100n 20% 50V	213-401
C	102	Electrolytic 47/25, 2000h/85°, R:5*11, RM2	261-085
C	103	C Ceramic 100n 20% 50V	213-401
C	104	C Polyst 10n0 1% 63V	243-302
C	105	C Polyst 10n0 1% 63V	243-302
C	106	C Polyst 10n0 1% 63V	243-302
C	107	C Polyst 10n0 1% 63V	243-302
C	108	C Solid Aluminium 10u 20% 16V Short Type	265-108
C	109	C Solid Aluminium 10u 20% 25V Short Type	265-110

C 110	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 111	C Ceramic 100n 20% 50V	213-401
C 112	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 113	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 114	C Ceramic 100n 20% 50V	213-401
C 115	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 116	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 117	C Ceramic 100n 20% 50V	213-401
C 118	C Ceramic 100n 20% 50V	213-401
C 119	C Ceramic 100n 20% 50V	213-401
C 120	C Ceramic 100n 20% 50V	213-401
C 121	C Ceramic 100n 20% 50V	213-401
C 122	C Ceramic 100n 20% 50V	213-401
C 123	C Ceramic 100n 20% 50V	213-401
C 124	C Ceramic 100n 20% 50V	213-401
C 125	C Ceramic 100n 20% 50V	213-401
C 126	C Ceramic 100n 20% 50V	213-401
C 127	C Ceramic 100n 20% 50V	213-401
C 128	C Ceramic 100n 20% 50V	213-401
C 129	C Ceramic 100n 20% 50V	213-401
C 130	C Ceramic 100n 20% 50V	213-401
C 131	C Ceramic 100n 20% 50V	213-401
C 132	C Ceramic 100n 20% 50V	213-401
C 133	C Ceramic 100n 20% 50V	213-401
C 134	C Ceramic 100n 20% 50V	213-401
C 135	C Ceramic 10p0 2% 100V NP0	213-205
C 137	C Ceramic 5p60 p25 100V NPO	213-226
C 139	C Ceramic 10p0 2% 100V NP0	213-205
C 140	C Ceramic 10p0 2% 100V NP0	213-205
C 141	C Solid Aluminium 10u 20% 25V Short Type	265-110

DIODES

CR 1	Diode 1N3595 SI 100V 100mA	350-415
CR 2	Diode 1N3595 SI 100V 100mA	350-415
CR 3	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 4	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 5	Diode zener BZX79-C10V 0.4W	350-657
CR 6	Diode zener BZX79-C4V3 0.4W	350-639
CR 7	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 8	Diode zener BZX79-C10V 0.4W	350-657
CR 9	Diode 1N3595 SI 100V 100mA	350-415
CR 10	Diode 1N3595 SI 100V 100mA	350-415
CR 11	Diode 1N3595 SI 100V 100mA	350-415
CR 12	Diode 1N3595 SI 100V 100mA	350-415
CR 13	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 14	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 15	Diode zener BZX79-C10V 0.4W	350-657
CR 16	Diode zener BZX79-C4V3 0.4W	350-639
CR 17	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 18	Diode zener BZX79-C10V 0.4W	350-657
CR 19	Diode 1N3595 SI 100V 100mA	350-415
CR 20	Diode 1N3595 SI 100V 100mA	350-415
CR 21	Diode BAV10 Si Vr-60V If-600mA	350-022

CR 22	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 23	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 24	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 25	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 26	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 27	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 28	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 29	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 30	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 31	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 32	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 33	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 34	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 35	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 36	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 37	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 38	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 39	Diode 1N3595 SI 100V 100mA	350-415
CR 40	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 41	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 42	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 43	Diode 1N3595 SI 100V 100mA	350-415
CR 44	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 45	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 46	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 47	Diode zener BZX79-C8V2 0.4W	350-607
CR 48	Diode BAV45 Si Vr-20V If-50mA	350-432
CR 49	Diode BAV45 Si Vr-20V If-50mA	350-432
CR 50	Diode BAV45 Si Vr-20V If-50mA	350-432
CR 51	Diode BAV45 Si Vr-20V If-50mA	350-432
CR 52	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 53	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 54	Diode BAV10 Si Vr-60V If-600mA	350-022

CONNECTORS

J 1	Angle Bnc Jack For Printed Circuin Board 50E	800-524
J 2	Angle Bnc Jack For Printed Circuin Board 50E	800-524
J 3	Square Pin Straight Header 6 Pol	806-046
J 4	DIN 41612 64 pol male 90°, C/2 class II	805-958

RELAYS & JUMPERS

K 1	Relay Double Throw 5 V0lt	570-090
K 2	Relay Double Throw 5 V0lt	570-090
K 3	Relay Double Throw 5 V0lt	570-090
K 4	2-pol amp connector	805-951
K 5	2-pol amp connector	805-951
K 6	Relay Double Throw 5 V0lt	570-090
K 7	Relay Double Throw 5 V0lt	570-090
K 8	Relay Double Throw 5 V0lt	570-090
K 9	2-pol amp connector	805-951
K 10	2-pol amp connector	805-951

CHOKES

L 1	RF-choke six-hole core green	731-204
L 2	RF-choke six-hole core green	731-204
L 3	RF-choke six-hole core green	731-204

TRANSISTORS

Q 1	Transistor PN3686-J35Z JFET	360-216
Q 2	Transistor BC547B npn	360-159
Q 3	Transistor BSR50 npn	360-201
Q 4	Transistor BSR50 npn	360-201
Q 5	Transistor BC547B npn	360-159
Q 6	Transistor BSR50 npn	360-201
Q 7	Transistor PN3686-J35Z JFET	360-216
Q 8	Transistor PN3686-J35Z JFET	360-216
Q 9	Transistor BC547B npn	360-159
Q 10	Transistor BSR50 npn	360-201
Q 11	Transistor BSR50 npn	360-201
Q 12	Transistor BC547B npn	360-159
Q 13	Transistor BSR50 npn	360-201
Q 14	Transistor PN3686-J35Z JFET	360-216
Q 15	Transistor J175-18 p jfet	360-252
Q 16	Transistor J109-18 n Fet	360-188
Q 17	Transistor J109-18 n Fet	360-188
Q 18	Transistor J175-18 p jfet	360-252
Q 19	Transistor J109-18 n Fet	360-188
Q 20	Transistor J109-18 n Fet	360-188
Q 21	Transistor J109-18 n Fet	360-188
Q 22	Transistor J109-18 n Fet	360-188
Q 23	Transistor J109-18 n Fet	360-188
Q 24	Transistor J109-18 n Fet	360-188
Q 25	Transistor J109-18 n Fet	360-188
Q 26	Transistor J109-18 n Fet	360-188
Q 27	Transistor J109-18 n Fet	360-188
Q 28	Transistor J109-18 n Fet	360-188
Q 29	Transistor J109-18 n Fet	360-188
Q 30	Transistor J109-18 n Fet	360-188
Q 31	Transistor J109-18 n Fet	360-188
Q 32	Transistor J175-18 p jfet	360-252
Q 33	Transistor J109-18 n Fet	360-188
Q 34	Transistor J109-18 n Fet	360-188
Q 35	Transistor BC547B npn	360-159
Q 36	Transistor J109-18 n Fet	360-188

INTEGRATED ANALOG CIRCUITS

QA 1	IC 5534A op amp	364-639
QA 2	IC 5534A op amp	364-639
QA 3	IC 5534A op amp	364-639
QA 4	IC 5534A op amp	364-639
QA 5	IC 5534A op amp	364-639
QA 6	IC 5534A op amp	364-639
QA 7	IC 5534A op amp	364-639

QA 8	IC AD712K Dual OP.AMP.	364-791
QA 9	IC LM324N Quad OP-Amp	364-176
QA 10	IC LM324N Quad OP-Amp	364-176
QA 11	IC LM324N Quad OP-Amp	364-176
QA 12	IC TL082 dual op amp	364-619
QA 13	IC LM324N Quad OP-Amp	364-176
QA 14	IC LM311N comparator	364-024
QA 15	IC LF356 op amp	364-203
QA 16	IC NJM2068D op-amp	364-889
QA 17	IC NJM2068D op-amp	364-889
QA 18	IC NJM2068D op-amp	364-889
QA 19	IC NJM2068D op-amp	364-889
QA 20	IC NJM2068D op-amp	364-889
QA 21	IC NJM2068D op-amp	364-889
QA 22	IC AD711K OP.AMP	364-792

INTEGRATED DIGITAL CIRCUITS

QD 1	IC 74HC4094 8 stage shift REG.	364-811
QD 2	IC 74HC4094 8 stage shift REG.	364-811

RESISTORS

R 1	R Metal Film 75K0 0.1% 0.25W TC25	141-300
R 2	R Metal Film 12K1 1% 0.5W TC50	115-121
R 3	R Metal Film 22E1 1% 0.5W TC50	112-221
R 4	R Metal Film 22K1 1% 0.5W TC50	115-221
R 5	R Cermet Trimpot 200E 20% 0.5W TC70	182-315
R 6	R Metal Film 2K37 1% 0.5W TC50	114-237
R 7	R Metal Film 18K2 0,1% 0,125W TC25	141-269
R 8	R Metal Film 1K00 1% 0.5W TC50	114-100
R 9	R Metal Film 1K87 1% 0.5W TC50	114-187
R 10	R Metal Film 2K49 1% 0.5W TC50	114-249
R 11	R Cermet Trimpot 100K 20% 0.5W TC70	182-311
R 12	R Metal Film 549E 1% 0.5W TC50	113-549
R 13	R Metal Film 59E0 1% 0.5W TC50	112-590
R 14	R Metal Film 6K19 0.1% 0.25W TC25	141-304
R 15	R Metal Film 4K75 1% 0.5W TC50	114-475
R 16	R Metal Film 12K1 1% 0.5W TC50	115-121
R 17	R Cermet Trimpot 100E 20% 0.5W TC70	182-317
R 18	R Metal Film 12K1 1% 0.5W TC50	115-121
R 19	R Metal film 1K00 5% 0.2W TC250	107-410
R 20	R Metal Film 15E0 1% 0.5W TC50	112-150
R 21	R Metal Film 6K19 0.1% 0.25W TC25	141-304
R 22	R Cermet Trimpot 200E 20% 0.5W TC70	182-315
R 23	R Metal Film 6K65 1% 0.5W TC50	114-665
R 24	R Metal film 1K00 5% 0.2W TC250	107-410
R 25	R Metal Film 12K1 1% 0.5W TC50	115-121
R 26	R Metal Film 453E 1% 0.5W TC50	113-453
R 27	R Metal Film 22E1 1% 0.5W TC50	112-221
R 28	R Metal Film 12K1 1% 0.5W TC50	115-121
R 29	R Metal Film 4K75 1% 0.5W TC50	114-475
R 30	R Metal film 27K0 5% 0.2W TC250	107-527
R 31	R Metal film 27K0 5% 0.2W TC250	107-527

R 32	R Metal film 27K0 5% 0.2W TC250	107-527
R 33	R Metal Film 18K2 0,1% 0,125W TC25	141-269
R 34	R Metal Film 1K87 1% 0.5W TC50	114-187
R 35	R Metal Film 1K00 1% 0.5W TC50	114-100
R 36	R Metal Film 75K0 0.1% 0.25W TC25	141-300
R 37	R Metal film 2K49 0.1% 0.25w TC25	141-297
R 38	R Metal film 2K49 0.1% 0.25w TC25	141-297
R 39	R Metal Film 12K1 1% 0.5W TC50	115-121
R 40	R Metal Film 75K0 0.1% 0.25W TC25	141-300
R 41	R Metal Film 12K1 1% 0.5W TC50	115-121
R 42	R Metal Film 22E1 1% 0.5W TC50	112-221
R 43	R Metal Film 22K1 1% 0.5W TC50	115-221
R 44	R Cermet Trimpot 200E 20% 0.5W TC70	182-315
R 45	R Metal Film 2K37 1% 0.5W TC50	114-237
R 46	R Metal Film 18K2 0,1% 0,125W TC25	141-269
R 47	R Metal Film 1K00 1% 0.5W TC50	114-100
R 48	R Metal Film 1K87 1% 0.5W TC50	114-187
R 49	R Metal Film 2K49 1% 0.5W TC50	114-249
R 50	R Cermet Trimpot 100K 20% 0.5W TC70	182-311
R 51	R Metal Film 549E 1% 0.5W TC50	113-549
R 52	R Metal Film 59E0 1% 0.5W TC50	112-590
R 53	R Metal Film 6K19 0.1% 0.25W TC25	141-304
R 54	R Metal Film 4K75 1% 0.5W TC50	114-475
R 55	R Metal Film 12K1 1% 0.5W TC50	115-121
R 56	R Cermet Trimpot 100E 20% 0.5W TC70	182-317
R 57	R Metal Film 12K1 1% 0.5W TC50	115-121
R 58	R Metal film 1K00 5% 0.2W TC250	107-410
R 59	R Metal Film 15E0 1% 0.5W TC50	112-150
R 60	R Metal Film 6K19 0.1% 0.25W TC25	141-304
R 61	R Metal film 27K0 5% 0.2W TC250	107-527
R 62	R Cermet Trimpot 200E 20% 0.5W TC70	182-315
R 63	R Metal Film 6K65 1% 0.5W TC50	114-665
R 64	R Metal film 1K00 5% 0.2W TC250	107-410
R 65	R Metal Film 12K1 1% 0.5W TC50	115-121
R 66	R Metal Film 453E 1% 0.5W TC50	113-453
R 67	R Metal Film 22E1 1% 0.5W TC50	112-221
R 68	R Metal Film 12K1 1% 0.5W TC50	115-121
R 69	R Metal Film 4K75 1% 0.5W TC50	114-475
R 70	R Metal film 27K0 5% 0.2W TC250	107-527
R 71	R Metal film 27K0 5% 0.2W TC250	107-527
R 72	R Metal Film 18K2 0,1% 0,125W TC25	141-269
R 73	R Metal Film 1K87 1% 0.5W TC50	114-187
R 74	R Metal Film 1K00 1% 0.5W TC50	114-100
R 75	R Metal Film 75K0 0.1% 0.25W TC25	141-300
R 76	R Metal film 2K49 0.1% 0.25w TC25	141-297
R 77	R Metal film 2K49 0.1% 0.25w TC25	141-297
R 78	R Metal Film 12K1 1% 0.5W TC50	115-121
R 79	R Metal film 100E 5% 0.2W TC250	107-310
R 80	R Metal film 33K0 5% 0.2W TC250	107-533
R 81	R Cermet Trimpot 100K 20% 0.5W TC70	182-311
R 82	R Metal Film 30K1 1% 0.5W TC50	115-301
R 83	R Metal film 22K0 5% 0.2W TC250	107-522
R 84	R Metal film 1M00 5% 0.2W TC250	107-710
R 85	R Metal Film 1K00 1% 0.5W TC50	114-100

R 86	R Cermet Trimpot 100K 20% 0.5W TC70	182-311
R 87	R Metal film 33K0 5% 0.2W TC250	107-533
R 88	R Metal film 33K0 5% 0.2W TC250	107-533
R 89	R Metal Film 1K24 0.1% 0.25W TC25	141-296
R 90	R Metal Film 1K87 1% 0.5W TC50	114-187
R 91	R Metal Film 294K 0.1% 0.2W TC25	140-984
R 92	R Metal Film 10K 0.1% 0.1W TC25	141-010
R 93	R Metal film 2K49 0.1% 0.25w TC25	141-297
R 94	R Metal film 33K0 5% 0.2W TC250	107-533
R 95	R Metal Film 6K04 0.1% 0.5W TC25	141-158
R 96	R Metal Film 402K 1% 0.5W TC50	116-402
R 97	R Metal film 33K0 5% 0.2W TC250	107-533
R 98	R Metal Film 32K4 0.1% 0.2W TC25	141-005
R 99	R Metal film 33K0 5% 0.2W TC250	107-533
R 100	R Metal film 20K0 0.5% 0.25w TC25	140-473
R 101	R Metal film 33K0 5% 0.2W TC250	107-533
R 102	R Metal film 33K0 5% 0.2W TC250	107-533
R 103	R Metal film 33K0 5% 0.2W TC250	107-533
R 104	R Thick Film Sil 4*47K 5% 0.1W	146-018
R 105	R Metal film 2K49 0.1% 0.25w TC25	141-297
R 106	R Metal film 4k99 0.1% 0.25w TC25	140-981
R 107	R Metal Film 10K 0.1% 0.1W TC25	141-010
R 108	R Metal film 20K0 0.5% 0.25w TC25	140-473
R 109	R Metal film 47E0 5% 0.2W TC250	107-247
R 110	R Thick Film Sil 4*47K 5% 0.1W	146-018
R 111	R Metal film 47E0 5% 0.2W TC250	107-247
R 112	R Metal film 4k99 0.1% 0.25w TC25	140-981
R 113	R Metal Film 5K62 1% 0.5W TC50	114-562
R 114	R Metal film 4k99 0.1% 0.25w TC25	140-981
R 115	R Metal film 2K70 5% 0.2W TC250	107-427
R 116	R Metal Film 1K69 1% 0.5W TC50	114-169
R 117	R Metal Film 2K49 1% 0.5W TC50	114-249
R 118	R Metal film 33K0 5% 0.2W TC250	107-533
R 119	R Metal film 100E 5% 0.2W TC250	107-310
R 120	R Metal film 680E 5% 0.2W TC250	107-368
R 121	R Metal film 100K 5% 0.2W TC250	107-610
R 122	R Metal film 1K00 5% 0.2W TC250	107-410
R 123	R Metal film 47E0 5% 0.2W TC250	107-247
R 124	R Metal film 33K0 5% 0.2W TC250	107-533
R 125	R Metal film 680K 5% 0.2W TC250	107-668
R 126	R Metal Film 5K62 1% 0.5W TC50	114-562
R 127	R Metal film 1K00 5% 0.2W TC250	107-410
R 128	R Metal film 100E 5% 0.2W TC250	107-310
R 129	R Metal film 680E 5% 0.2W TC250	107-368
R 130	R Cermet Trimpot 100K 20% 0.5W TC70	182-311
R 131	R Metal film 47E0 5% 0.2W TC250	107-247
R 132	R Metal film 1M00 5% 0.2W TC250	107-710
R 133	R Metal Film 1K69 1% 0.5W TC50	114-169
R 134	R Metal Film 2K49 1% 0.5W TC50	114-249
R 135	R Metal Film 200K 1% 0.5W TC50	116-200
R 136	R Metal Film 2K74 1% 0.5W TC50	114-274
R 137	R Metal Film 374K 1% 0.5W TC50	116-374
R 138	R Metal film 33K0 5% 0.2W TC250	107-533
R 139	R Metal film 100E 5% 0.2W TC250	107-310

R 140	R Metal film 68K0 5% 0.2W TC250	107-568
R 141	R Cermet Trimpot 10K 10% 0.5W TC100	182-422
R 142	R Metal Film 2K49 1% 0.5W TC50	114-249
R 143	R Metal film 10K0 5% 0.2W TC250	107-510
R 144	R Metal film 4K70 5% 0.2W TC250	107-447
R 145	R Metal film 47E0 5% 0.2W TC250	107-247
R 146	R Metal film 47E0 5% 0.2W TC250	107-247
R 147	R Metal film 47E0 5% 0.2W TC250	107-247
R 148	R Metal film 47E0 5% 0.2W TC250	107-247
R 149	R Metal film 1K00 5% 0.2W TC250	107-410
R 150	R Metal Film 24K9 1% 0.5W TC50	115-249
R 151	R Metal Film 475E 1% 0.5W TC50	113-475
R 152	R Metal Film 976E 1% 0.5W TC50	113-976
R 153	R Metal Film 909E 1% 0.5W TC50	113-909
R 154	R Metal Film 909E 1% 0.5W TC50	113-909
R 155	R Metal Film 422E 1% 0.5W TC50	113-422
R 156	R Metal Film 27E4 1% 0.5W TC50	112-274
R 157	R Metal Film 147E 1% 0.5W TC50	113-147
R 158	R Metal Film 196E 1% 0.5W TC50	113-196
R 159	R Metal Film 100E 1% 0.5W TC50	113-100
R 160	R Metal Film 4K99 1% 0.5W TC50	114-499
R 161	R Metal Film 24K9 1% 0.5W TC50	115-249
R 162	R Metal Film 1K00 1% 0.5W TC50	114-100
R 163	R Metal Film 1K00 1% 0.5W TC50	114-100
R 164	R Metal Film 1K00 1% 0.5W TC50	114-100
R 165	R Metal Film 1K00 1% 0.5W TC50	114-100
R 166	R Metal film 22E0 5% 0.2W TC250	107-222
R 167	R Metal Film 4K75 1% 0.5W TC50	114-475
R 168	R Cermet Trimpot 4K7 20% 0.5W TC70	182-312
R 169	R Cermet Trimpot 470E 20% 0.5W TC70	182-302
R 170	R Metal film 22E0 5% 0.2W TC250	107-222
R 171	R Metal Film 1K00 1% 0.5W TC50	114-100
R 172	R Metal Film 1K00 1% 0.5W TC50	114-100
R 173	R Metal Film 1K00 1% 0.5W TC50	114-100
R 174	R Metal Film 1K00 1% 0.5W TC50	114-100
R 175	R Metal Film 1K18 1% 0.5W TC50	114-118
R 176	R Metal Film 1K21 1% 0.5W TC50	114-121
R 177	R Metal Film 1K27 1% 0.5W TC50	114-127
R 178	R Metal Film 1K33 1% 0.5W TC50	114-133
R 179	R Thick Film Sil 4*47K 5% 0.1W	146-018
R 180	R Metal Film 4K99 1% 0.5W TC50	114-499
R 181	R Metal Film 4K99 1% 0.5W TC50	114-499
R 182	R Metal film 1K00 5% 0.2W TC250	107-410
R 183	R Metal film 1M00 5% 0.2W TC250	107-710

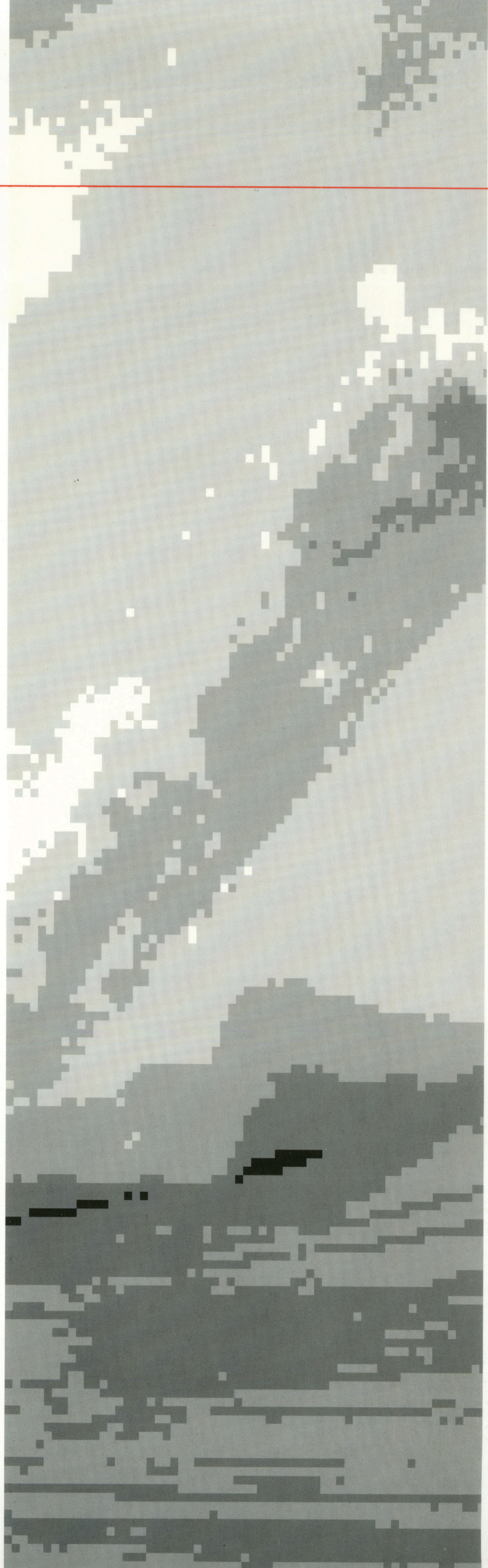
TESTPOINTS

TP 1	Term. strip 50pol mod 2	806-072
TP 2	Term. strip 50pol mod 2	806-072
TP 3	Term. strip 50pol mod 2	806-072
TP 4	Term. strip 50pol mod 2	806-072
TP 5	Term. strip 50pol mod 2	806-072
TP 6	Term. strip 50pol mod 2	806-072
TP 7	Term. strip 50pol mod 2	806-072

TP 8	Term. strip 50pol mod 2	806-072

MISCELLANEOUS

	Screw pozidriv panhead M2.5x8	008-208
	Spacer for PCB MSP-4x6,4	857-047
	PCB For RE204 Analog Frontend	971-387
GND1	Solder Terminal 0.1 O2	823-303



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