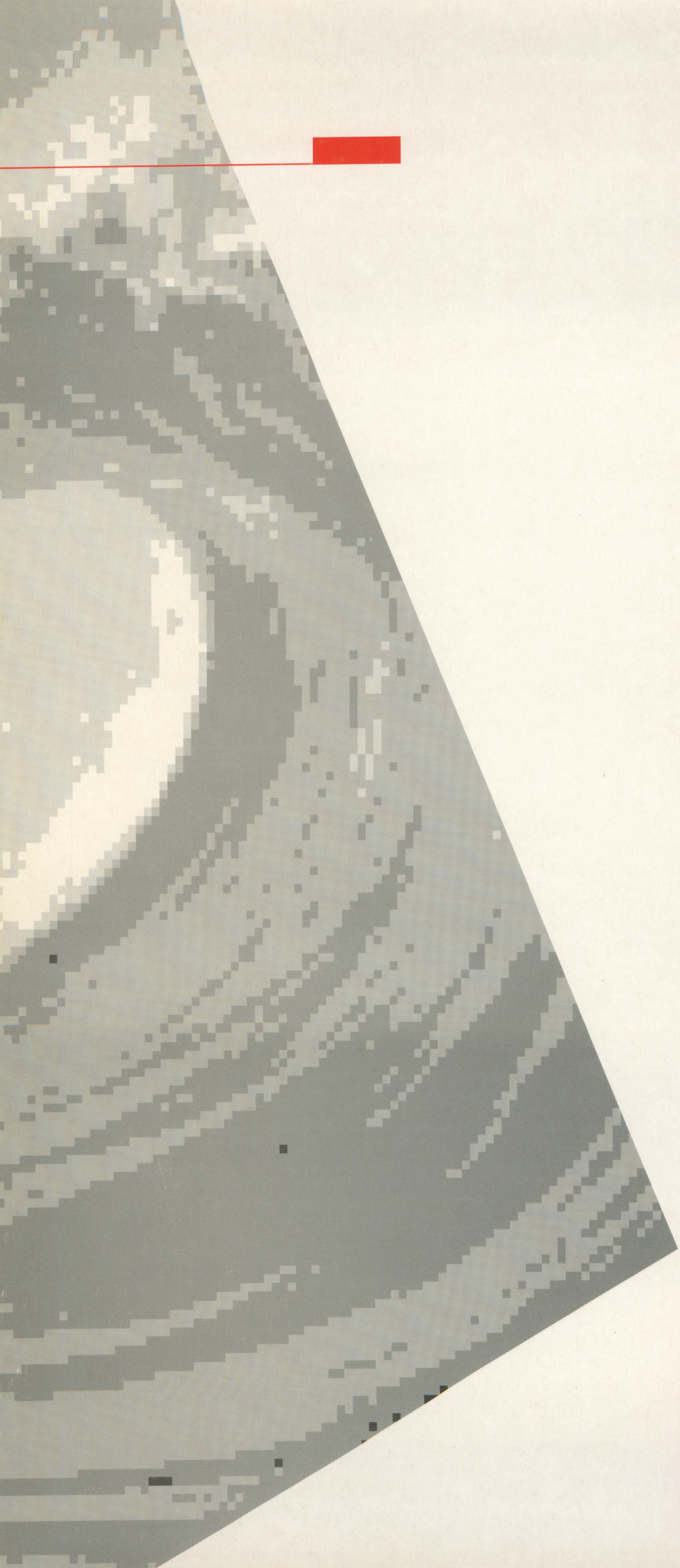


RE 650 & RE 651
RDS Data Codec
Operator and Service Manual

Volume I

RE 650 & RE 651
RDS Data Codec
Operator and 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.

Short Contents

Chapter

Table of Contents

List of Circuit Boards

Name	Order No.	Schematic Diagram
RE 650 Modulator	902-100	985-463
RE 650 Low-pass Filter	902-066	985-426
RE 650 Power Supply	902-086	985-444
RE 650 Motherboard	902-084	985-434
RE 651 Demodulator	902-101	985-464
RE 651 Low-pass Filter	902-124	985-426
RE 651 Power Supply	902-125	985-485
RE 651 Motherboard	902-084	985-434
Protocol Converter Option	902-087	985-445

1. Introduction

1.1 Introduction

The RE 65x RDS Data Codec allows you to establish 2 independent data channels, each with a data capacity of 400 bit/s in the standard 15 kHz audio signal from studio to FM-transmitter.

These data channels may be used in live broadcasts by studio people to activate dynamic RDS features in the RDS encoder placed at the transmitter site, without having to lease expensive modem lines. If the program is recorded on a DAT-tape recorder, the data channels are recorded together with the program, as the demodulator is able to decode the data channels when the tape is replayed. This does not work with ordinary tape recorders.

Each data channel establishes a transparent one-way RS-232 link. Simultaneously, the codec handles a remote in/relay out interface. This interface works as follows. If one of the 12 remote inputs of the RE 650 is connected to ground for at least 100 ms, a message is transferred to the RE 651 which then activates the corresponding relay for at least 100 ms.

Fig. 1.1 shows an application of the RDS Data Codec.

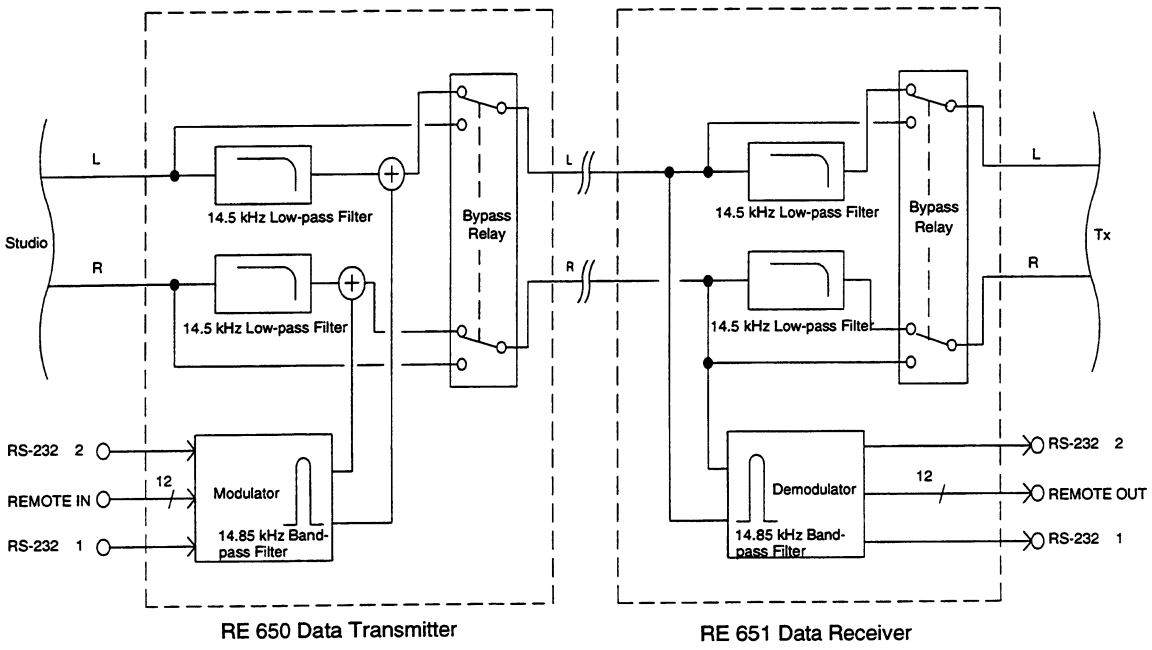


Fig. 1.1 Application of RE 65x RDS Data Codec

2. Installation

2.1 Unpacking

When unpacking the RE 65x, the accessories and the packing material should be inspected for physical damage. Should any item be damaged, please notify the carrier and your local RE TECHNOLOGY AS representative or the factory.

The following equipment and accessories must be found when unpacking the RE 650, 230 V version.

Code	Type	Description
450-014	250 mA	Fuse, slow blow
615-303	230 V	Line Cord, 2.5 m
983-412		Operator and Service Manual
983-722		Installation Instruction

Table 2.1 Equipment and Accessories for RE 650, 230 V Version

The following equipment and accessories must be found when unpacking the RE 651, 230 V version.

Code	Type	Description
450-014	250 mA	Fuse, slow blow
615-303	230 V	Line Cord, 2.5 m
983-722		Installation Instruction

Table 2.2 Equipment and Accessories for RE 651, 230 V Version

The following equipment and accessories must be found when unpacking the RE 650, 120 V version.

Code	Type	Description
450-017	500 mA	Fuse, slow blow
615-403	120 V	Line Cord, 2.5 m
983-412		Operator and Service Manual
983-726		Installation Instruction

Table 2.3 Equipment and Accessories for RE 650 120 V, Version

The following equipment and accessories must be found when unpacking the RE 651, 120 V version.

Code	Type	Description
450-017	500 mA	Fuse, slow blow
615-403	120 V	Line Cord, 2.5 m
983-726		Installation Instruction

Table 2.4 Equipment and Accessories for RE 651, 120 V Version

In case of complaint, you must retain the package material for inspection by the carrier.

After you have ensured that no damage has occurred, the subrack module is ready for installation. However, before applying line power to the subrack, we recommend that you read Chapter 2.3, **Power Application**, thoroughly.

2.2 Ventilation Requirements

The RE 65x is cooled by air convection. To avoid thermal stress inside the subrack we recommend that you place an air separator in every third position when installing in 19" mainframes. The maximum operating temperature is 45 °C.

2.3 Power Application

The correct value of the installed line fuse is:

Subrack	AC Voltage	Line Fuse
RE 650/RE 651	198 to 260 V AC	250 mA slow blow
RE 650/RE 651	99 to 130 V AC	500 mA slow blow

Table 2.5 Line Fuse Ratings

CAUTION Always make sure that a fuse with the correct rating is installed in the fuse holder before connecting the subrack to any AC power source.

NOTE According to international safety regulations, the subrack must be grounded via the third wire in the power cord supplied with the subrack.

2.4 RE 650 Setup

The following sections list the jumper and DIP switch settings.

NOTE An asterisk (*) next to a setting means that the equipment is delivered with that setting from the factory.

2.4.1 Modulator

Jumpers JP1, JP2 and JP3 are used to select the characteristics (V.28 or HCMOS) of the Clock/data interface on the front panel. Fig. 2.1 shows the jumper location

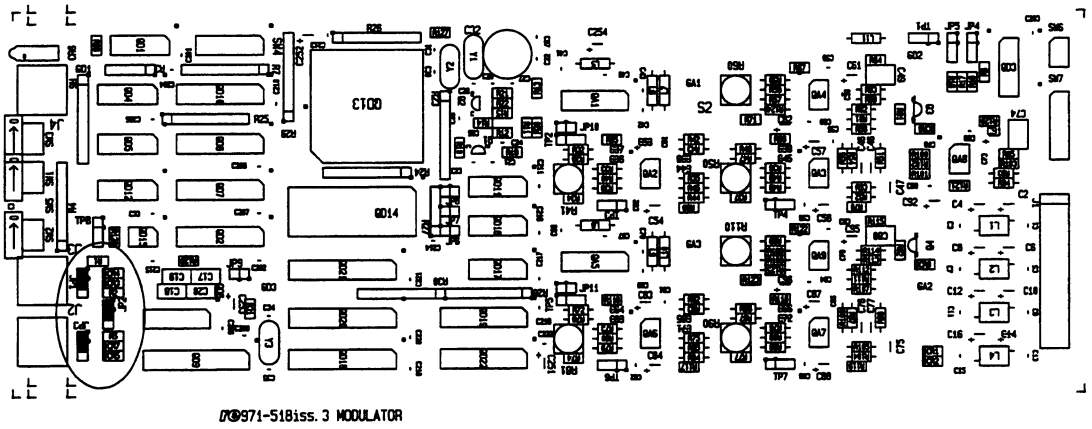


Fig. 2.1 Location of Jumpers JP1, JP2 and JP3, HCMOS Characteristics

JP1	JP2	JP3
2-3 *	2-3 *	2-3 *

Table 2.6 V.28 Characteristics

In the above configuration the Clock/Data interface has V.28 characteristics.

JP1	JP2	JP3
1-2	1-2	1-2

Table 2.7 HCMOS Characteristics

In the above configuration the Clock/Data interface has HCMOS characteristics.

To protect the interface, a 2.7 kΩ resistor is inserted in DATA IN and a 100 Ω resistor is inserted in CLOCK OUT.

DIP switches SW6 and SW7 are for future use. All switches should be set in the on position.

DIP switch SW4 is used to set the communication parameters for the two rear panel RS-232 interfaces, Lines 1 and 2.

The baud rate is set using switches 1 and 2 as shown in Table 2.8.

Baud Rate	Switch 1	Switch 2
9600	ON (Closed) *	ON (Closed) *
4800	OFF (Open)	ON (Closed)
2400	ON (Closed)	OFF (Open)
1200	OFF (Open)	OFF (Open)

Table 2.8 Baud Rate

The number of data bits for each RS-232 character is set using switch 3 as shown in Table 2.9.

Data bits	Switch 3
7	ON (Closed)
8	OFF (Open) *

Table 2.9 Number of Data Bits

The parity is set using switches 4 and 5 as shown in Table 2.10.

Parity	Switch 4	Switch 5
Odd	ON (Closed)	ON (Closed)
Even	OFF (Open)	ON (Closed)
None	ON (Closed)	OFF (Open)
None	OFF (Open) *	OFF (Open) *

Table 2.10 Parity

The number of stop bits are set using switch 6 as shown in Table 2.11.

Stop Bits	Switch 6
1	ON (Closed) *
2	OFF (Open)

Table 2.11 Number of Stop Bits

The last two switches, 7 and 8, are for future use.

2.4.2 Power Supply

Jumpers JP5 and JP8 are used to select between 600 Ω or high input impedance. Fig. 2.2 shows the jumper location.

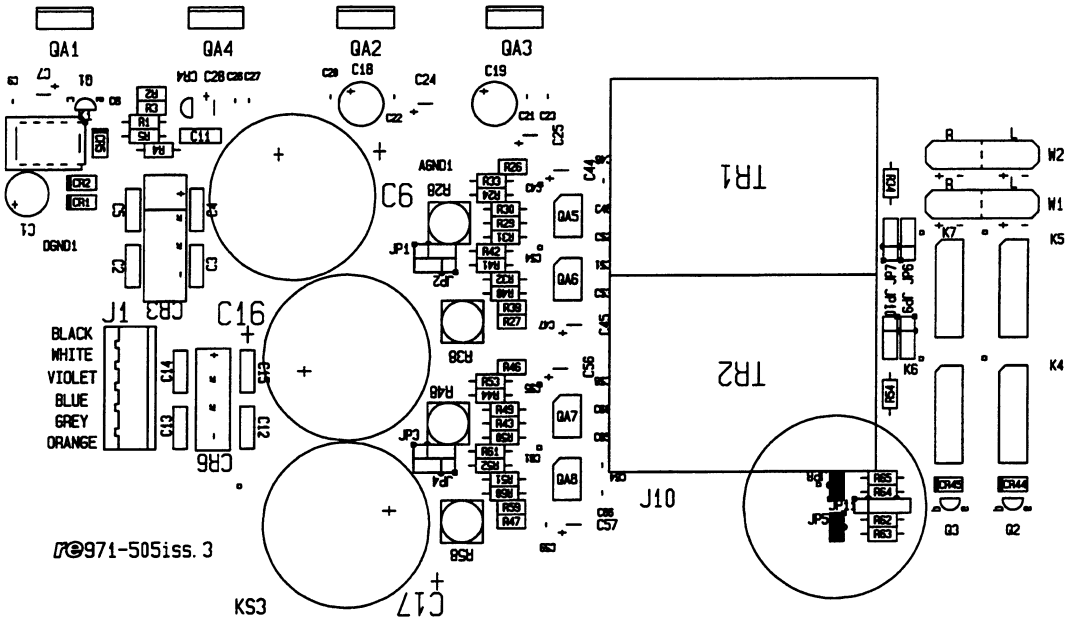


Fig. 2.2 Location of Jumpers JP5 and JP8, 600 Ω Input Resistance

JP5	JP8
Removed*	Removed*

Table 2.12 High Input Impedance

JP5	JP8
Inserted	Inserted

Table 2.13 600 Ω Input Impedance

When the two jumpers are removed they can be parked on JP11.

Jumpers JP6, JP7, JP9 and JP10 are used to select between 600 Ω or low output impedance. Fig. 2.3 shows the jumper location.

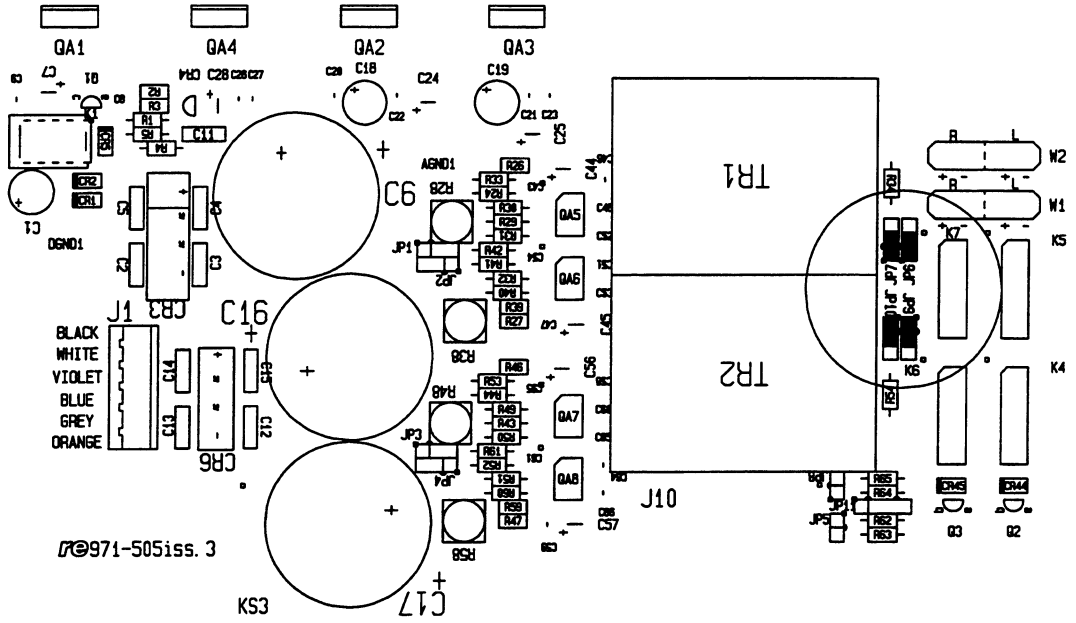


Fig. 2.3 Location of Jumpers JP6, JP7, JP9 and JP10, <25 Ω Output Resistance

JP6	JP7	JP9	JP10
1-2*	1-2*	1-2*	1-2*

Table 2.14 Low Output Impedance

JP6	JP7	JP9	JP10
2-3	2-3	2-3	2-3

Table 2.15 600 Ω Output Impedance

2.5 RE 651 Setup

The following sections list the jumper and DIP switch settings. An asterisk (*) next to a setting means that this is the default setting from the factory.

2.5.1 Demodulator

Jumpers JP7 and JP8 are used to select the characteristics (V.28 or HCMOS) of the Clock/data interface on the front panel. Fig. 2.4 shows the jumper location.

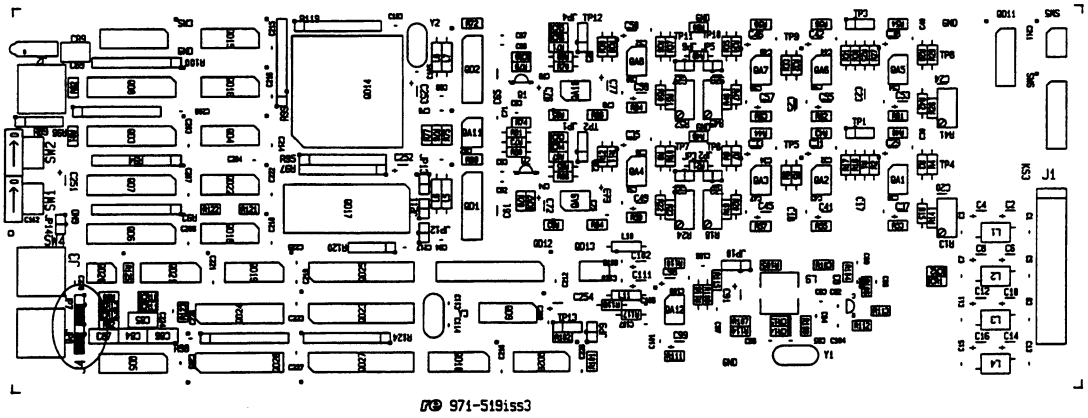


Fig. 2.4 Location of Jumpers JP7 and JP8, V28 Characteristics

JP7	JP8
2-3 *	2-3 *

Table 2.16 V.28 Characteristics

In the above configuration the Clock/Data interface has V.28 characteristics.

JP7	JP8
1-2	1-2

Table 2.17 HCMOS Characteristics

In the above configuration the Clock/Data interface has HCMOS characteristics.

To protect the interface, a 100 Ω resistor is inserted in DATA OUT and a 100 Ω resistor is inserted in CLOCK OUT.

DIP switches SW5 and SW6 are for future use. All switches should be set in the on position.

DIP switch SW3 is used to set the communication parameters for the two rear panel RS-232 interfaces, Lines 1 and 2.

The baud rate is set using switches 1 and 2 as shown in Table 2.18.

Baud Rate	Switch 1	Switch 2
9600	ON (Closed) *	ON (Closed) *
4800	OFF (Open)	ON (Closed)
2400	ON (Closed)	OFF (Open)
1200	OFF (Open)	OFF (Open)

Table 2.18 Baud Rate

The number of data bits for each RS-232 character is set using switch 3 as shown in Table 2.19.

Data Bits	Switch 3
7	ON (closed)
8	OFF (Open) *

Table 2.19 Number of Data Bits

The parity is set using switches 4 and 5 as shown in Table 2.20.

Parity	Switch 4	Switch 5
Odd	ON (Closed)	ON (Closed)
Even	OFF (Open)	ON (Closed)
None	ON (Closed)	OFF (Open)
None	OFF (Open) *	OFF (Open) *

Table 2.20 Parity

The number of stop bits is set using switch 6 as shown in Table 2.21.

Stop bits	Switch 6
1	ON(closed) *
2	OFF (Open)

Table 2.21 Number of Stop Bits

The last two switches, switch 7 and 8, are for future use.

2.5.2 Power Supply

Jumpers JP5 and JP8 are used to select between 600 Ω or high input impedance. Fig. 2.5 shows the jumper location.

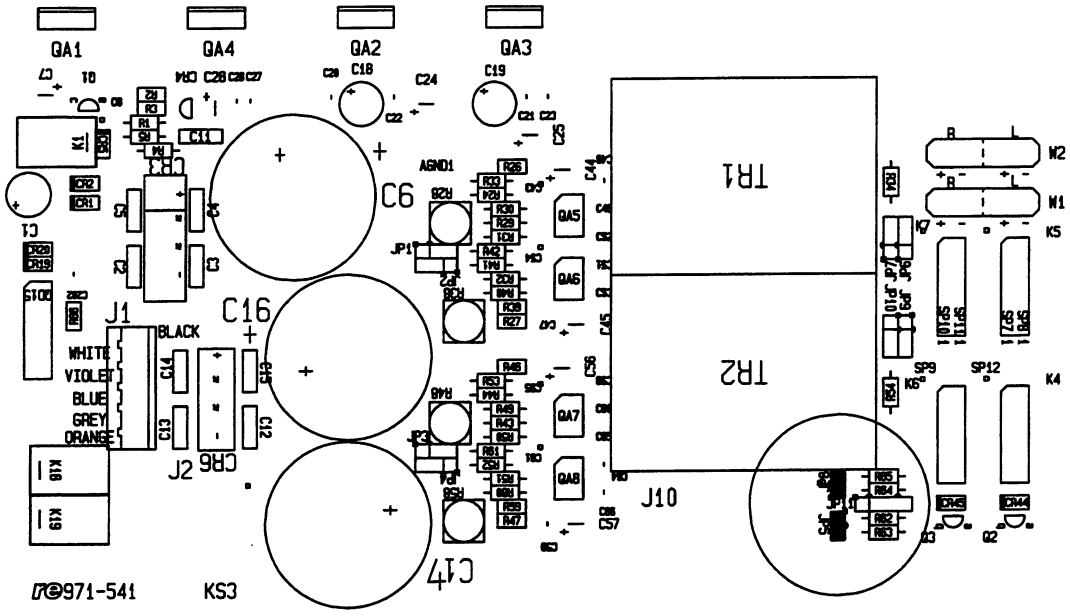


Fig. 2.5 Location of Jumpers JP5 and JP8, 600 Ω Input Resistance

	JP5	JP8
High	Removed*	Removed*
600 Ω	Inserted	Inserted

Table 2.22 Input Impedance

When the two jumpers are removed they can be parked on JP11.

Jumpers JP6, JP7, JP9 and JP10 are used to select between 600 Ω or low output impedance. Fig. 2.6 shows the jumper location.

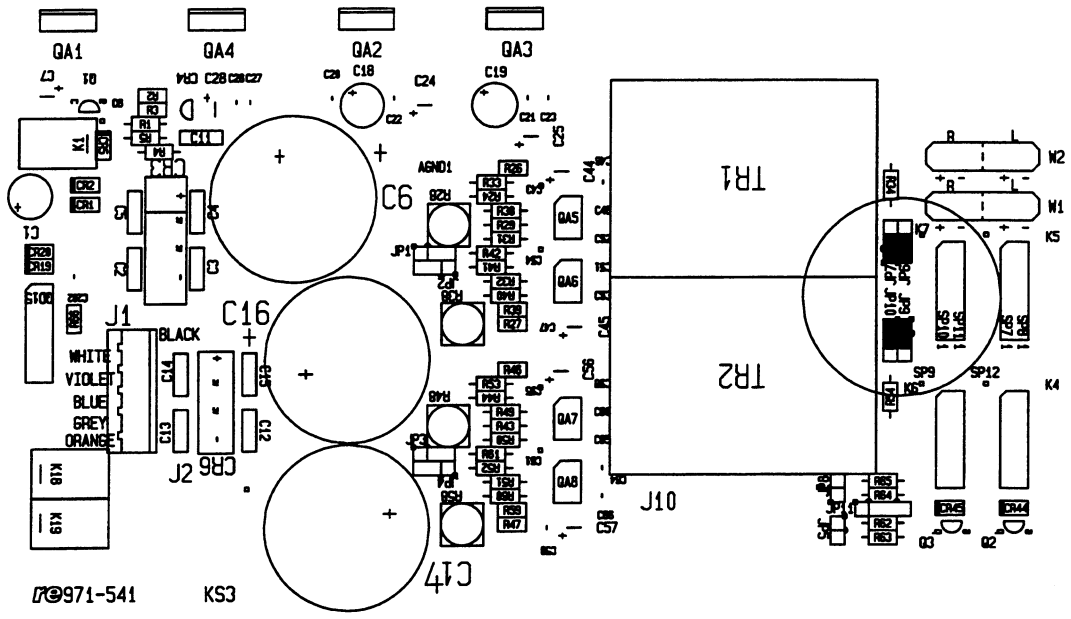


Fig. 2.6 Location of Jumpers JP6, JP7, JP9 and JP10, <25 Ω Output Resistance

JP6	JP7	JP9	JP10
1-2*	1-2*	1-2*	1-2*

Table 2.23 Low Output Impedance

JP6	JP7	JP9	JP10
2-3	2-3	2-3	2-3

Table 2.24 600 Ω Output Impedance

Soldering points SP7, SP8 and SP9 and SP10, SP11 and 12 are used to select between normal bypass mode or muted bypass mode. The soldering points are pre-strapped from the factory to the normal bypass mode. The muted bypass mode is selected by removing these four pre-straps and then solder pad 1 of SP7, SP8 and SP9 together, and solder pad 1 of SP10, SP11 and SP12 together. Figs. 2.7 and 2.8 show the location of soldering points in normal bypass mode and respectively muted bypass mode.

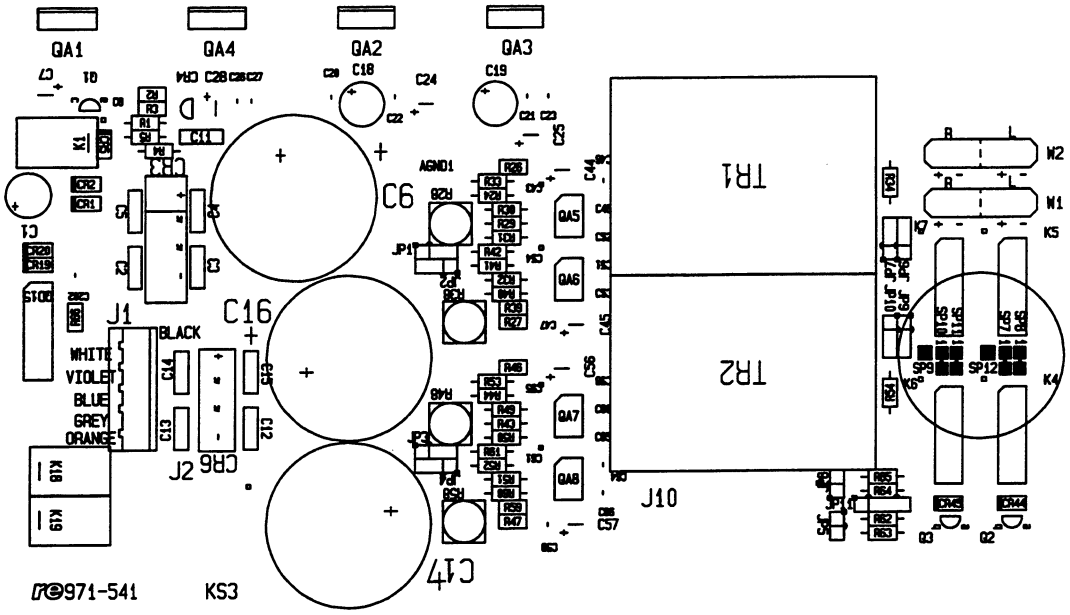


Fig. 2.7 Normal Bypass Mode

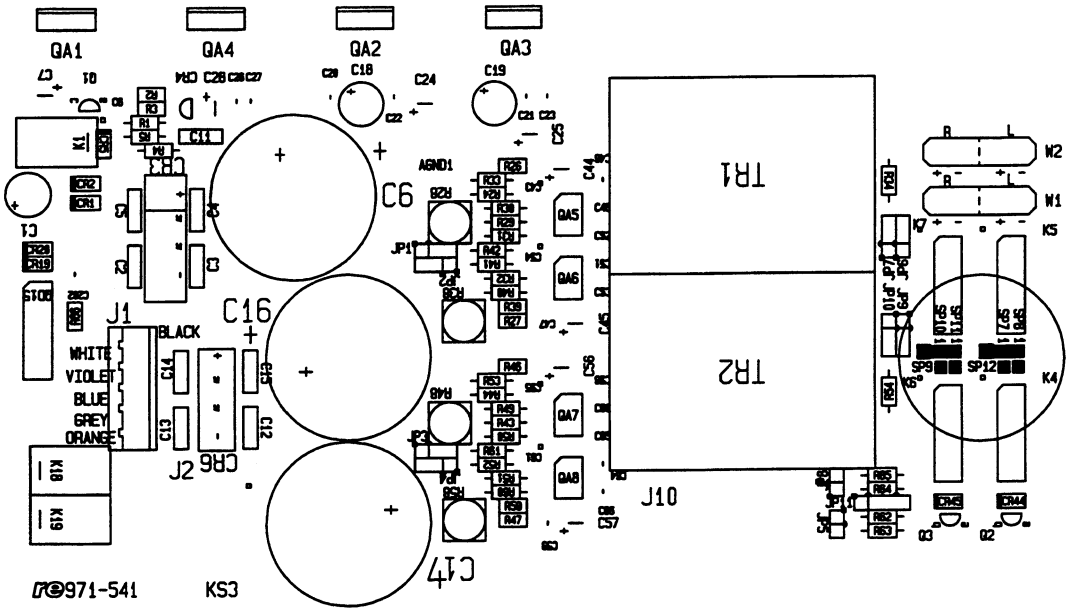


Fig. 2.8 Muted Bypass Mode

3. Front and Rear Panels

3.1 RE 650 Front Panel

Fig. 3.1 shows the front panel of the RE 650.

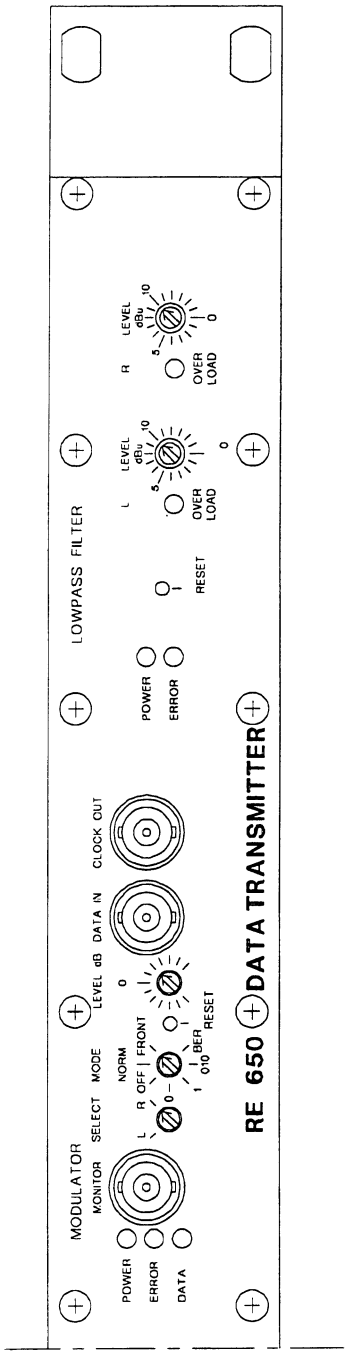


Fig. 3.1 RE 650 Front Panel

On the front of the low-pass filter section the following is seen.

L LEVEL Control
This control allows you to adjust the clipping level in the left channel without changing the overall gain. If the input level is bigger than the clipping level, the left OVERLOAD LED lights. If, for example, the control is set to 12 dBu, the low-pass filter overloads when the input level exceeds 4.4 Vp (3.1 V_{rms} = 12 dBu).

R LEVEL Control
This control allows you to adjust the clipping level in the right channel without changing the overall gain. If the input level is bigger than the clipping level, the right OVERLOAD LED lights. If, for example, the control is set to 12 dBu, the low-pass filter overloads when the input level exceeds 4.4 Vp (3.1 V_{rms} = 12 dBu).

RESET Button
Using a small screwdriver or a pencil it is possible to reset the low-pass filter by pressing this small button. During reset the ERROR LED and the OVERLOAD LEDs are lit.

POWER (green LED)
When lit, this LED indicates the presence of +5 V.

ERROR (red LED)
When lit, this LED indicates that the low-pass filter is in a "NOT normal" operation. A "NOT normal" situation is one or more of the following:

- Watchdog on low-pass filter is not toggled
- Low-pass filter is RESET
- The audio signals are bypassed

L OVERLOAD (red LED)
This LED is lit when the input level of the left input signal is above the selected clipping level or when the RESET button is activated.

R OVERLOAD (red LED)
This LED is lit when the input level of the right input signal is above the selected clipping level or when the RESET button is activated.

On the front of the modulator section the following is seen.

LEVEL Control
This control allows you to adjust the level of the sub-carriers ±6 dB around the normal level of 34.6 mV_p (24.5 mV_{rms} = -30 dBu).

SELECT Control
In position L the QPSK signal which is added to the left channel is fed to the MONITOR output. In position R the QPSK signal which is added to the right channel is fed to the MONITOR output.

MODE Control
This control allows you to change the data source for the modulator and to turn the signal off. In all positions except NORM the data is identical for the left and right channels.

Setting	Function
NORM	The data input is taken from the lines 1 and 2 on the rear panel
OFF	The output is turned off in both channels
0	The data is all zeroes in both channels
1	The data is all ones in both channels
010	The 3-bit long sequence 010 is repeated in both channels
BER	511-bit long Pseudo Random Bit Sequence is repeated in both channels
FRONT	The data input is taken from DATA IN on the front panel

Table 3.1 RE 650, Mode Switch Settings

The sequence "010" gives 5 lines in the spectrum placed at the carrier, ±400 Hz/6, and at the carrier ±400 Hz/3.

The Pseudo Random Bit Sequence (PRBS) is according to CCITT Recommendation V.53 and can be used for Bit Error Rate (BER) measurements.

RESET Button
Using a small screwdriver or a pencil it is possible to reset the modulator by pressing this small button.

MONITOR Connector (BNC)
On this output it is possible to monitor one of the QPSK-modulated sub-carriers. The output is 30 dB bigger than the signal added to the sound. You select the sub-carrier to monitor using the SELECT control.

CLOCK OUT Connector (BNC)
The bit clock (400 Hz/50 % duty cycle) is found at this output. The logical level depends on the jumper setting and can be either HCMOS or V.28. Refer to Chapter 2.4.1, **Modulator**, and Tables 2.6 and 2.7.

DATA IN Connector (BNC)
If the MODE control is set to FRONT, the modulator uses this input as the data source for the left and right data channels. The modulator evaluates the data input synchronously to the CLOCK OUT. If CLOCK OUT has HCMOS characteristics DATA IN is evaluated on the rising edge. If, on the other hand, CLOCK OUT has V.28 characteristics, DATA IN is evaluated on the falling edge. The logical thresholds of the data input depend on the jumper setting and can be either HCMOS or V.28. Refer to Chapter 2.4.1, **Modulator**, and Tables 2.6 and 2.7.

POWER (green LED)
When lit, this LED indicates the presence of +5 V.

ERROR (red LED)
When lit, this LED indicates that the modulator is in a "NOT normal" operation. This may either be because the internal Digital Signal Processor has not toggled the internal watchdog or because the MODE knob is not set to the NORM position.

DATA (yellow LED)
When the MODE control is in the NORM or FRONT position, this LED monitors the data input to the modulator from the rear panel or from the front panel, respectively. If the MODE control is set to NORM and the SELECT control is set to L, this LED monitors the data fed to Line 1. If, on the other hand, the SELECT control is set to R, the LED monitors the data fed to Line 2. When a logical 0 is received, the LED lights, and it stops lighting when the input data is a logical 1. Since the rear panel interface always has V.28 characteristics, a positive voltage lights the LED and a negative voltage makes it go out. The same applies to the front panel interface if it is set to V.28 characteristics. If you select HCMOS characteristics for the front panel interface, a voltage of 0 V lights the LED and 5 V makes it go out. If you set the MODE control in one of the other positions, the data is generated internally and the LED monitors the data on the front panel input.

3.2 RE 650 Rear Panel

Fig. 3.2 shows the rear panel of the RE 650.

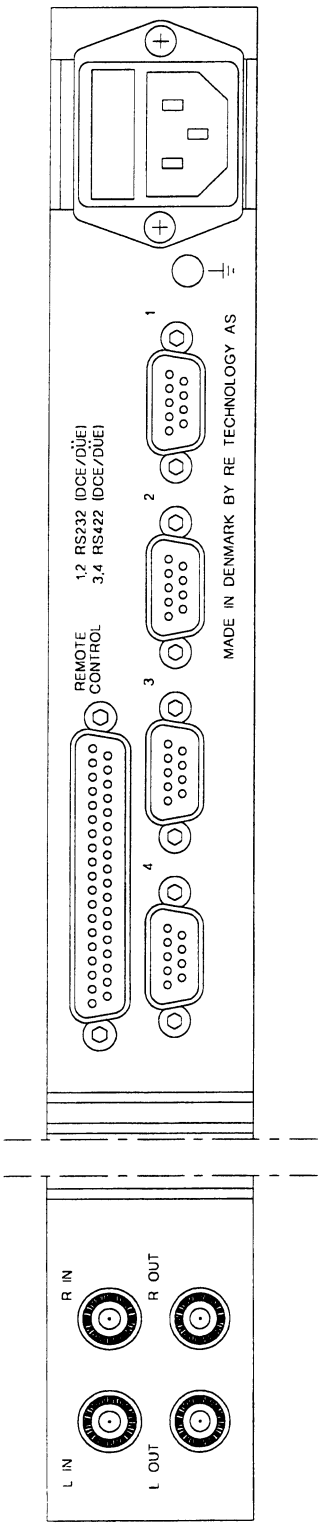


Fig. 3.2 RE 650 Rear Panel

POWER INLET

The power inlet is a standard IEC type with protective earth terminal without ON/OFF switch.

DATA INTERFACES 1 and 2

Lines 1 and 2, RS-232 interfaces, are made with 9-pole female Sub-D connectors. The interfaces are made as Data Communication Equipment (DCE). Fig. 3.3 shows the pin out.

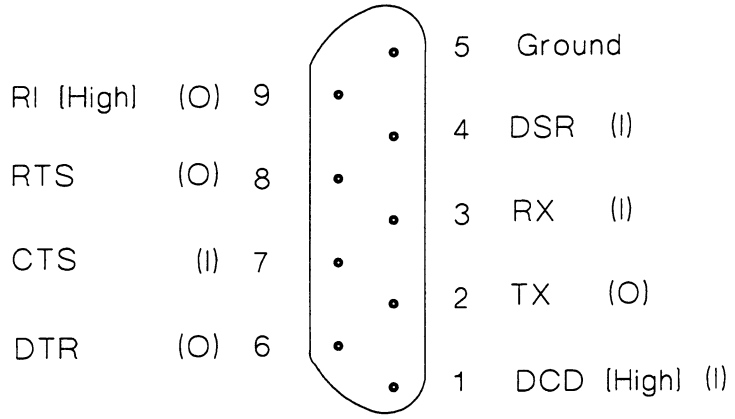


Fig. 3.3 Pin Out for Lines 1 and 2

Both lines use hardware handshake (CTS/RTS). If the modulator is not set to NORM mode on the front panel, the RTS output indicates "not ready to receive data". The state of DTR reflects the state of the low-pass filter and the bypass relay. This means that DTR indicates "terminal not ready" if the low-pass filter fails or the audio is by-passed. The DSR input is not monitored.

DATA INTERFACES 3 and 4

These two data interfaces are for future options.

L IN, L OUT, R IN, R OUT

The audio connections, L IN, L OUT and R IN, R OUT, are made with triaxial LEMO connectors. The two innermost rings constitute the pair for a balanced signal. The innermost ring is labeled the I-ring and the outermost of this pair is labeled the O-ring. If the I-ring is positive relative to the O-ring on the input, the same applies for the corresponding output. The third outer ring is always shield and connected to chassis.

REMOTE CONTROL

This connector (37-pole Sub-D, female) contains the following inputs/outputs:

- The 12 remote inputs of the RE 650
- Remote control input for the bypass function
- Power Fail relay
- Error Relay
- Ground

Fig. 3.4 shows the pin out of the connector.

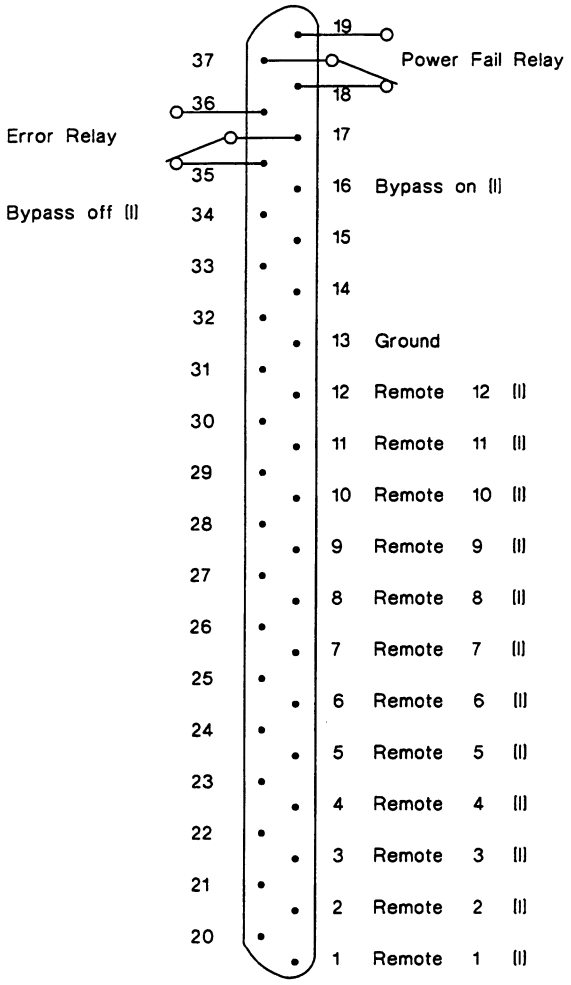


Fig. 3.4 Pin Out of Remote Control Connector

The positions of the two alarm relays are shown when no power is applied to the equipment.

3.3 RE 651 Front Panel

Fig. 3.5 shows the front panel of the RE 651.

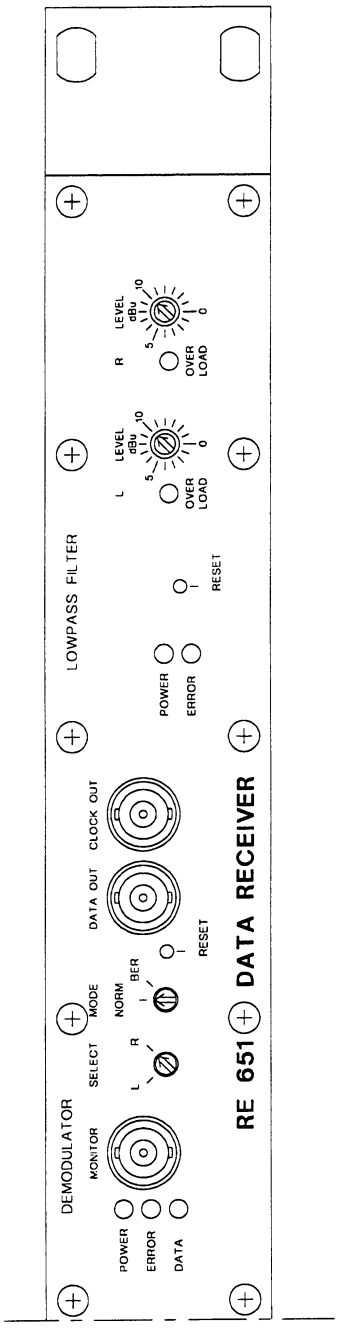


Fig. 3.5 RE 651 Front Panel

On the front of the low-pass filter section the following is seen.

L LEVEL Control
This control allows you to adjust the clipping level in the left channel without changing the overall gain. If the input level is bigger than the clipping level, the left OVERLOAD LED is turned on. If, for example, the control is set to 12 dBu, the low-pass filter overloads when the input level exceeds 4.4 Vp (3.1 V_{rms} = 12 dBu).

R LEVEL Control
This control allows you to adjust the clipping level in the right channel without changing the overall gain. If the input level is bigger than the clipping level, the right OVERLOAD LED is turned on. If, for example, the control is set to 12 dBu, the low-pass filter overloads when the input level exceeds 4.4 Vp (3.1 V_{rms} = 12 dBu).

RESET Button
Using a small screwdriver or a pencil it is possible to reset the low-pass filter by pressing this little button. During reset the ERROR LED and the OVERLOAD LEDs are turned on.

POWER (green LED)
When lit, this LED indicates the presence of +5 V.

ERROR (red LED)
When lit, this LED indicates that the low-pass filter is in a "NOT normal" operation. A "NOT normal" situation is one or more of the following:

- Watchdog on low-pass filter is not toggled
- Low-pass filter is being RESET
- The audio signals are bypassed

L OVERLOAD (red LED)
This LED is lit when the input level of the left input signal is above the selected clipping level or when the RESET button is pressed.

R OVERLOAD (red LED)
This LED is lit when the input level of the right input signal is above the selected clipping level or when the RESET button is activated.

On the front of the demodulator section the following is seen.

SELECT Control
In position L, the band-pass filtered L-channel is fed to the MONITOR output and the demodulated bits from the left data channel are fed to the DATA OUT connector. In position R, the band-pass filtered R-channel is fed to the MONITOR output and the demodulated bits from the right data channel are fed to the DATA OUT connector.

MODE Control
This control allows you to change the data source for the demodulator.

Setting	Function
NORM	The data output interface lines 1 and 2 on the rear panel is used.
BER	The demodulator packs the raw demodulated bits into 8-bit characters and outputs them on the rear panel. The communication parameters MUST be set to 8-bit/character and at least 2400 baud by using the DIP switch (SW3).

Table 3.2 RE 651, Mode Switch Settings

By selecting the BER mode in both modulator and demodulator it is possible, using a PC and if you develop a computer program for a PC, to make Bit Error Rate (BER) measurements without expensive test equipment.

RESET Button
Using a small screwdriver or a pencil it is possible to reset the demodulator by pressing this small button. During reset, the ERROR and DATA LED on the front panel are turned on.

MONITOR Connector (BNC)
On this output, it is possible to monitor the left or right signal after it is band-pass filtered around the sub-carrier. The data channel may be clearly identified although some part of the audio signal passes the band-pass filter.

CLOCK OUT Connector (BNC)
The bit clock (400 Hz, 50 % duty cycle) is found at this output . The logical level depends on the jumper setting and can be either HCMOS or V.28. Refer to Chapter 2.5.1, **Demodulator**, and Tables 2.16 and 2.17.

DATA OUT Connector (BNC)
If the SELECT control is set to L, the raw demodulated bit stream received on the left channel can be monitored on this output. If the SELECT control is set to R, the raw demodulated bit stream received on the right channel can be monitored on this output. They are clocked out synchronously to CLOCK OUT. If CLOCK OUT has HCMOS characteristics, the data is clocked out on the rising edge. If V.28 is selected, it is clocked out on the falling edge. The logical levels of the DATA OUT output depend on the jumper setting and can be either HCMOS or V.28. Refer to Chapter 2.5.1, **Demodulator**, and Tables 2.16 and 2.17.

POWER (green LED)
When lit, this LED indicates the presence of +5 V.

ERROR (red LED)
When lit, this LED indicates that the demodulator is in a "NOT normal" operation. This may either be because the internal Digital Signal Processor has not toggled the internal watchdog or because the MODE control is set to the BER position.

DATA (yellow LED)
If the SELECT control is set to L, this LED monitors the raw demodulated bit stream received on the left channel. If the SELECT control is set to R, this LED monitors the raw demodulated bit stream received on the right channel. When a logical 0 is received, it is turned on and it is turned off when the received bit is a logical 1. Since the rear panel interface always has V.28 characteristics, a positive voltage turns the LED on and a negative voltage turns it off. The same applies to the front panel interface if it is set to V.28 characteristics. If HCMOS characteristics are selected for the front panel interface, a voltage of 0 V turns the LED on and 5 V turns it off.

3.4 RE 651 Rear Panel

Fig. 3.6 shows the rear panel of the RE 651.

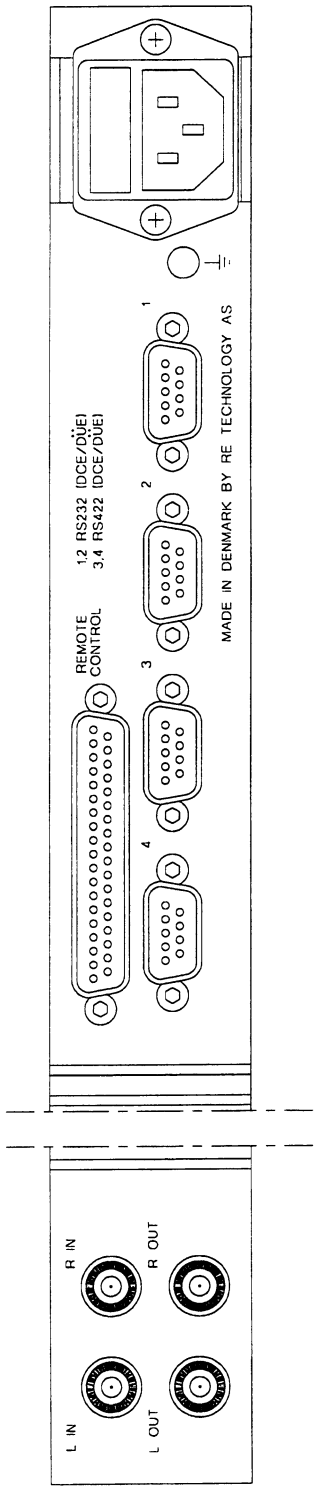


Fig. 3.6 RE 651 Rear Panel

POWER INLET

The power inlet is a standard IEC type with protective earth terminal without an ON/OFF switch.

DATA INTERFACES 1 and 2

The lines 1 and 2 RS-232 interfaces are made with 9-pole female Sub-D connectors. The interfaces are made as Data Communication Equipment (DCE). Fig. 3.3 shows the pin out. The received characters are transmitted on TX independently on the state of DSR and CTS. DTR and RTS are normally set to the active state. The state of DTR reflects the data channel quality, and the state of the low-pass filter and bypass function. This means that DTR indicates "terminal not ready" if the data channel fails, the low-pass filter fails or the audio is bypassed. The DSR input is not monitored.

DATA INTERFACES 3 and 4

These two data interfaces are for future options.

L IN, L OUT, R IN, R OUT

The audio connections, L/R in and L/R out, are made with triaxial LEMO connectors. The two innermost rings constitute the pair for a balanced signal. The innermost ring is labeled the I-ring and the outermost of this pair is labeled the O-ring. If the I-ring is positive relative to the O-ring on the input, the same applies for the corresponding output. The third outer ring is always shield and connected to chassis.

REMOTE CONTROL

This connector (37-pole Sub-D, female) contains the following inputs/outputs:

- The 12 relay outputs of the RE 651
- Remote control input for the bypass function
- Power Fail relay
- Error Relay
- Ground

Fig. 3.7 shows the pinout of the connector.

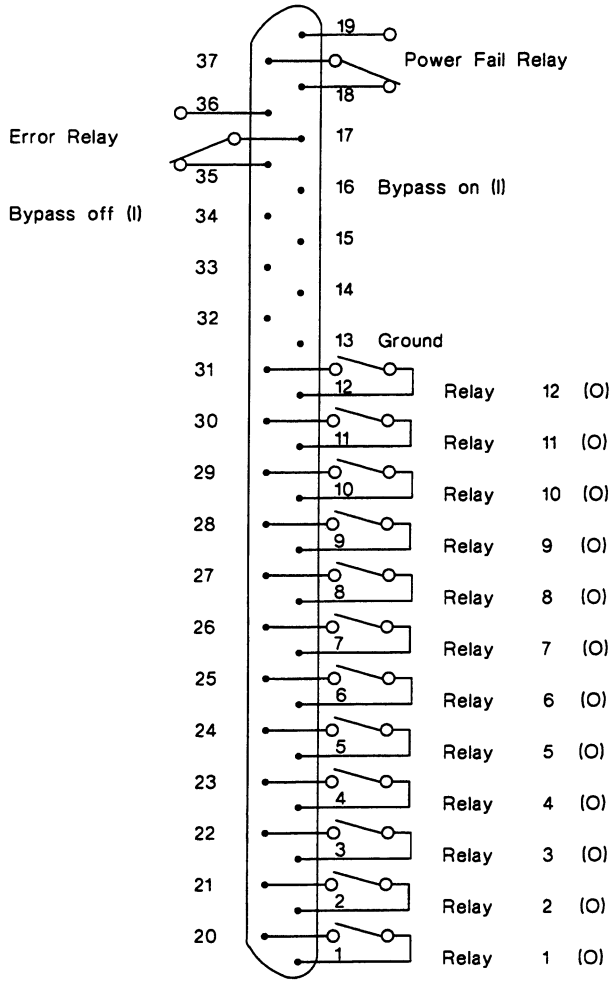


Fig. 3.7 Pinout of Remote Control Connector of RE 651

The positions of the two alarm relays are shown when no power is applied to the equipment.

4. Principle of Operation

4.1 General Description

Fig. 4.1 shows an application of the RDS Data Codec.

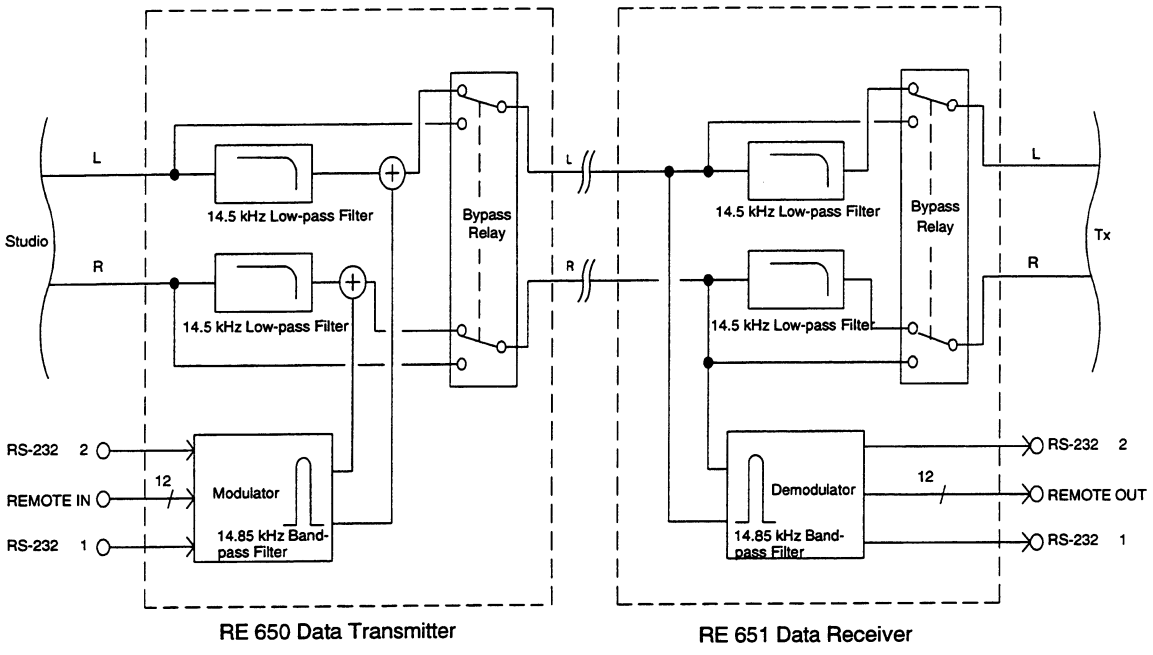


Fig. 4.1 Application of RE 65x RDS Data Codec

The low-pass filter in the RE 650 removes the upper 500 Hz of the left and right audio signal thus ensuring a high signal-to-noise ratio for the data channels. After the low-pass filtering the modulated sub-carriers placed at 14.85 kHz are added. The modulator takes the data input 1 and modulates the data on the sub-carrier which is added to the left channel. The 2 input interface is modulated on the sub-carrier which is added to the right channel. If the remote input is activated, two identical messages are transferred simultaneously over the left and right channel. On the transmitter site, the low-pass filter in the RE 651 reduces the sub-carriers to an inaudible level before the left and right signals are fed to the stereo encoder. The demodulator demodulates the two data channels and transfers the decoded information to the correct output interface. The RE 651 activates the relays if the left channel message or the right channel message is received or both.

In case of power failure or internal failure both the RE 650 and RE 651, are equipped with bypass relays, in order not to interrupt the audio signals, which bypass the audio signals in these situations.

Fig. 4.1 has been simplified with regard to the bypass relay in order to give a clearer overview. In reality, the connections from the L and R inputs to the low-pass filter are also disconnected during bypass. There is, therefore, no attenuation during bypass when the input impedance of the RE 650 or RE 651 is 600 Ω and they are connected to a device with a 600 Ω input impedance.

In order not to influence the audio signals, each data channel only uses ±140 Hz and the low-pass filters are carefully designed to be very steep and optimized with regard to constant group delay.

The modulation scheme used is Quadrature Phase Shift Keying (QPSK) with a 40 % cosine roll-off shaping filter and differential bit encoding. Both modulator and demodulator are built around a digital signal processor ensuring high spectral purity of the modulated sub-carrier, superior performance of the demodulator, and low drift.

Similarly, the very steep characteristics of the low-pass filters are made by digital signal processors to obtain the very steep characteristics. The RE 650 Filter has a typical attenuation of -0.7 dB at 14.5 kHz and a stop band attenuation of at least -48 dB starting at 14.71 kHz. In the RE 651, the low-pass filter is not as steep.

4.2 Functional Description

The audio inputs are identical for the RE 650 and RE 651. The input impedance can be set to either 600 Ω or high impedance (> 10 kΩ). The maximum input level can be adjusted independently for L and R on the front panel from 1.1 V_p (0.775 V_{rms} = 0 dBu) to 6.2 V_p (4.4 V_{rms} = 15 dBu) in 1 dB steps. The audio inputs are balanced and floating.

The audio outputs are identical for the RE 650 and RE 651. The output impedance can be set to either 600 Ω or low impedance (< 25 Ω). If the output impedance is set to 600 Ω, the 0 dB gain is changed to +6 dB. The audio outputs are balanced and floating.

The communication parameters for the two RS-232 interfaces of the RE 650 are identical and set using a DIP switch. The interfaces use hardware handshake to control the data flow. The RE 650 has 12 remote inputs which are activated when pulled low for at least 100 ms. The normal level of the modulated sub-carrier is 34.6 mV_p (24.5 mV_{rms} = -30 dBu). The level may be adjusted ±6 dB in 1 dB steps.

The communication parameters for the two RS-232 interfaces of the RE 651 are identical and set using a DIP switch. The interfaces use no hardware handshake (no output buffer). It expects the connected device to be able to handle an effective data flow of at least 400 baud. The RE 651 has 12 relay contacts corresponding to the 12 remote inputs of the RE 650. When a relay is activated, it is activated for at least 100 ms (typically 120 ms).

The data encoding between RE 650 and RE 651 is an asynchronous scheme as the one used in RS-232. The contents (the 7 or 8 data bits) of the RS-232 character or the relay number are inserted in a 12-bit frame. Table 4.1 shows how the frame is made.

bit 1	start bit (0)
bits 2-9	relay number or contains RS-232 character
bit 10	interface bit (0: relay command, 1: RS-232 character)
bit 11	parity bit (even)
bit 12	stop bit (1)

Table 4.1 Framing

The effective baud rate can then be calculated. If the RE 650 is set to 8 data bits, no parity and 1 stop bit, the effective baud rate is (1+8+0+1)/12*400 baud = 333.3 baud.

Note, that the RDS Data codec is not RS-232 transparent when the number of data bits for RE 650 is set to 8 and the number of data bits for the RE 651 is set to 7. In this case, the MSB of the transferred RS-232 character is removed in the RE 651. In the opposite case, the MSB is set to 0 in the RE 651.

The RE 651 supervises the quality of the two data channels independently. If a received frame is erroneous due to a framing error or parity error, the RE 651 does nothing with that frame. After receiving an erroneous frame, the RE 651 does nothing with the received frames until 3 correct frames in succession are received. These three correct frames are lost.

The RE 651 also measures the RMS value of the two modulated subcarriers independently so it can determine whether the data connection is established or not.

If the data connection is missing, the DTR is put into the inactive state on the corresponding RE-232 interface, thus telling the connected device that no data connection exists.

Both the RE 650 and the RE 651 have two alarm relays (change over type). That is, power fail or system fail.

The RE 650 bypasses the audio signals if power fails or a system error appears. Furthermore, the bypass can be controlled by two remote inputs, bypass on and bypass off. If the bypass on input is connected to ground for at least 100 ms, the RE 650 bypasses the audio signals. The bypass off input is activated in a similar way, but the function is the opposite. The bypass state is remembered during power fail.

The RE 651 works in a similar way. However, in the RE 651 it is also possible to select whether the output should be muted or the audio signal should be bypassed if

an error appears or bypass on is activated. In this way, it is possible to choose between no audio signal or audio signal with modulated sub-carrier led to the stereo-encoder in case the RE 651 fails but not the RE 650.

5. Dismantling

This chapter describes how you get access to the individual printed circuit boards and the various modules of the RE 65x. Reassembling is not described, as it is, in principle, just the opposite of the dismantling operation.

To help you understand the interconnections between the boards, we recommend that you read Chapter 9, **RE 650 Subrack** and Chapter 12, **RE 651 Subrack**, first.

5.1 Top and Bottom

The top and bottom plates are dismantled by unscrewing the 22 screws holding them in place (see Fig. 5.1). After you have removed the top and bottom plates, you have access to the soldered components.

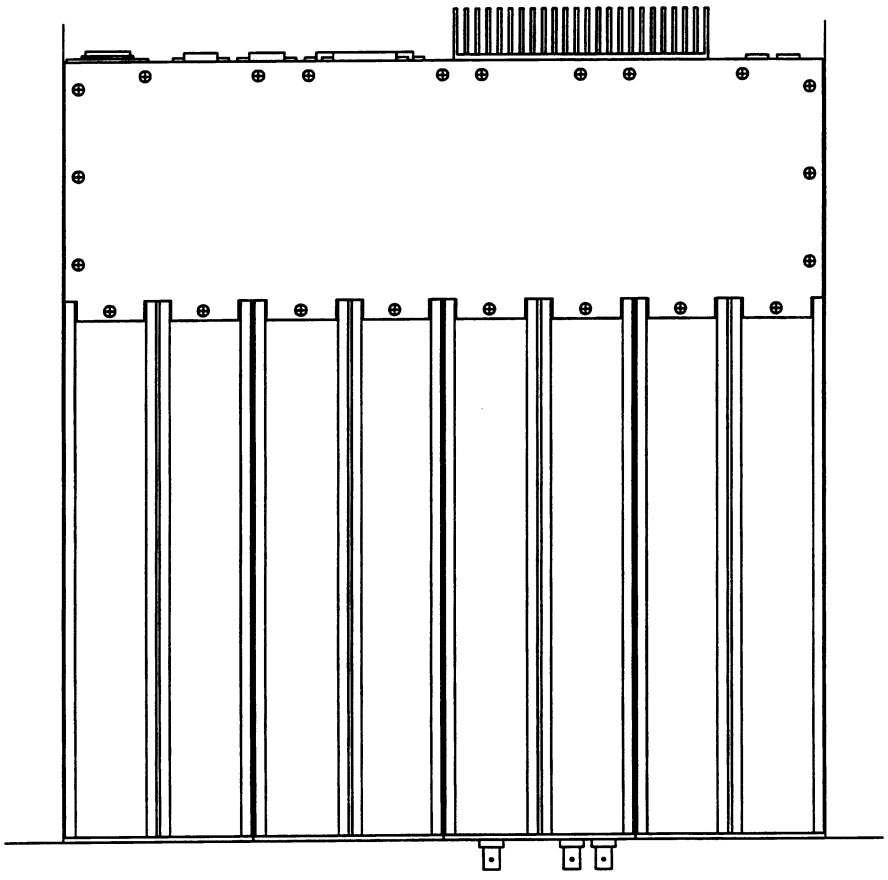


Fig. 5.1 Top View

5.2 Front Panel Section

The front panel section contains the various modules. To remove a module, unscrew the 18 screws on the front panel; you now have access to the individual printed circuit boards and are able to pull them out.

When you replace the printed circuit board, take great care of the small springs placed on each side of the board. The motherboard connectors are coded individually, so it is not possible to place a module in a wrong position.

5.3 Power Supply

To get access to the power supply:

1. Remove the top and bottom plates (see Chapter 5.1, **Top and Bottom**).
2. Unscrew the 4 screws on each side panel (see Fig. 5.2).
3. Note the position and appearance of the 4 flat cables connected to the printed circuit boards, as they are different from each other. Remove the 4 flat cables.

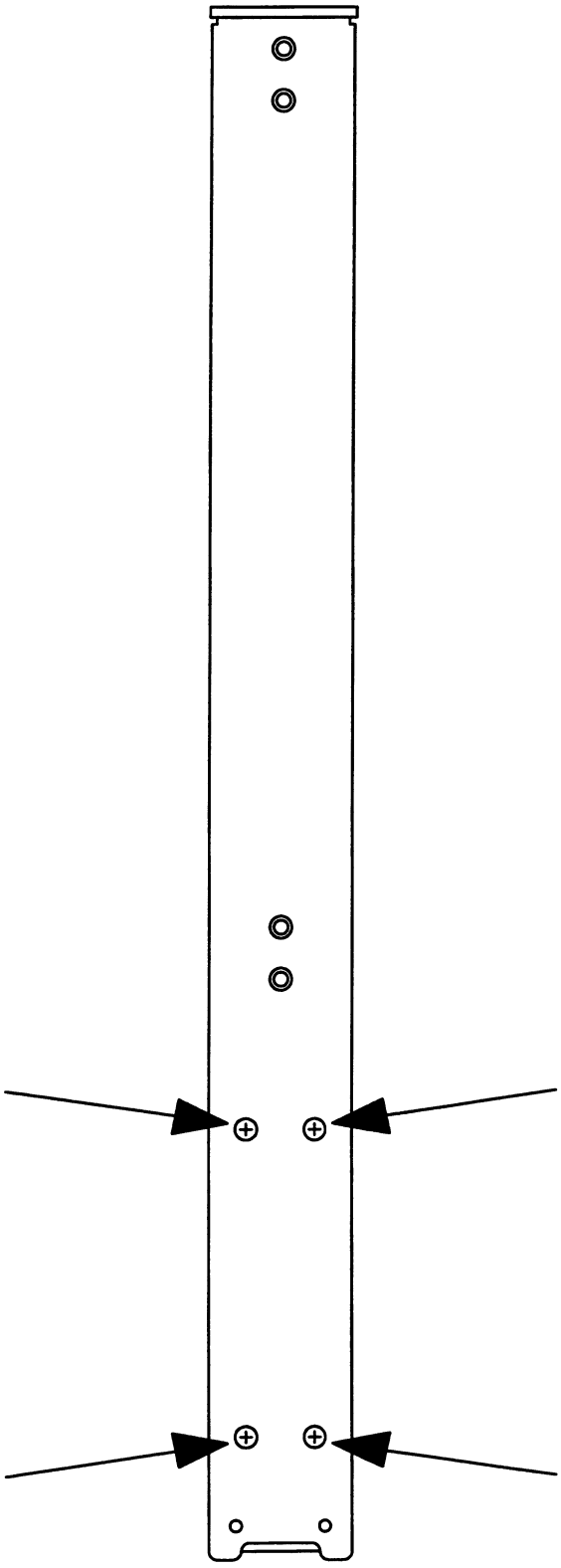


Fig. 5.2 Dismantling the Power Supply

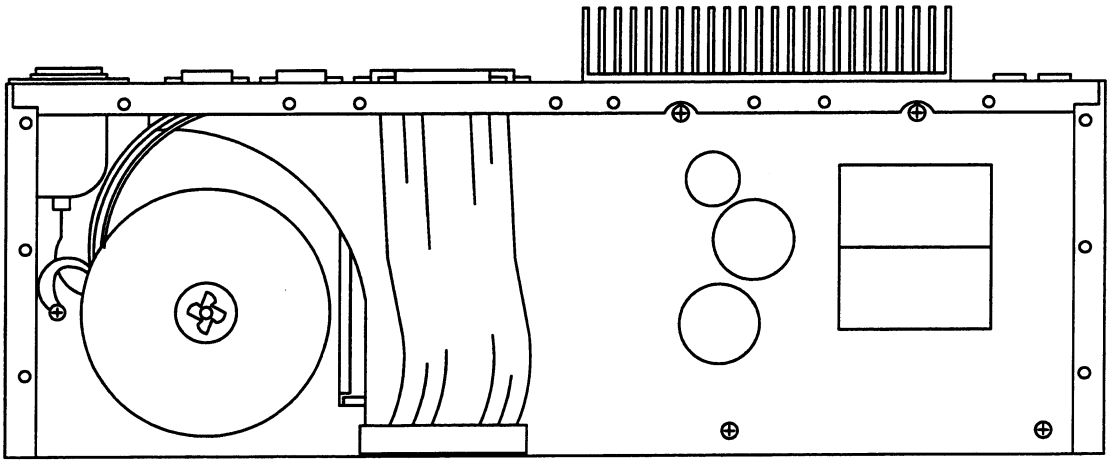


Fig. 5.3 Power Supply Unit

5.4 Motherboard

To get access to the motherboard:

1. Remove the power supply as described in Chapter 5.3, **Power Supply**.
2. Unscrew the 8 screws on the 4 15-pole Sub-D connectors and remove the connectors.
3. Remove the 18 screws (see Fig. 5.4).

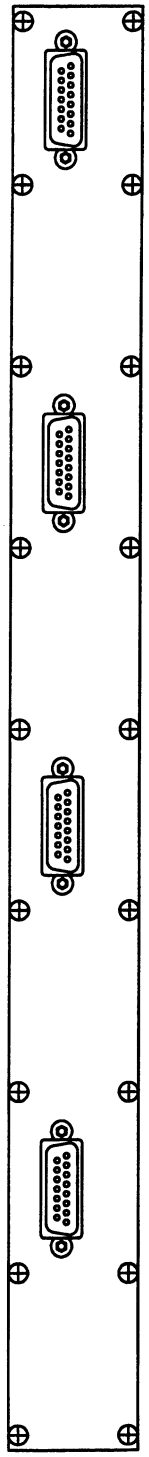


Fig. 5.4 Dismantling the Motherboard

6. Adjustment and Maintenance

In the loop-back connector, pins 3 (Rx) and 2 (Tx) and pins 8 (RTS) and 7 (CTS) are connected.

6.1 RE 650 Modulator Board

There are only 3 potentiometers per channel and one capacitor which have to be adjusted on the modulator board. For each channel, two potentiometers are used to adjust the band-pass filter and one to adjust the output level. The capacitor C32 is used to adjust the local oscillator. The following equipment is needed:

- An audio signal generator (frequency accuracy < ±5 Hz)
- An AC voltmeter (accuracy < ±0.01 dB from 1 to 15 kHz)
- A frequency counter
- Two 9-pole loop-back connectors
- An Extender Board

Oscillator Adjustment:

1. Connect the modulator to an extender board.
2. Check that jumpers JP4 and JP5 are both in position 1-2.
3. Connect a frequency counter to TP1.
4. Adjust C32 until the frequency is 10.929600 MHz ±5 Hz.

NOTE It is very important that the frequency counter is calibrated or locked to a clock standard such as DCF77 since the acquisition range of the demodulator is only ±50 ppm.

Adjustment of the Left Channel Filter:

1. Connect the modulator to an extender board.
2. Remove JP11.
3. Connect a pure sinus 12.660 kHz/500 mV_{rms} to TP5.
4. Adjust R81 until the level on TP6 is 7.31 dB ±0.01 dB greater than the level at TP5.
5. Change the frequency to 14.350 kHz.
6. Measure the level on TP7.
7. Change the frequency to 15.350 kHz.
8. Adjust R90 until the level on TP7 is the same as the level at 14.350 kHz.
9. Repeat the previous 4 steps until the level at TP7 for both frequencies is equal to ±0.01 dB.
10. Disconnect the sinus signal.
11. Insert JP11 again.

Adjustment of the Right Channel Filter:

1. Connect the modulator to an extender board.
2. Remove JP11.
3. Connect a pure sinus 12.660 kHz/500 mV_{rms} to TP2.
4. Adjust R41 until the level on TP3 is 7.31 dB ±0.01 dB greater than the level at TP2.
5. Change the frequency to 14.350 kHz.
6. Measure the level on TP4.
7. Change the frequency to 15.350 kHz.
8. Adjust R50 until the level on TP4 is the same as the level at 14.350 kHz.
9. Repeat the previous 4 steps until the level at TP4 for both frequencies is equal to ±0.01 dB.
10. Disconnect the sinus signal.
11. Insert JP11 again.

Adjustment of the Left Output Level:

1. Connect the modulator to an extender board.
2. Connect a loop-back connector to data interfaces 1 and 2
3. Make sure that the audio is not bypassed.
4. Check that jumper JP4 and JP5 are in position 1-2.
5. Move the jumper placed on JP9 to JP6.
6. Press SW5 (RESET) on the front panel of the modulator.
7. Adjust R110 until the output measured on the left audio output is 775 mV_{rms} ±1 mV.
8. Move the jumper placed on JP6 back to JP9.
9. Press SW5 (RESET) on the front panel of the modulator.

If you insert a jumper on JP6 and then press RESET, the DSP boots a special test page. The test page has two functions:

a) To make a loop-back test of the three UARTs (QD18, 20 and 21). That is, a character can be transmitted and received and the hardware handshake input and output work.
b) To make a pure 14.85 kHz sinus with peak level equal to the peak level of the QPSK signal.

Function b can be used to adjust the level as described above. Note, that the carrier is only made if test a, the loop-back test, is passed.

If the loop-back test is passed, the modulator continues to transmit the setting of switches SW4, SW2, SW1 and SW3 in that order on data interfaces 1 and 2. SW4 is shown as 8 bits, and SW2, SW1 and SW3 are shown as hexadecimal digits corresponding to the values indicated on the hexagonal switch (the front plate must be removed to see this). An example of the transmitted string is:

01011100[space]4[space]4[space]4[carriage return][line feed]

In this way, you can check that all bits on SW1, SW2, SW3 and SW4 can be toggled.

The communication parameters are fixed to 9600 baud, 7 data bits, even parity and 1 stop bit. When a terminal or PC is connected to the data interface 1 or 2, only pin 2 (Tx) and pin 5 Ground are to be connected to the correct pins on the Terminal/PC. If the connector on the PC is a 9-pole Sub-D connector it is pins 2 and 5 respectively. If it is a 25-pole Sub-D connector it is pins 3 and 7 respectively. The short-circuiting done by the loop-back connector should still be obtained.

6.2 RE 650 Low-pass Filter Board

There are only 3 potentiometers per channel to be adjusted on the low-pass filter board. One is used to minimize the harmonic distortion in the D/A Converter. The second is used to adjust the pass-band of the reconstruction low-pass filter, Bessel-filter adjustment. The third is used to adjust the gain from input to output. The following equipment is required:

- An audio signal generator (frequency accuracy better than ±5 Hz, harmonic distortion < -95 dB and output level difference @ 1 kHz and @ 14.5 kHz is < ±0.01 dB)
- An AC voltmeter (accuracy < ±0.01 dB from 1 kHz to 15 kHz)
- An audio analyzer for THD-measurements (THD < -95 dB)
- An extender board

Minimizing THD in L-channel:

1. Connect the low-pass filter to an extender board.
2. Make sure that the audio is not bypassed.
3. Set SW1 to position C.
4. Connect 1 kHz/775 mV_{rms} to the left input on the rear panel.
5. Measure THD (2nd to 9th harmonic) on the left output on the rear panel.
6. Adjust R60 until THD is < -88 dB.

Minimizing THD in R-channel :

1. Connect the low-pass filter to an extender board.
2. Make sure that the audio is not bypassed.
3. Set SW2 to position C.
4. Connect 1 kHz/775 mV_{rms} to the right input on the rear panel.
5. Measure THD (2nd to 9th harmonic) on the right output on the rear panel.
6. Adjust R64 until THD is < -88 dB.

Adjustment of the Bessel-filter and Gain in the L-channel:

1. Connect the low-pass filter to an extender board.
2. Make sure that the audio is not bypassed.
3. Move jumper from JP4 to JP1.
4. Press SW3 (RESET).
5. Set SW1 to position C.
6. Connect 1 kHz/775 mV_{rms} to the left input on the rear panel.
7. Measure the left input level and note the value (this is used as reference).
8. Adjust R86 until the left output level is equal to the input level.

9. Change the frequency to 14.5 kHz.
10. Adjust R73 until the left output level is -0.64 dB below the output level @ 1 kHz.
11. Move jumper from JP1 back to JP4.
12. Press SW3 (RESET).

Adjustment of the Bessel-filter and Gain in the R-channel:

1. Connect the low-pass filter to an extender board.
2. Make sure that the audio is not bypassed.
3. Move jumper from JP4 to JP1.
4. Press SW3 (RESET).
5. Set SW2 to position C.
6. Connect 1 kHz/775 mV_{rms} to the right input on the rear panel.
7. Measure the right input level and note the value (this is used as reference).
8. Adjust R109 until the right output level is equal to the input level.
9. Change the frequency to 14.5 kHz.
10. Adjust R105 until the output level is -0.64 dB below the output level @ 1 kHz.
11. Move jumper from JP1 back to JP4.
12. Press SW3 (RESET).

Switches SW1 and SW2 can also be tested in conjunction with the 4 multiplying D/A Converters (see diagram Chapter 8, **RE 650 Low-pass Filter**). This is done by enabling two test pages.

Test of SW1, SW2 and QA3 and QA7:

1. Connect the low-pass filter to an extender board.
2. Make sure that the audio is not bypassed.
3. Insert a jumper on JP2.
4. Press SW3 (RESET).
5. Connect 1 kHz/775 mV_{rms} to the two inputs on the rear panel.
6. Measure the output level on the left output on the rear panel, and check that the output changes by -1 dB each time SW1 is moved from position C to B counter clockwise.
7. Measure the output level on the right output on the rear panel, and check that the output changes by -1 dB each time SW2 is moved from position C to B counter clockwise.
8. Remove the jumper from JP1.
9. Press SW3 (RESET).

Test of SW1, SW2 and QA11 and QA15:

1. Connect the low-pass filter to an extender board.
2. Make sure that the audio is not bypassed.
3. Insert a jumper on JP2 and JP2.
4. Press SW3 (RESET).
5. Connect 1 kHz/775 mV_{rms} to the two inputs on the rear panel.
6. Measure the output level on the left output on the rear panel, and check that the output changes by +1 dB each time SW1 is moved from position C to B counter clockwise.
7. Measure the output level on the right output on the rear panel, and check that the output changes by +1 dB each time SW2 is moved from position C to B counter clockwise.
8. Remove the jumper from JP1 and JP2.
9. Press SW3 (RESET).

6.3 RE 650 Power Supply Board

The left and right output stages with transformers are situated on the power supply board. Two adjustments are necessary for each audio-channel: one to remove the DC offset of the amplifier driving the audio-transformer, and one to adjust the gain. The following equipment is necessary:

- An audio signal generator (frequency accuracy < ±5 Hz)
- An AC voltmeter (accuracy < ±0.01 dB from 1 to 15 kHz)
- A DC ampere meter (accuracy < ±1 µA)

Adjustment of the Left Channel DC Offset:

1. Remove the top plate as described in Chapter 5.1, **Top and Bottom**, to get access to the power supply board.
2. Remove the low-pass filter.
3. Make sure that the audio is not bypassed.
4. Move the jumper placed on JP2 to JP1 position 1-2.
5. Measure the current running between JP2 pin 1 and JP2 pin 2.
6. Adjust R38 until the current is 0 A ±1 µA.
7. Move the jumper placed on JP1 back to JP2 position 1-2.

Adjustment of the Right Channel DC Offset:

1. Remove the top plate as described in Chapter 5.1, **Top and Bottom**, to get access to the power supply board.
2. Remove the low-pass filter.
3. Make sure that the audio is not bypassed.
4. Move the jumper placed on JP4 to JP3 position 1-2.
5. Measure the current running between JP4 pin 1 and JP4 pin 2.
6. Adjust R58 until the current is 0 A ±1 µA.
7. Move the jumper placed on JP3 back to JP4 position 1-2.

Adjustment of Left Channel Gain:

1. Remove the top plate as described in Chapter 5.1, **Top and Bottom**, to get access to the power supply board.
2. Remove the low-pass filter.
3. Make sure that the audio is not bypassed.
4. Place jumper JP6 and JP7 in position 1-2.
5. Park jumper JP5 on JP11.
6. Connect 1 kHz/775 mV_{rms} to the left input on the rear panel.
7. Measure this input level.
8. Adjust R28 until the output level is equal to the input level ±0.01 dB.
9. Rearrange jumper JP6 and JP7 to their previous settings.
10. Rearrange jumper JP5 and JP11.

Adjustment of Right Channel Gain:

1. Remove the top plate as described in Chapter 5.1, **Top and Bottom**, to get access to the power supply board.
2. Remove the low-pass filter.
3. Make sure that the audio is not bypassed.
4. Place jumper JP9 and JP10 in position 1-2.
5. Park jumper JP8 on JP11.
6. Connect 1 kHz/775 mV_{rms} to the right input on the rear panel.
7. Measure this input level.
8. Adjust R48 until the right output level is equal to the input level ±0.01 dB.
9. Rearrange jumper JP9 and JP10 to their previous settings.
10. Rearrange jumper JP8 and JP11.

6.4 RE 651 Demodulator Board

Only three potentiometers per channel and one coil have to be adjusted on the demodulator board. The three potentiometers are to adjust the band-pass filter. The coil L9 is used to adjust the local oscillator. The following equipment is required:

- An audio signal generator (frequency accuracy < ±5 Hz)
- An AC voltmeter (accuracy < ±0.01 dB from 1 to 15 kHz)
- A frequency counter
- An oscilloscope
- An extender board
- Two 9-pole loop-back connectors

Oscillator Adjustment:

1. Insert jumper JP10 in position 1-2.
2. Connect a frequency counter to TP13.
3. Adjust L7 until the frequency is 10.929840 MHz ±5 Hz.
4. Insert jumper JP10 in position 2-3.

NOTE It is very important that the frequency counter is calibrated or locked to a clock standard such as DCF77 since the acquisition range of the demodulator is only ±50 ppm.

The filter is adjusted using an oscilloscope in XY-mode with two x10 probes. In this mode, the oscilloscope can be used to detect when two signals with the same frequency are in phase. This is the case when only one straight line appears on the oscilloscope. It is very important that the oscilloscope does not have any phase offset and that the range setting is always kept the same for the X and Y channel.

Adjustment of Left Channel Band-pass Filter:

1. Connect the demodulator to an extender board.
2. Make sure that the audio is not bypassed.
3. Connect a pure sinus 14.85 kHz/500 mV_{rms} to the left input on the rear panel.
4. Connect the X-input of the oscilloscope to TP3.
5. Connect the Y-input of the oscilloscope to TP3.
6. Check that a straight line appears on the oscilloscope.

Adjustment of Gyrator 1:

1. Move the Y-input of the oscilloscope to TP8.
2. Adjust R41 until a straight line is seen on the oscilloscope.

Adjustment of Gyrator 2:

1. Move the jumper placed on JP4 to JP6.
2. Connect the X-input of the oscilloscope to TP9.
3. Connect the Y-input of the oscilloscope to TP10.
4. Adjust R45 until a straight line is seen on the oscilloscope.

Adjustment of Gyrator 3:

1. Move the jumper placed on JP6 to JP5.
2. Remove the 14.85 kHz signal from the left input on the rear panel.
3. Connect a pure sinus 14.85 kHz/500 mV_{rms} to JP4.
4. Connect the X-input of the oscilloscope to TP12.
5. Connect theY-input of the oscilloscope to TP11.
6. Adjust R52 until a straight line is seen on the oscilloscope.
7. Remove the 14.85 kHz signal from JP4.
8. Move the jumper placed on JP5 to JP4.

Adjustment of the Right Channel Band-pass Filter:

1. Connect the demodulator to an extender board.
2. Make sure that the audio is not bypassed.
3. Connect a pure sinus 14.85 kHz/500 mV_{rms} to the right input on the rear panel.
4. Connect the X-input of the oscilloscope to TP1.
5. Connect the Y-input of the oscilloscope to TP1.
6. Check that a straight line appears on the oscilloscope.

Adjustment of Gyrator 1:

1. Move the Y-input of the oscilloscope to TP4.
2. Adjust R13 until a straight line is seen on the oscilloscope.

Adjustment of Gyrator 2:

1. Move the jumper placed on JP1 to JP3.
2. Connect the X-input of the oscilloscope to TP5.
3. Connect the Y-input of the oscilloscope to TP6.
4. Adjust R18 until a straight line is seen on the oscilloscope.

Adjustment of Gyrator 3:

1. Move the jumper placed on JP3 to JP2.
2. Remove the 14.85 kHz signal from the right input on the rear panel.
3. Connect a pure sinus 14.85 kHz/500 mV_{rms} to JP1.
4. Connect the X-input of the oscilloscope to TP2.
5. Connect the Y-input of the oscilloscope to TP7.
6. Adjust R24 until a straight line is seen on the oscilloscope.
7. Remove the 14.85 kHz signal from JP1.
8. Move the jumper placed on JP2 to JP1.

The gyrators may alternatively be adjusted using a network analyzer. They should all be adjusted so that the center frequency is 14.85 kHz.

The demodulator has a test page similar to the modulator. To activate it, do the following.

1. Connect a loop-back connector on data interfaces 1 and 2.
2. Move the jumper placed on JP14 to JP11.
3. Press RESET on the front panel of the demodulator.

The test page has only one function on the demodulator, which is to make a loop-back test of the three UARTs (QD23, 25 and 27), that is, a character can be transmitted and received and the hardware handshake input and output work.

On data interfaces 1 and 2, the demodulator continues to transmit the setting of switches SW3, SW1 and SW2 in that order if the loop-back test is passed. SW3 is shown as 8 bits and SW1 and SW2 are shown as a hexadecimal digit corresponding to the values indicated on the hexagonal switch (the front plate must be removed to see this). An example of the transmitted string:

01011100[space]4[space]4[carriage return][line feed]

In this way, it can be checked that all bits on SW1, SW2 and SW3 can be toggled.

The communication parameters are fixed to 9600 baud, 7 data bits, even parity and 1 stop bit. When a terminal or PC is connected to the data interface, only pin 2 (Tx) and pin 5 Ground must be connected to the correct pins on the Terminal/PC. If the connector on the PC is a 9-pole Sub-D connector they are pins 2 and 5, respectively. If it is a 25-pole Sub-D connector they are pins 3 and 7, respectively. The short-circuiting done by the loop-back connector should still be obtained.

To run the normal software do the following:

1. Move the jumper placed on JP11 back to JP14.
2. Press the RESET on the front panel of the demodulator.

6.5 RE 651 Low-pass Filter Board

This adjustment is made exactly as described in Chapter 6.2, **RE 650 Low-pass Filter Board**.

6.6 RE 651 Power Supply Board

This adjustment is made exactly as described in Chapter 6.3, **RE 650 Power Supply Board**.

7. RE 650 Modulator

7.1 Circuit Description

Fig. 7.1 shows a block diagram of the modulator.

The DSP, an ADSP2101, 10 MHz, boots on power up or after RESET from the boot-EPROM. The three upper address bits (A13, A14 and A15) can be pulled high individually using JP6, 7 and 8, respectively. If A13 is pulled high, the DSP boots the special test page as described in Chapter 6.1, **RE 650 Modulator Board**, after power up or after RESET. The DSP interfaces to the data source using the UARTs (QD18, 20 and 21) or using the Clock/data interface on the front panel, an input on input port A7. The interface the DSP should use depends on the switch SW1 setting (labeled MODE on the front panel). UART1 (QD20) and UART2 (QD21) take care of the interface to line 1 and 2, respectively. UART0 (QD18) establishes a serial interface with serial interface logic on the power supply board. The DSP uses this interface to read the status of the Remote Control input on the rear panel. The I/O ports on the modulator board are named according to the address bit that should be taken low to select the port. To save components, the chip selects are made very simple, that is, one address bit for each port.

Input port A6 (QD7) is used by the DSP to read the settings of the hexagonal switches SW1 and SW2 (labeled MODE and LEVEL on the front panel of the modulator). The DSP can then change the LEVEL of the QPSK signals or change MODE accordingly.

Input port A7 (QD8 and QD10) is used by the DSP to read the settings of DIP switch SW4 and hexagonal switch SW3 (labeled SELECT on the front panel of the modulator). The DSP can then change the communication parameters or SELECT which channel to monitor accordingly. Input port A7 is also used by the DSP to read the status of the low-pass filter board. Proper status information is then shown on the line interfaces, 1 or 2.

The input ports are read every 51 ms.

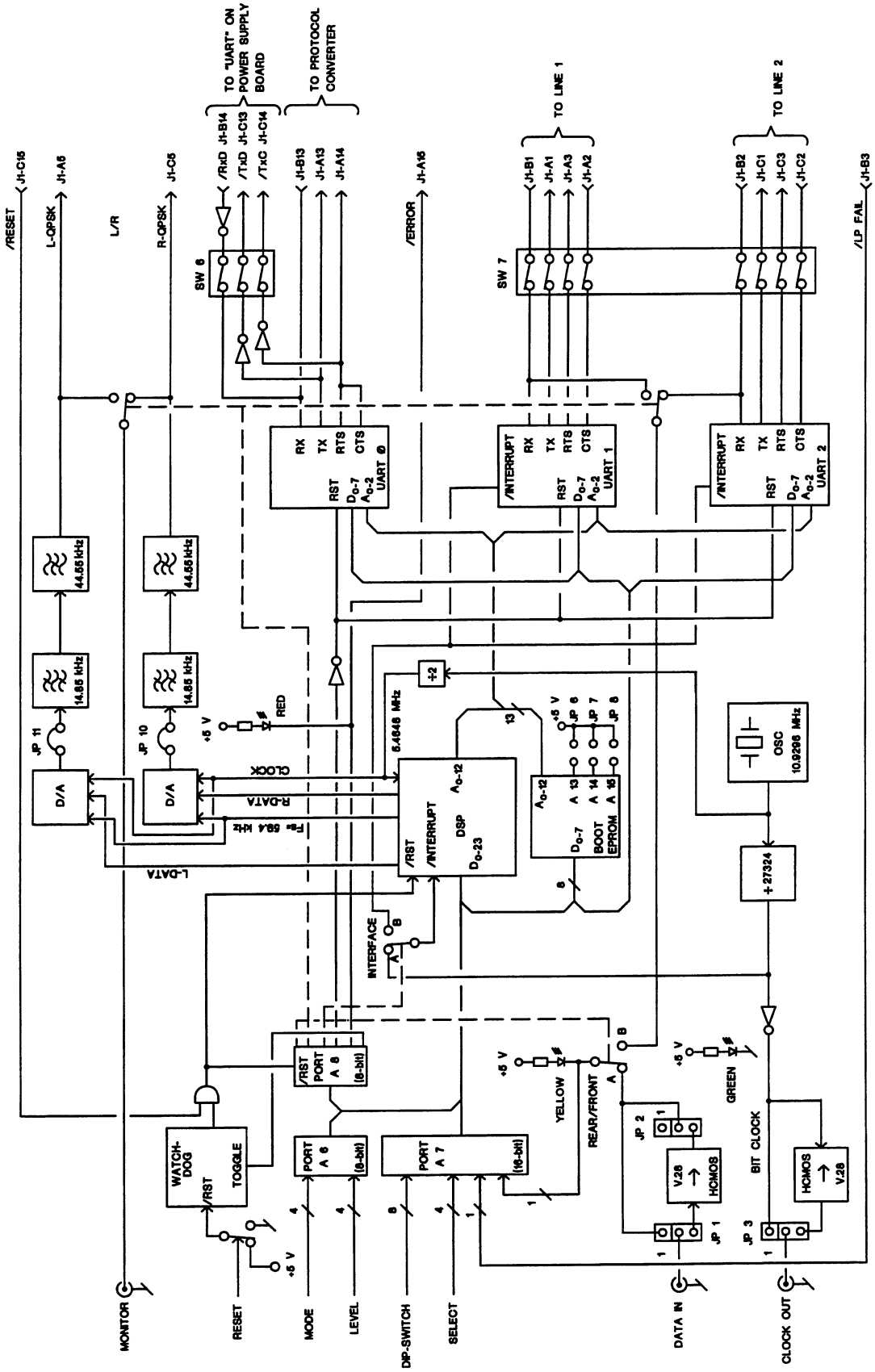


Fig. 7.1 Block Diagram of RE 650 Modulator

Output port A8 (QD2) is used by the DSP for internal hardware control. The 5 bits have the following meaning :

D0 0: Switch rear/front in position A, that is, yellow DATA LED on the front panel monitors data on DATA IN connector on the front panel of modulator.
1: Switch rear/front in position B, that is, yellow DATA LED on the front panel monitors data on UART 1 or 2.

D1 0: Right data and QPSK signal are monitored on the front panel (MONITOR and yellow DATA LED, respectively).
1: Left data and QPSK signal are monitored on the front panel (MONITOR and yellow DATA LED, respectively).

D2 0: Switch Interface in position B, that is, data taken from UARTs 1 and 2.
1: Switch Interface in position A, that is, data taken from DATA IN on the front panel of the modulator (MODE switch in position FRONT).

D3 0: UARTs 1 and 2 are disabled.
1: UARTs 1 and 2 are enabled.

D4 0: DSP is in a "not NORMAL" mode (red ERROR LED lit on the front panel).
1: DSP is in a NORMAL mode (red ERROR LED not lit on the front panel).

D5 0: Watchdog toggle input low.
1: Watchdog toggle input high.

The watchdog has to be toggled at least every second. If not, it resets the DSP, and output port A8 turns on the red ERROR LED on the front panel. The watchdog can be disabled by removing jumper JP9. The reset output of the watchdog also depends on the RESET button at the front panel of the modulator. If pressed, a reset is issued to the DSP.

The DSP generates samples for the two QPSK signals according to the received bits. These samples are fed via a serial interface to the two 16-bit D/A Converters (QA1 and QA5). The serial data bits are transferred synchronously with the serial clock (5.4648 MHz). The DSP divides the serial clock with 92 thus obtaining the sampling frequency of 59.4 kHz.

The output from the D/A Converter is fed through the 14.85 kHz band-pass filter and through a 44.55 kHz notch filter. The reason for the notch filter is that most of the energy of the first not-wanted frequency is situated around 44.55 kHz.

When the LEVEL on the front panel is set to 0 dB, only 15 of the 16 bits in the D/A Converters are used. This allows the DSP to increase the level by 6 dB if selected on the LEVEL control.

Since the UARTs are slow devices compared to the DSP (100 ns per instruction) it has been necessary to make special hardware to interface although 3 wait states (100 ns) are inserted.

QD19 latches the data during a write operation so that the hold time required by the addressed UART is fulfilled. QD22 makes sure that the hold time and bus release time required by the DSP are fulfilled during a read operation.

UART 0 makes a 3-wire serial interface (transmit, receive and clock) with the I/O-ports on the power supply board. UART 0 is set up to transmit the transmission clock (38.4 kHz) on its RTS output, and communication parameters are set to 8 data bits, no parity and 1 stop bit. The interface works as follows. The first character transferred is a command informing the interface logic on the power supply which I/O-port the DSP wants to access and whether it is a read- or a write-operation. If it is a write-operation the DSP transfers the 8-bit value for the 8-bit output port as the next character. The interface logic on the power supply then writes the value to the addressed output port. If it is a read-operation the DSP expects that the interface logic on the power supply board reads the addressed 8-bit input port and transfers the value to the DSP.

The Remote Control input is continuously read so the DSP can investigate if a remote input is activated and take proper action.

JP1, 2 and 3 are used to select whether the front panel data interface should have HCMOS or V.28 characteristics. QD6 takes care of this translation.

7.2 Schematic Diagrams

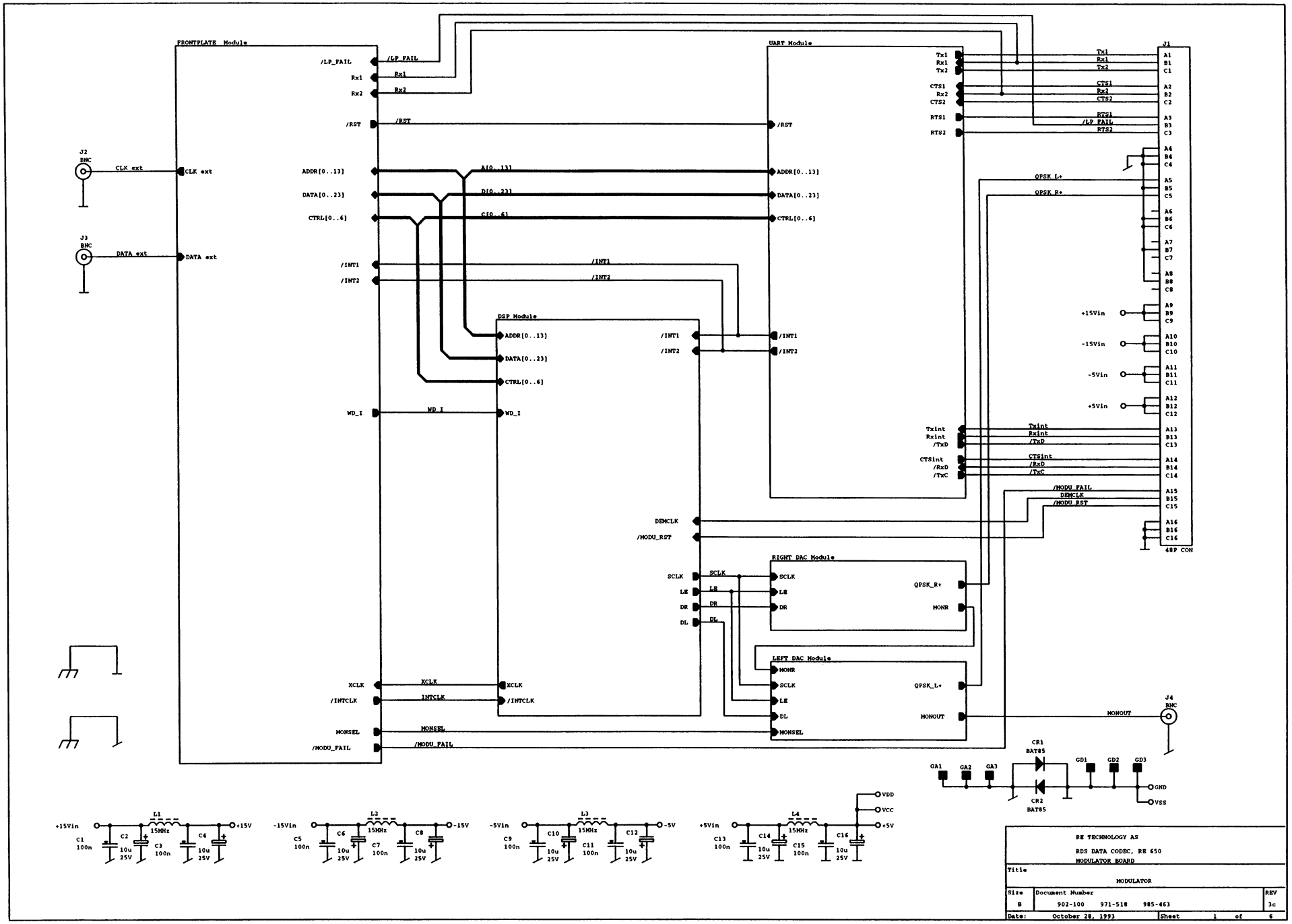
The schematic diagram for the RE 650 Modulator is located in the following. The diagram number is 985-463.

7.3 Component Locations

The component locations on the RE 650 Modulator are shown in the following.

7.4 Parts List

A copy of the parts list from the production documentation is located in the following. The order number of the assembled PCB is 902-100.



RE TECHNOLOGY AS

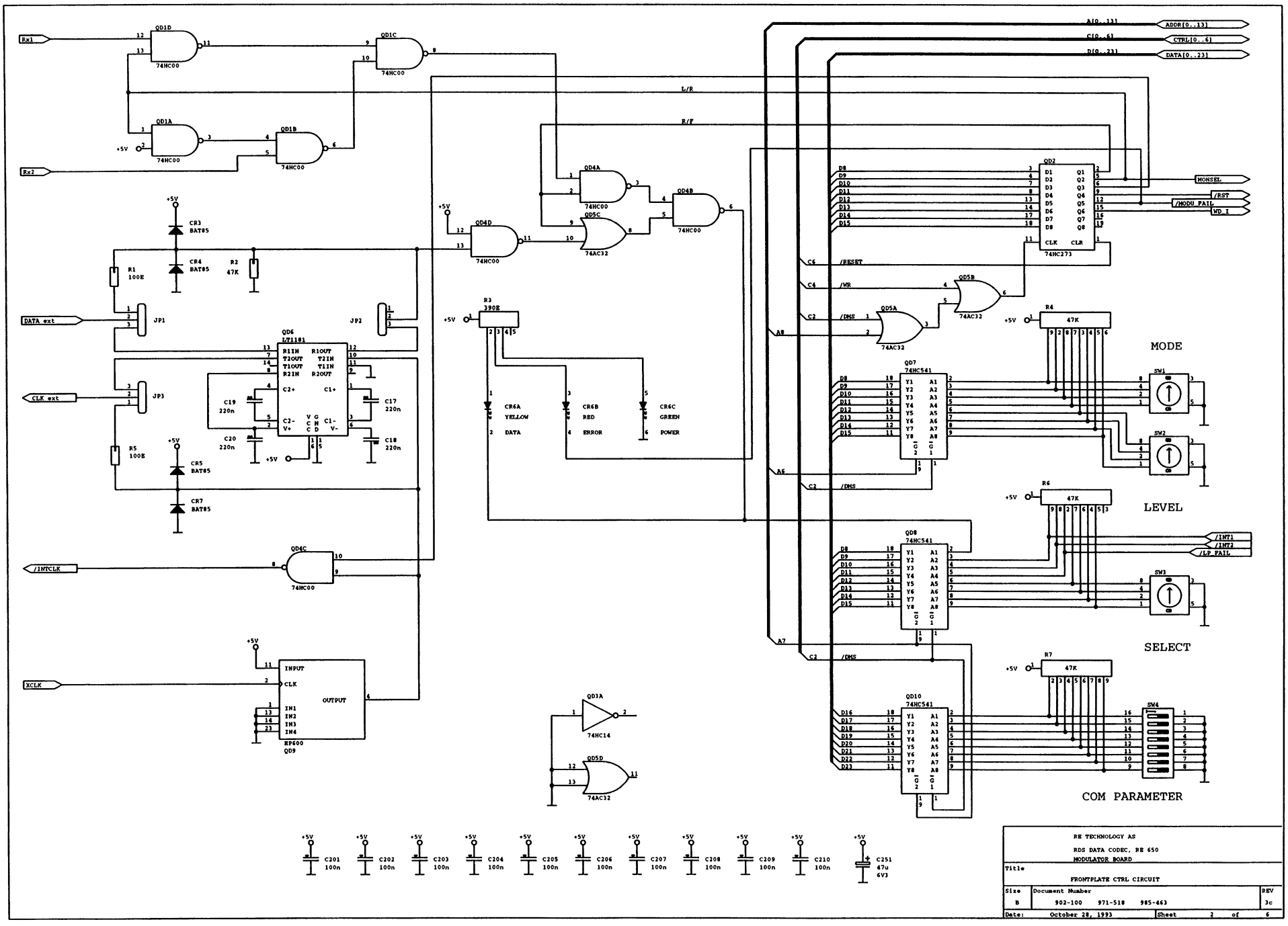
RDS DATA CODEC, RE 650

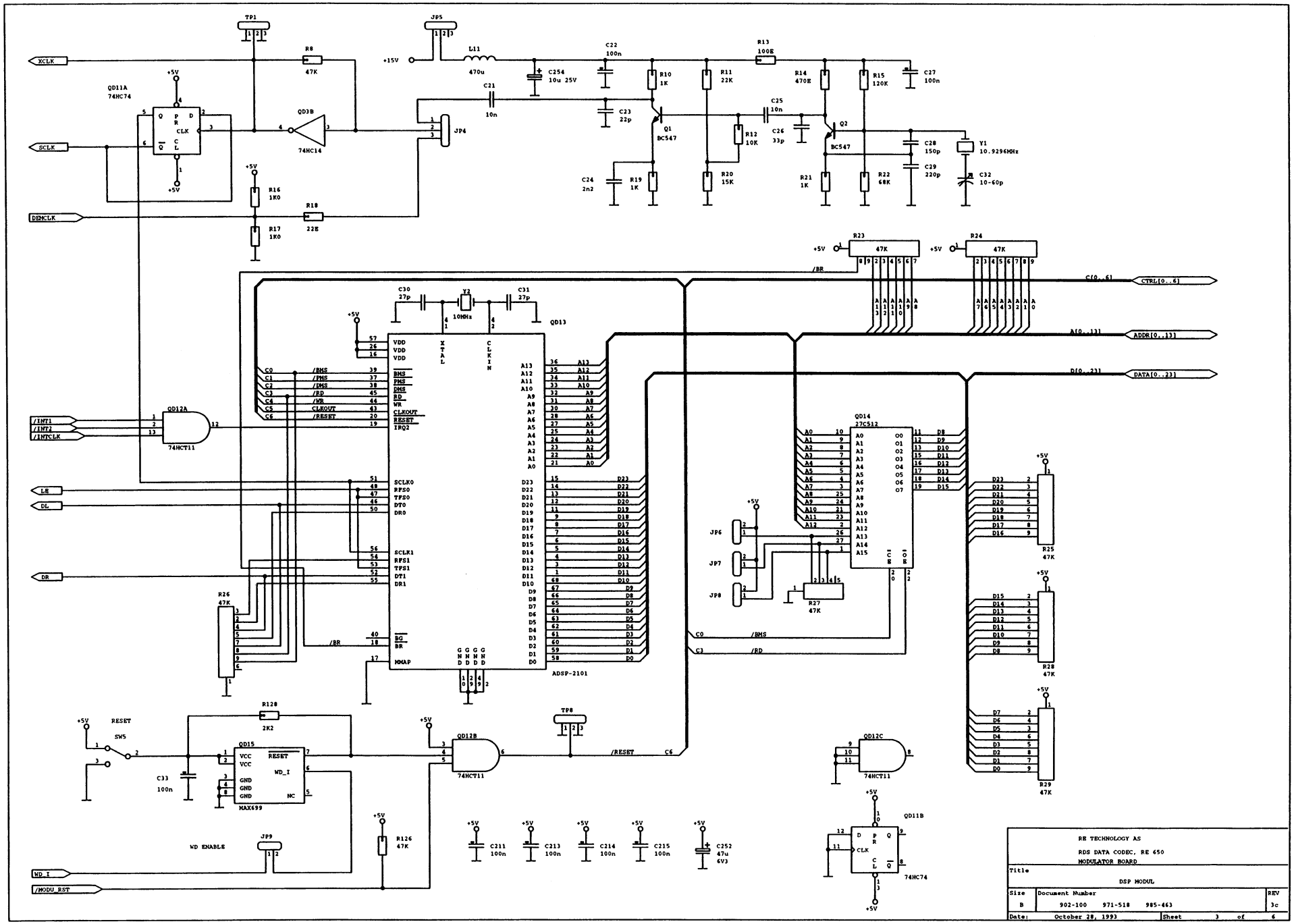
MODULATOR BOARD

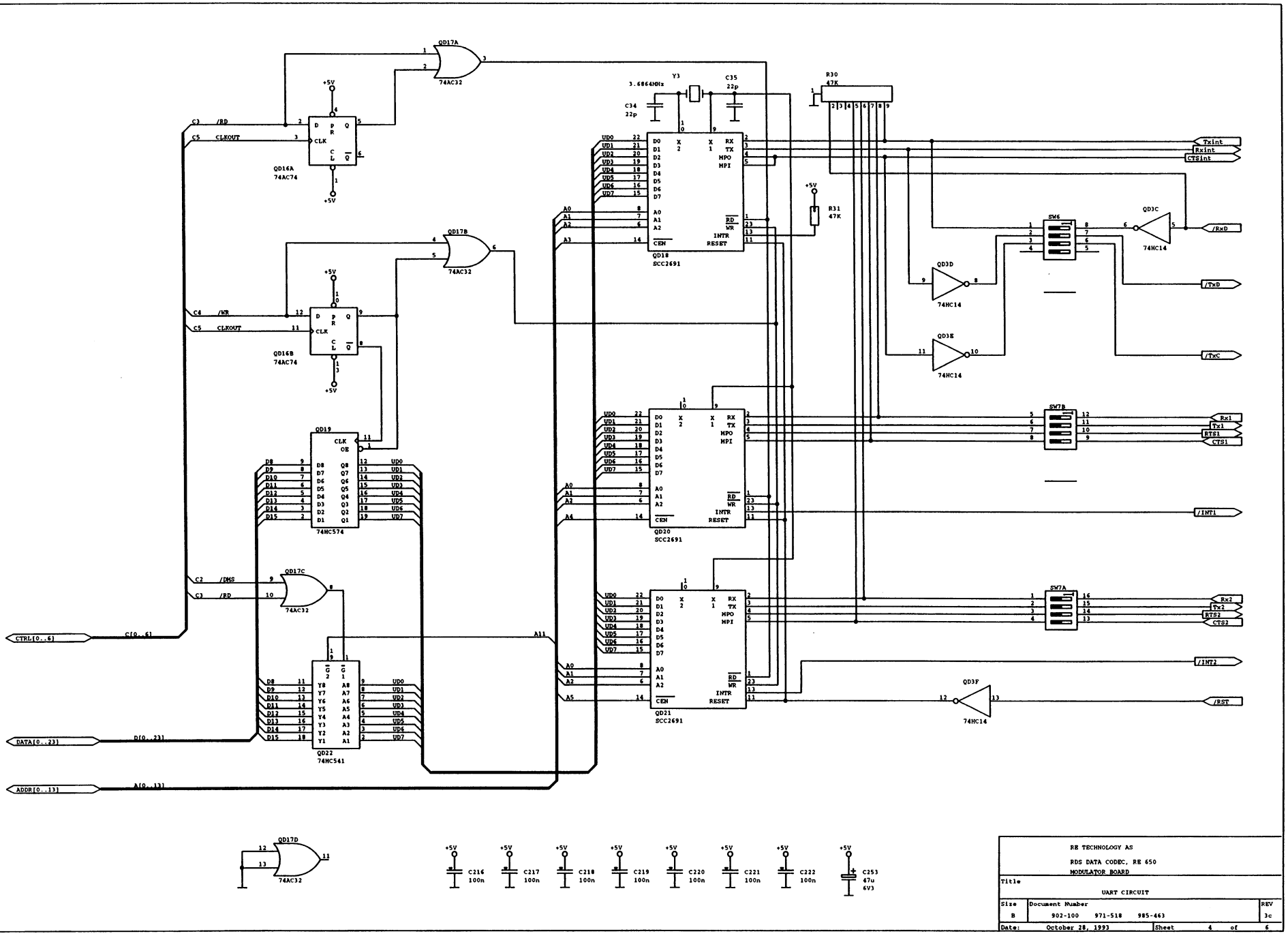
Title: MODULATOR

Size	Document Number	REV
B	902-100 971-518 985-463	3c

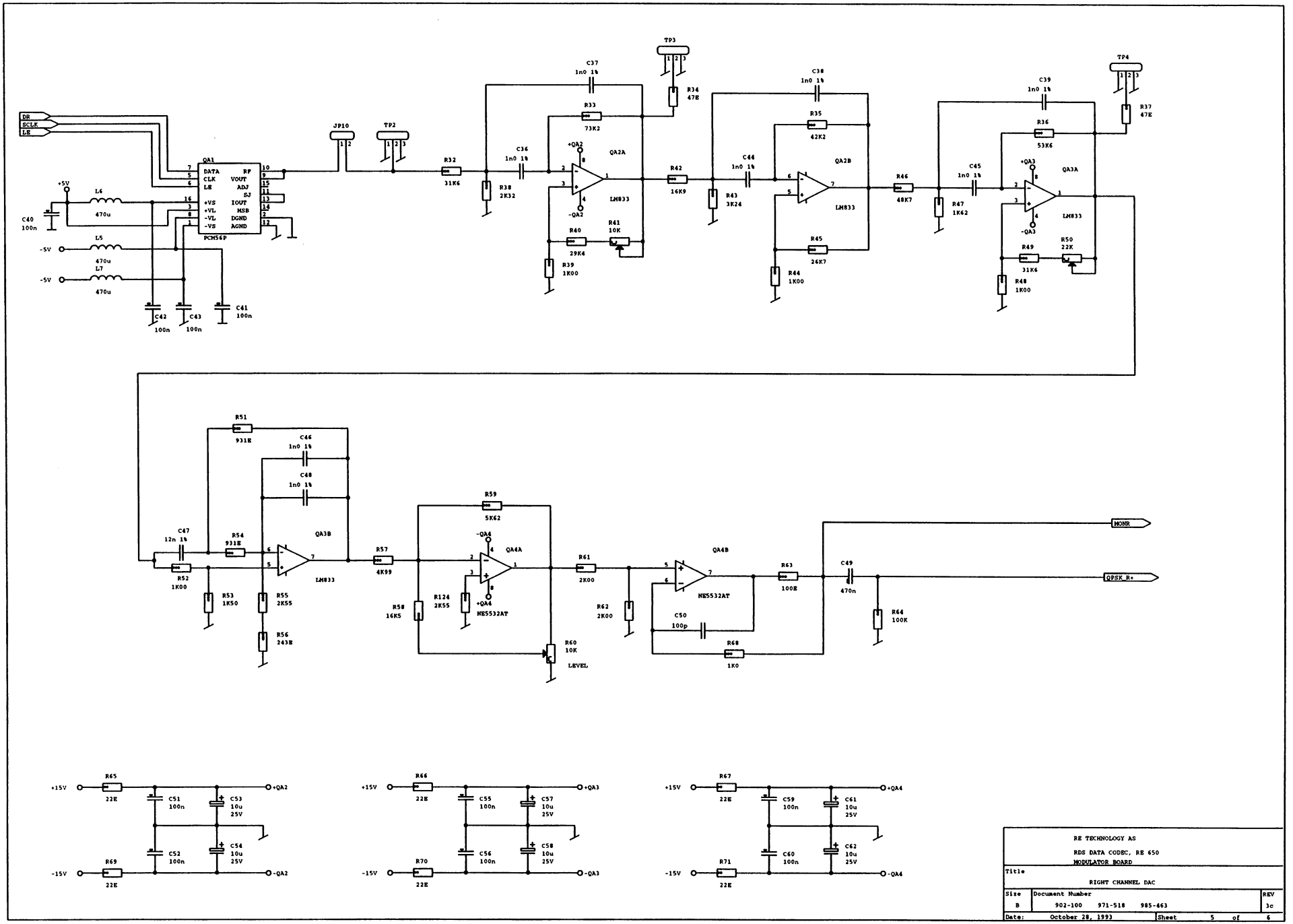
Date: October 28, 1993 Sheet 1 of 6


Rx1
Rx2
QD1D
QD1C
QD1A
QD1B
74HC00
+5V
L/R
R/F
A[0..13]
C[0..6]
D[0..23]
ADDR[0..13]
CTRL[0..6]
DATA[0..23]
QD4A
QD4B
QD4D
QD5C
74AC32
QD2
74HC273
MONSEL
/RST
/MODU_FAIL
WD_I
C6
/RESET
C4
/WR
C2
/DMS
QD5B
QD5A
A8
A6
A7
CR3
BAT85
CR4
CR5
CR7
R1
100E
R2
47K
R3
390E
R4
R5
R6
R7
47K
MODE
LEVEL
SELECT
COM PARAMETER
DATA ext
CLK ext
JP1
JP2
JP3
QD6
LT1181
C17
C18
C19
C20
220n
CR6A
YELLOW
DATA
CR6B
RED
ERROR
CR6C
GREEN
POWER
QD7
QD8
QD10
74HC541
SW1
SW2
SW3
SW4
/INT1
/INT2
/LP_FAIL
/INTCLK
QD4C
XCLK
INPUT
CLK
OUTPUT
IN1
IN2
IN3
IN4
BP600
QD9
QD3A
74HC14
QD5D
C201
C202
C203
C204
C205
C206
C207
C208
C209
C210
C251
100n
47u
6V3
RE TECHNOLOGY AS
RDS DATA CODEC, RE 650
MODULATOR BOARD
Title
FRONTPLATE CTRL CIRCUIT
Size
B
Document Number
902-100 971-518 985-463
REV
3c
Date: October 28, 1993
Sheet 2 of 6


XCLK
SCLK
DEMCLK
+15V
+5V
TP1
JP5
L11
470u
C254
10u 25V
C22
100n
C21
10n
C23
22p
C24
2n2
R8
47K
R16
1K0
R17
1K0
R18
22E
JP4
QD11A
74HC74
QD3B
74HC14
R10
1K
R11
22K
R12
10K
R13
100E
R14
470E
R15
120K
R19
1K
R20
15K
R21
1K
R22
68K
C25
10n
C26
33p
C27
100n
C28
150p
C29
220p
Q1
BC547
Q2
BC547
Y1
10.9296MHz
C32
10-60p
R23
47K
R24
47K
/BR
C[0..6]
CTRL[0..6]
A[0..13]
ADDR[0..13]
D[0..23]
DATA[0..23]
C30
27p
C31
27p
Y2
10MHz
QD13
ADSP-2101
/INT1
/INT2
/INTCLK
QD12A
74HCT11
LE
DL
DR
/BMS
/PMS
/IOMS
/RD
/WR
CLKOUT
/RESET
QD14
27C512
JP6
JP7
JP8
R27
47K
R25
47K
R28
47K
R29
47K
R26
47K
R128
2K2
RESET
SW5
QD15
MAX699
C33
100n
WD_I
WD ENABLE
JP9
/MODU_RST
TP8
QD12B
74HCT11
QD12C
74HCT11
R126
47K
C211
100n
C213
100n
C214
100n
C215
100n
C252
47u
6V3
QD11B
74HC74
RE TECHNOLOGY AS
RDS DATA CODEC, RE 650
MODULATOR BOARD
Title
DSP MODUL
Size
B
Document Number
902-100 971-518 985-463
REV
3c
Date:
October 28, 1993
Sheet 3 of 6



RR TECHNOLOGY AS		
RDS DATA CODEC, RR 650		
MODULATOR BOARD		
Title: UART CIRCUIT		
Size: B	Document Number: 902-100 971-518 985-463	REV: 3c
Date: October 28, 1993	Sheet 4 of 6	



RE TECHNOLOGY AS

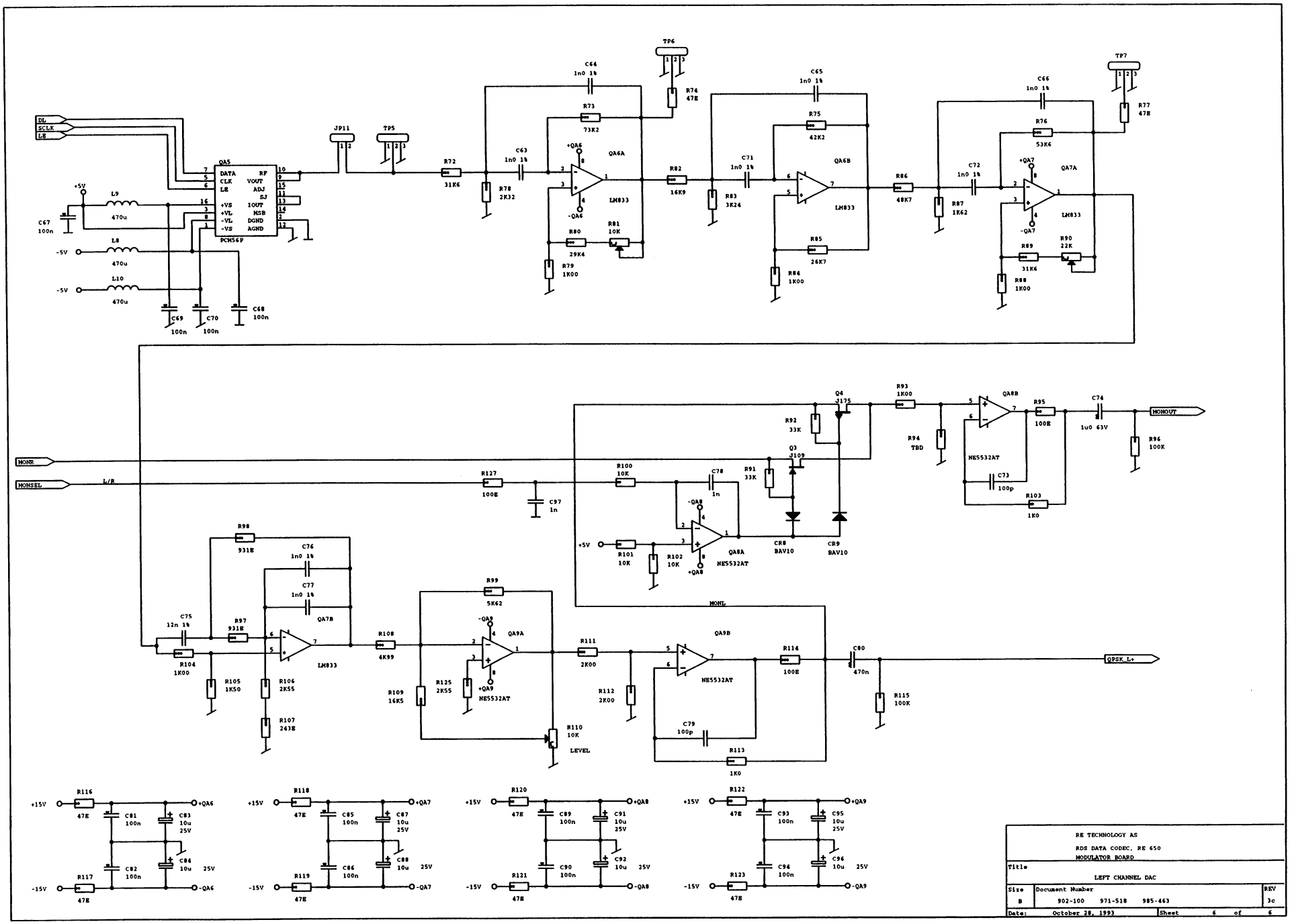
RDS DATA CODEC, RE 650

MODULATOR BOARD

Title

RIGHT CHANNEL DAC

Size	Document Number	REV
B	902-100 971-518 985-463	3c
Date: October 28, 1993	Sheet 5 of 6	



RE TECHNOLOGY AS

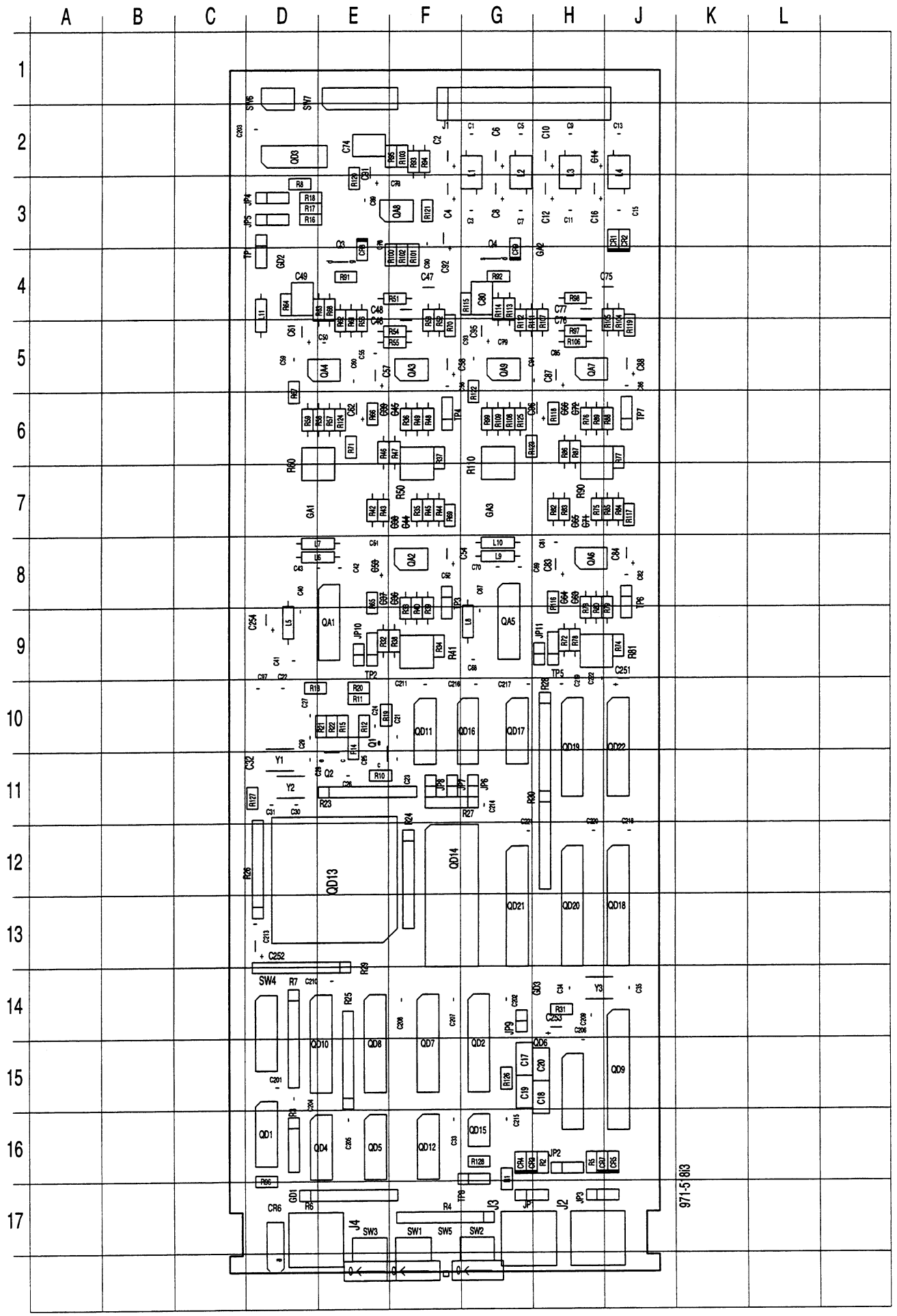
RDS DATA CODEC, RE 650

MODULATOR BOARD

Title: LEFT CHANNEL DAC

Size	Document Number	REV
B	902-100 971-518 985-463	3c

Date: October 28, 1993 Sheet 6 of 6


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
971-5 813

COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	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	J3	C41	D9	C90	F4	JP11	H9	Q3	E3	R49	F6	R98	H4																								
CR2	J3	C42	E8	C91	E2	J1	F2	Q4	G3	R50	F7	R99	G6																								
CR3	G16	C43	D8	C92	F4	J2	H17	R1	G16	R51	F4	R100	F4																								
CR4	G16	C44	F7	C93	G5	J3	G17	R2	H16	R52	F5	R101	F4																								
CR5	J16	C45	F6	C94	G5	J4	E17	R3	D16	R53	F5	R102	F4																								
CR6	D17	C46	E5	C95	G5	L1	G2	R4	F17	R54	F5	R103	F2																								
CR7	H16	C47	F4	C96	G6	L2	G2	R5	H16	R55	F5	R104	J5																								
CR8	E4	C48	E4	C97	D9	L3	H2	R6	D17	R56	E5	R105	J5																								
CR9	G4	C49	D4	C201	D15	L4	J2	R7	D14	R57	E6	R106	H5																								
C1	G2	C50	E5	C202	G14	L5	D9	R8	D3	R58	E6	R107	H5																								
C2	F2	C51	E8	C203	C2	L6	E8	R10	E11	R59	D6	R108	G6																								
C3	G3	C52	F8	C204	D15	L7	E8	R11	E10	R60	D7	R109	G6																								
C4	F3	C53	E8	C205	E16	L8	G9	R12	E10	R61	E5	R110	G7																								
C5	G2	C54	G8	C206	H14	L9	G8	R13	D10	R62	E5	R111	G5																								
C6	G2	C55	E5	C207	F14	L10	G8	R14	E10	R63	E4	R112	G5																								
C7	G3	C56	G5	C208	F14	L11	D4	R15	E10	R64	D4	R113	G4																								
C8	G3	C57	E5	C209	H14	QA1	E9	R16	D3	R65	E8	R114	G4																								
C9	H2	C58	G5	C210	D14	QA2	F8	R17	D3	R66	E6	R115	G4																								
C10	H2	C59	D5	C211	F10	QA3	F5	R18	D3	R67	D6	R116	H8																								
C11	H3	C60	E5	C213	D13	QA4	E5	R19	E10	R68	E4	R117	J7																								
C12	H3	C61	D5	C214	G11	QA5	G9	R20	E10	R69	F7	R118	H6																								
C13	J2	C62	E6	C215	G16	QA6	H8	R21	E10	R70	F5	R119	J5																								
C14	H2	C63	H8	C216	F10	QA7	H5	R22	E10	R71	E6	R120	E3																								
C15	J3	C64	H8	C217	G10	QA8	F3	R23	E11	R72	H9	R121	F3																								
C16	H3	C65	H7	C218	J11	QA9	G5	R24	F11	R73	H9	R122	G6																								
C17	G15	C66	H6	C219	H10	QD1	D16	R25	E14	R74	J9	R123	G6																								
C18	H15	C67	G8	C220	H11	QD2	G15	R26	D12	R75	H7	R124	E6																								
C19	G15	C68	G9	C221	G11	QD3	D2	R27	G11	R76	H6	R125	G6																								
C20	H15	C69	H8	C222	H9	QD4	E16	R28	H10	R77	J6	R126	G15																								
C21	F10	C70	G8	C251	J9	QD5	E16	R29	E14	R78	H9	R127	D11																								
C22	D9	C71	H7	C252	D13	QD6	H15	R30	G11	R79	J9	R128	G16																								
C23	F11	C72	H6	C253	H14	QD7	F15	R31	H14	R80	H9	SW1	F17																								
C24	E10	C73	F3	C254	D9	QD8	E15	R32	E9	R81	J9	SW2	G17																								
C25	E11	C74	E2	GA1	D7	QD9	J15	R33	F9	R82	H7	SW3	E17																								
C26	E11	C75	J4	GA2	H4	QD10	E15	R34	F9	R83	H7	SW4	D14																								
C27	D10	C76	H5	GA3	G7	QD11	F10	R35	F7	R84	J7	SW5	F17																								
C28	E11	C77	H4	GD1	D17	QD12	F16	R36	F6	R85	J7	SW6	D2																								
C29	D10	C78	E3	GD2	D4	QD13	E12	R37	F6	R86	H6	SW7	D2																								
C30	D11	C79	G5	GD3	H14	QD14	F12	R38	F9	R87	H6	TP1	D4																								
C31	D11	C80	G4	JP1	G17	QD15	G16	R39	F9	R88	J6	TP2	E9																								
C32	D11	C81	H8	JP2	H16	QD16	G10	R40	F9	R89	H6	TP3	F8																								
C33	F16	C82	J8	JP3	H17	QD17	G10	R41	F9	R90	H7	TP4	F6																								
C34	H14	C83	H8	JP4	D3	QD18	J13	R42	E7	R91	E4	TP5	H9																								
C35	J14	C84	J8	JP5	D3	QD19	H10	R43	E7	R92	G4	TP6	J8																								
C36	F8	C85	H5	JP6	G11	QD20	H13	R44	F7	R93	F2	TP7	J6																								
C37	E8	C86	J5	JP7	G11	QD21	G13	R45	F7	R94	F2	TP8	G17																								
C38	F7	C87	H5	JP8	F11	QD22	J10	R46	E6	R95	F2	Y1	D11																								
C39	E6	C88	J5	JP9	G14	Q1	E10	R47	F6	R96	D16	Y2	D11																								
C40	D8	C89	E3	JP10	E9	Q2	E11	R48	F6	R97	H5	Y3	H14																								

COMPONENT SIDE 971-518i3

PCB Assy RE 650 Modulator (902-100)

CAPACITORS

C 1	C Ceramic 100n 20% 50V	213-401
C 2	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 3	C Ceramic 100n 20% 50V	213-401
C 4	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 5	C Ceramic 100n 20% 50V	213-401
C 6	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 7	C Ceramic 100n 20% 50V	213-401
C 8	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 9	C Ceramic 100n 20% 50V	213-401
C 10	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 11	C Ceramic 100n 20% 50V	213-401
C 12	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 13	C Ceramic 100n 20% 50V	213-401
C 14	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 15	C Ceramic 100n 20% 50V	213-401
C 16	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 17	MKT, 0.22/63/10, R:3.5*8*7.2, RM2	241-071
C 18	MKT, 0.22/63/10, R:3.5*8*7.2, RM2	241-071
C 19	MKT, 0.22/63/10, R:3.5*8*7.2, RM2	241-071
C 20	MKT, 0.22/63/10, R:3.5*8*7.2, RM2	241-071
C 22	C Ceramic 100n 20% 50V	213-401
C 23	C Ceramic 22p0 2% 100V NP0	213-206
C 24	MKT, 0.0022/63/10, R:2.5*6.5*7.2, RM2	241-091
C 26	C Ceramic 33p0 2% 100V NP0	213-208
C 27	C Ceramic 100n 20% 50V	213-401
C 28	C Ceramic 150p 2% 100V N750	213-212
C 29	C Ceramic 220p 2% 100V N750	213-218
C 30	C Ceramic 27p0 2% 100V NP0	213-207
C 31	C Ceramic 27p0 2% 100V NP0	213-207
C 32	C Var. 10-60p hor	286-007
C 33	C Ceramic 100n 20% 50V	213-401
C 34	C Ceramic 22p0 2% 100V NP0	213-206
C 35	C Ceramic 22p0 2% 100V NP0	213-206
C 36	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 37	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 38	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 39	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 40	C Ceramic 100n 20% 50V	213-401
C 41	C Ceramic 100n 20% 50V	213-401
C 42	C Ceramic 100n 20% 50V	213-401
C 43	C Ceramic 100n 20% 50V	213-401
C 44	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 45	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 46	C Ceramic 1n0 1% 50V NPO RM2	213-621

C 47	C Ceramic 12n 1% 50V NPO RM2	213-631
C 48	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 49	MKT, 0.47/63/10, R:4.5*9*7.2, RM2	241-073
C 50	C Ceramic 100p 2% 100V NP0	213-211
C 51	C Ceramic 100n 20% 50V	213-401
C 52	C Ceramic 100n 20% 50V	213-401
C 53	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 54	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 55	C Ceramic 100n 20% 50V	213-401
C 56	C Ceramic 100n 20% 50V	213-401
C 57	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 58	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 59	C Ceramic 100n 20% 50V	213-401
C 60	C Ceramic 100n 20% 50V	213-401
C 61	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 62	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 63	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 64	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 65	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 66	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 67	C Ceramic 100n 20% 50V	213-401
C 68	C Ceramic 100n 20% 50V	213-401
C 69	C Ceramic 100n 20% 50V	213-401
C 70	C Ceramic 100n 20% 50V	213-401
C 71	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 72	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 73	C Ceramic 100p 2% 100V NP0	213-211
C 74	MKT, 1/63/10, R:6*11.5*7.2, RM2	241-064
C 75	C Ceramic 12n 1% 50V NPO RM2	213-631
C 76	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 77	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 78	C Ceramic 1n 5% NP0 63V	213-616
C 79	C Ceramic 100p 2% 100V NP0	213-211
C 80	MKT, 0.47/63/10, R:4.5*9*7.2, RM2	241-073
C 81	C Ceramic 100n 20% 50V	213-401
C 82	C Ceramic 100n 20% 50V	213-401
C 83	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 84	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 85	C Ceramic 100n 20% 50V	213-401
C 86	C Ceramic 100n 20% 50V	213-401
C 87	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 88	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 89	C Ceramic 100n 20% 50V	213-401
C 90	C Ceramic 100n 20% 50V	213-401
C 91	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 92	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 93	C Ceramic 100n 20% 50V	213-401
C 94	C Ceramic 100n 20% 50V	213-401

C 95	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 96	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 97	C Ceramic 1n 5% NP0 63V	213-616
C 201	C Ceramic 100n 20% 50V	213-401
C 202	C Ceramic 100n 20% 50V	213-401
C 203	C Ceramic 100n 20% 50V	213-401
C 204	C Ceramic 100n 20% 50V	213-401
C 205	C Ceramic 100n 20% 50V	213-401
C 206	C Ceramic 100n 20% 50V	213-401
C 207	C Ceramic 100n 20% 50V	213-401
C 208	C Ceramic 100n 20% 50V	213-401
C 209	C Ceramic 100n 20% 50V	213-401
C 210	C Ceramic 100n 20% 50V	213-401
C 211	C Ceramic 100n 20% 50V	213-401
C 213	C Ceramic 100n 20% 50V	213-401
C 214	C Ceramic 100n 20% 50V	213-401
C 215	C Ceramic 100n 20% 50V	213-401
C 216	C Ceramic 100n 20% 50V	213-401
C 217	C Ceramic 100n 20% 50V	213-401
C 218	C Ceramic 100n 20% 50V	213-401
C 219	C Ceramic 100n 20% 50V	213-401
C 220	C Ceramic 100n 20% 50V	213-401
C 221	C Ceramic 100n 20% 50V	213-401
C 222	C Ceramic 100n 20% 50V	213-401
C 251	C Solid Aluminium 47u 20% 6V3 Short Type	265-106
C 252	C Solid Aluminium 47u 20% 6V3 Short Type	265-106
C 253	C Solid Aluminium 47u 20% 6V3 Short Type	265-106
C 254	C Solid Aluminium 10u 20% 25V Short Type	265-110

DIODES

CR 1	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 2	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 3	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 4	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 5	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 6	LED stack unit single, 3mm green	350-816
CR 7	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 8	Diode BAV10 Si Vr-60V If-600mA	350-022
CR 9	Diode BAV10 Si Vr-60V If-600mA	350-022

CONNECTORS

J 1	DIN 41612 48 pol male 90ø with coding, C/2 class II	806-190
J 2	Angle Bnc Jack For Printed Circuin Board 50E	800-524
J 3	Angle Bnc Jack For Printed Circuin Board 50E	800-524
J 4	Angle Bnc Jack For Printed Circuin Board 50E	800-524

RELAYS & JUMPERS

JP 1	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 2	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 3	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 4	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 5	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 6	Pin header 2 pol straight l:6.7mm with lock	805-951
JP 7	Pin header 2 pol straight l:6.7mm with lock	805-951
JP 8	Pin header 2 pol straight l:6.7mm with lock	805-951
JP 9	Pin header 2 pol straight l:6.7mm with lock	805-951
JP 10	Pin header 2 pol straight l:6.7mm with lock	805-951
JP 11	Pin header 2 pol straight l:6.7mm with lock	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
L 4	RF-choke six-hole core green	731-204
L 5	Choke HF Mini 470uH 10% 124MA	703-014
L 6	Choke HF Mini 470uH 10% 124MA	703-014
L 7	Choke HF Mini 470uH 10% 124MA	703-014
L 8	Choke HF Mini 470uH 10% 124MA	703-014
L 9	Choke HF Mini 470uH 10% 124MA	703-014
L 10	Choke HF Mini 470uH 10% 124MA	703-014
L 11	Choke HF Mini 470uH 10% 124MA	703-014

TRANSISTORS

Q 1	Transistor BC547B npn	360-159
Q 2	Transistor BC547B npn	360-159
Q 3	Transistor J109-18 n Fet	360-188
Q 4	Transistor J175-18 p jfet	360-252

INTEGRATED ANALOG CIRCUITS

QA 1	IC PCM56P-K Digital-To-Analog Converter	365-003
QA 2	IC LM833N Dual Low Noise OPamp	365-037
QA 3	IC LM833N Dual Low Noise OPamp	365-037
QA 4	IC NE5532A Dual OP-Amp low noise	364-640
QA 5	IC PCM56P-K Digital-To-Analog Converter	365-003
QA 6	IC LM833N Dual Low Noise OPamp	365-037
QA 7	IC LM833N Dual Low Noise OPamp	365-037
QA 8	IC NE5532A Dual OP-Amp low noise	364-640
QA 9	IC NE5532A Dual OP-Amp low noise	364-640

INTEGRATED DIGITAL CIRCUITS

QD 1	IC 74HC00 quad 2-input NAND gate	364-807
QD 2	IC 74HC273 Octal D-FF.	364-574
QD 3	IC 74HC14 Hex inv. Schmitt Trig	364-800
QD 4	IC 74HC00 quad 2-input NAND gate	364-807
QD 5	IC 74AC32 quad OR gate	364-864
QD 6	IC LT1181 5V RS232 Dual Driver Rec.W.Small Cap	365-190
QD 7	IC 74HC541 Octal buffer/line driver	364-781
QD 8	IC 74HC541 Octal buffer/line driver	364-781
QD 9	RE650 Prog EP610 902-100 QD02 Modulator	369-371
QD 10	IC 74HC541 Octal buffer/line driver	364-781
QD 11	IC 74HC74P dual d ff	364-755
QD 12	IC 74HCT11 triple 3-input and gate	364-683
QD 13	IC ADSP2101KP-40 C-Mos Signal Process Plcc 40MHz	365-143
QD 14	RE650 Prog Eprom 902-100 QD14 Modulator(RS232/Remote)	368-465
QD 15	IC MAX699 Power ON Reset And Watchdog	365-144
QD 16	IC 74AC74 dual D ff	364-795
QD 17	IC 74AC32 quad OR gate	364-864
QD 18	IC SCC2691 UART	364-882
QD 19	IC 74HCT574P octal d ff	364-716
QD 20	IC SCC2691 UART	364-882
QD 21	IC SCC2691 UART	364-882
QD 22	IC 74HC541 Octal buffer/line driver	364-781

RESISTORS

R 1	R Metal Film 100E 5% 0.2W TC250	107-310
R 2	R Metal Film 47K0 5% 0.2W TC250	107-547
R 3	Thick Film DIL 4*390E 2% 0.125W TC100	146-035
R 4	Thick Film SIL 8*47K	146-005
R 5	R Metal Film 100E 5% 0.2W TC250	107-310
R 6	Thick Film SIL 8*47K	146-005
R 7	Thick Film SIL 8*47K	146-005
R 8	R Metal Film 47K0 5% 0.2W TC250	107-547
R 10	R Metal Film 1K00 5% 0.2W TC250	107-410
R 11	R Metal Film 22K0 5% 0.2W TC250	107-522
R 12	R Metal Film 10K0 5% 0.2W TC250	107-510
R 13	R Metal Film 100E 5% 0.2W TC250	107-310
R 14	R Metal Film 470E 5% 0.2W TC250	107-347
R 15	R Metal Film 120K 5% 0.2W TC250	107-612
R 16	R Metal Film 1K00 5% 0.2W TC250	107-410
R 17	R Metal Film 1K00 5% 0.2W TC250	107-410
R 18	R Metal Film 22E0 5% 0.2W TC250	107-222
R 19	R Metal Film 1K00 5% 0.2W TC250	107-410
R 20	R Metal Film 15K0 5% 0.2W TC250	107-515
R 21	R Metal Film 1K00 5% 0.2W TC250	107-410
R 22	R Metal Film 68K0 5% 0.2W TC250	107-568

R 23	Thick Film SIL 8*47K	146-005
R 24	Thick Film SIL 8*47K	146-005
R 25	Thick Film SIL 8*47K	146-005
R 26	Thick Film SIL 8*47K	146-005
R 27	Thick Film SIL 4*47K 5% 0.1W	146-018
R 28	Thick Film SIL 8*47K	146-005
R 29	Thick Film SIL 8*47K	146-005
R 30	Thick Film SIL 8*47K	146-005
R 31	R Metal Film 47K0 5% 0.2W TC250	107-547
R 32	R Metal Film 31K6 1% 0.5W TC50	115-316
R 33	R Metal Film 73K2 1% 0.5W TC50	115-732
R 34	R Metal Film 47E0 5% 0.2W TC250	107-247
R 35	R Metal Film 42K2 1% 0.5W TC50	115-422
R 36	R Metal Film 53K6 1% 0.5W TC50	115-536
R 37	R Metal Film 47E0 5% 0.2W TC250	107-247
R 38	R Metal Film 2K32 1% 0.4W TC50	114-232
R 39	R Metal Film 1K00 1% 0.5W TC50	114-100
R 40	R Metal Film 29K4 1% 0.5W TC50	115-294
R 41	Cermet Trimpot 10K 20% 0.5W TC70	182-301
R 42	R Metal Film 16K9 1% 0.5W TC50	115-169
R 43	R Metal Film 3K24 1% 0.5W TC50	114-324
R 44	R Metal Film 1K00 1% 0.5W TC50	114-100
R 45	R Metal Film 26K7 1% 0.4W TC50	115-267
R 46	R Metal Film 48K7 1% 0.5W TC50	115-487
R 47	R Metal Film 1K62 1% 0.5W TC50	114-162
R 48	R Metal Film 1K00 1% 0.5W TC50	114-100
R 49	R Metal Film 31K6 1% 0.5W TC50	115-316
R 50	Cermet Trimpot 22K 20% 0.3W TC70	182-303
R 51	R Metal Film 931E 1% 0.5W TC50	113-931
R 52	R Metal Film 1K00 1% 0.5W TC50	114-100
R 53	R Metal Film 1K50 1% 0.5W TC50	114-150
R 54	R Metal Film 931E 1% 0.5W TC50	113-931
R 55	R Metal Film 2K55 1% 0.5W TC50	114-255
R 56	R Metal Film 243E 1% 0.5W TC50	113-243
R 57	R Metal Film 4K99 1% 0.5W TC50	114-499
R 58	R Metal Film 16K5 1% 0.4W TC50	115-165
R 59	R Metal Film 5K62 1% 0.5W TC50	114-562
R 60	Cermet Trimpot 10K 20% 0.5W TC70	182-301
R 61	R Metal Film 2K00 1% 0.5W TC50	114-200
R 62	R Metal Film 2K00 1% 0.5W TC50	114-200
R 63	R Metal Film 100E 1% 0.5W TC50	113-100
R 64	R Metal Film 100K 5% 0.2W TC250	107-610
R 65	R Metal Film 22E0 5% 0.2W TC250	107-222
R 66	R Metal Film 22E0 5% 0.2W TC250	107-222
R 67	R Metal Film 22E0 5% 0.2W TC250	107-222
R 68	R Metal Film 1K00 1% 0.5W TC50	114-100
R 69	R Metal Film 22E0 5% 0.2W TC250	107-222
R 70	R Metal Film 22E0 5% 0.2W TC250	107-222

R 71	R Metal Film 22E0 5% 0.2W TC250	107-222
R 72	R Metal Film 31K6 1% 0.5W TC50	115-316
R 73	R Metal Film 73K2 1% 0.5W TC50	115-732
R 74	R Metal Film 47E0 5% 0.2W TC250	107-247
R 75	R Metal Film 42K2 1% 0.5W TC50	115-422
R 76	R Metal Film 53K6 1% 0.5W TC50	115-536
R 77	R Metal Film 47E0 5% 0.2W TC250	107-247
R 78	R Metal Film 2K32 1% 0.4W TC50	114-232
R 79	R Metal Film 1K00 1% 0.5W TC50	114-100
R 80	R Metal Film 29K4 1% 0.5W TC50	115-294
R 81	Cermet Trimpot 10K 20% 0.5W TC70	182-301
R 82	R Metal Film 16K9 1% 0.5W TC50	115-169
R 83	R Metal Film 3K24 1% 0.5W TC50	114-324
R 84	R Metal Film 1K00 1% 0.5W TC50	114-100
R 85	R Metal Film 26K7 1% 0.4W TC50	115-267
R 86	R Metal Film 48K7 1% 0.5W TC50	115-487
R 87	R Metal Film 1K62 1% 0.5W TC50	114-162
R 88	R Metal Film 1K00 1% 0.5W TC50	114-100
R 89	R Metal Film 31K6 1% 0.5W TC50	115-316
R 90	Cermet Trimpot 22K 20% 0.3W TC70	182-303
R 91	R Metal Film 33K0 5% 0.2W TC250	107-533
R 92	R Metal Film 33K0 5% 0.2W TC250	107-533
R 93	R Metal Film 1K00 1% 0.5W TC50	114-100
R 95	R Metal Film 100E 5% 0.2W TC250	107-310
R 96	R Metal Film 100K 5% 0.2W TC250	107-610
R 97	R Metal Film 931E 1% 0.5W TC50	113-931
R 98	R Metal Film 931E 1% 0.5W TC50	113-931
R 99	R Metal Film 5K62 1% 0.5W TC50	114-562
R 100	R Metal Film 10K0 5% 0.2W TC250	107-510
R 101	R Metal Film 10K0 5% 0.2W TC250	107-510
R 102	R Metal Film 10K0 5% 0.2W TC250	107-510
R 103	R Metal Film 1K00 5% 0.2W TC250	107-410
R 104	R Metal Film 1K00 1% 0.5W TC50	114-100
R 105	R Metal Film 1K50 1% 0.5W TC50	114-150
R 106	R Metal Film 2K55 1% 0.5W TC50	114-255
R 107	R Metal Film 243E 1% 0.5W TC50	113-243
R 108	R Metal Film 4K99 1% 0.5W TC50	114-499
R 109	R Metal Film 16K5 1% 0.4W TC50	115-165
R 110	Cermet Trimpot 10K 20% 0.5W TC70	182-301
R 111	R Metal Film 2K00 1% 0.5W TC50	114-200
R 112	R Metal Film 2K00 1% 0.5W TC50	114-200
R 113	R Metal Film 1K00 1% 0.5W TC50	114-100
R 114	R Metal Film 100E 1% 0.5W TC50	113-100
R 115	R Metal Film 100K 5% 0.2W TC250	107-610
R 116	R Metal Film 47E0 5% 0.2W TC250	107-247
R 117	R Metal Film 47E0 5% 0.2W TC250	107-247
R 118	R Metal Film 47E0 5% 0.2W TC250	107-247
R 119	R Metal Film 47E0 5% 0.2W TC250	107-247

R 120	R Metal Film 47E0 5% 0.2W TC250	107-247
R 121	R Metal Film 47E0 5% 0.2W TC250	107-247
R 122	R Metal Film 47E0 5% 0.2W TC250	107-247
R 123	R Metal Film 47E0 5% 0.2W TC250	107-247
R 124	R Metal Film 2K55 1% 0.5W TC50	114-255
R 125	R Metal Film 2K55 1% 0.5W TC50	114-255
R 126	R Metal Film 47K0 5% 0.2W TC250	107-547
R 127	R Metal Film 100E 5% 0.2W TC250	107-310
R 128	R Metal Film 2K20 5% 0.2W TC250	107-422

TEST POINTS

TP 1	Pin header 3 pol straight l:6.7mm with lock	805-894
TP 2	Pin header 3 pol straight l:6.7mm with lock	805-894
TP 3	Pin header 3 pol straight l:6.7mm with lock	805-894
TP 4	Pin header 3 pol straight l:6.7mm with lock	805-894
TP 5	Pin header 3 pol straight l:6.7mm with lock	805-894
TP 6	Pin header 3 pol straight l:6.7mm with lock	805-894
TP 7	Pin header 3 pol straight l:6.7mm with lock	805-894
TP 8	Pin header 3 pol straight l:6.7mm with lock	805-894

CRYSTALS

Y 1	Quarts Crystal 10.9296MHz 20ppm	910-247
Y 2	Quarts Crystal 10MHz +-100 ppm	910-238
Y 3	Quarts Crystal 3,6864MHz +-100ppm	910-206

MISCELLANEOUS

Turbular Rivet B •2.3*0.25*3.6		060-312
C Ceramic 10n0 -20+80% 63V		213-020
DIN 41612 Access, coding key for Winchester Type		806-192
Plate Spring 7.5x15x0.1		878-087
PCB For RE650 Modulutor		971-518
GA 1	Solder Terminal 0.1 O2	823-303
GA 2	Solder Terminal 0.1 O2	823-303
GA 3	Solder Terminal 0.1 O2	823-303
GD 1	Solder Terminal 0.1 O2	823-303
GD 2	Solder Terminal 0.1 O2	823-303
GD 3	Solder Terminal 0.1 O2	823-303
J1S	Tubular Rivet 2.5X10	060-310
JP10S	Female Plug	805-718
JP11S	Female Plug	805-718
JP1S	Female Plug	805-718
JP2S	Female Plug	805-718
JP3S	Female Plug	805-718
JP4S	Female Plug	805-718
JP5S	Female Plug	805-718

JP9S	Female Plug	805-718
QD13S	Socket PLCC 68 pol	816-305
QD14S	Socket DIL 28 pol, h:4.95	816-251
QD6S	Socket DIL 16 pol, h:4.95 300mil	816-133
QD9S	Socket DIL 24 pol, h:4.95 300mil	816-274
SW 1	HEX switch angled	547-004
SW 2	HEX switch angled	547-004
SW 3	HEX switch angled	547-004
SW 4	Dil switch 1x8 pol piano type	547-901
SW 5	Switch Ultra Miniature Pushbottom SPDT	551-170
SW 6	Dil switch 4 bit 90ø	547-010
SW 7	Dil switch 1x8 pol piano type	547-901
Y1S	Isolating Plate F.Crystal	816-287
Y2S	Isolating Plate F.Crystal	816-287
Y3S	Isolating Plate F.Crystal	816-287

8. RE 650 Low-pass Filter

8.1 Circuit Description

Fig. 8.1 shows a block diagram of the RE 650 Low-pass Filter.

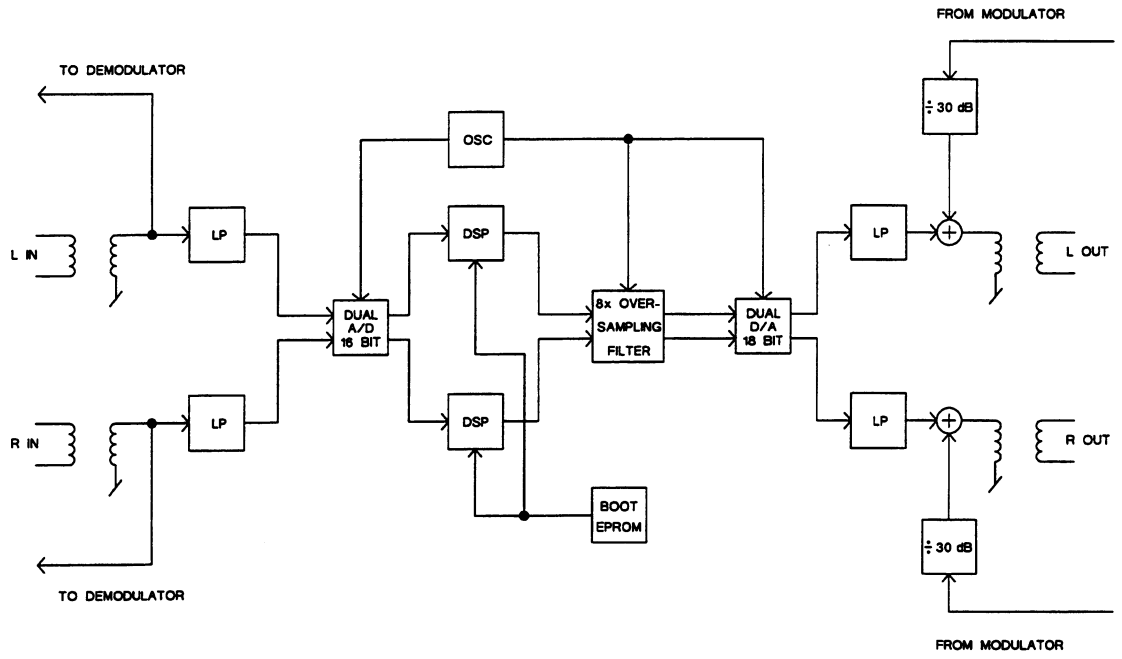


Fig. 8.1 Block Diagram of RE 650 Low-pass Filter

To achieve a very steep low-pass filter, digital signal processors (DSP) are used. An ADSP2105, 10 MHz DSP is used for each channel.

The hardware is the same for the RE 650 and RE 651. The only difference is the characteristics of the digital filter stored in the EPROM. In the following, all references in parenthesis are for the right channel. The input stage is made out of module QA1 (QA5) which contains the input transformer.

The signal is fed to the demodulator. The signal is fed through an analog anti-aliasing low-pass filter built with R7 and C22 (R28 and C44) to a dual 16-bit sigma-delta A/D Converter, sampling frequency 32 kHz. Using a sigma-delta converter (QD1), the anti-aliasing filter can be made without introducing any phase-non-linearities which otherwise would have implied a none constant group-delay. The left and right samples are fed serially to two DSPs. QD2 takes care of the left channel while QD3 takes care of the right channel. Each DSP makes the necessary filtering (tap long FIR-filter) and outputs the samples to an 8 times oversampling filter, QD18. In this way the

reconstruction low-pass filter can be optimized regarding minimum phase-variation since the first unwanted spectrum lies around 128 kHz ± 16 kHz. After the 18-bit dual D/A Converter (QA9), the signal is passed the reconstruction low-pass filter. This is a 5th order Bessel filter with a cut-off frequency of 15 kHz. The digital FIR-filter compensates for the attenuation of the Bessel-filter. The attenuation is -0.64 dB @ 14.5 kHz. After the Bessel-filter the QPSK signals from the modulator is attenuated -30 dB and added to the signal before it is fed to the output transformers. These are shown here although physically they are placed on the power supply board on the rear panel of the equipment.

The PAL QD16 makes the necessary control signals for the serial transfers from A/D Converter to the DSPs (L/R, TFSL and TFSR) and from DSPs to D/A Converter (L/R, RFSL and RFSR). The other task of this PAL is to see if both DSPs are continuosly reading the hexagonal switches SW1 and SW2. If they do, the counter QD14 is reset and this watchdog does not reset everything. If just one DSP is not reading the attached hexagonal switch, the counter reaches a state where pin 3 is high, which implies that everything is stopped, and an error message is sent to the power supply board and to the modulator or the demodulator via the /LPFAIL signal. On the power supply this implies that the bypass function is activated. The low-pass filter only starts again if the power is turned off and on again, or if the RESET switch (SW3) is activated on the front panel. /RESET always stays low if the watchdog counter QD14 runs out, because a low /RESET stops the ACLKA signal from the A/D Converter QD1. When ACLKA stops, SCLK also stops; then the L/R signal stops and this is the clock for QD14.

The DSPs adjust the clipping level using of a 12-bit multiplying D/A Converter QA3 (QA7) before the A/D Converter and another QA11 (QA15) after the D/A Converter. If the clipping level is set to 15 dBu, QA3 (QA7) is set to -15 dB attenuation and QA11 (QA15) is set to 0 dB. If the clipping level is set to 0 dB, the attenuation is exactly the opposite. The interface is serial (clock, data and latch) and only active if the clipping level is changed on the front panel. Together with the filtering of these digital connections, the digital part of the system can disturb the analog part.

Each DSP has an 8-bit output port, QD7 (QD10), with which it can control the multiplying D/A Converters and the overload LEDs. Furthermore, the DSP uses this register to acknowledge that it has booted with success. The DSP does this by pulling pin 15 to a high state. As can be seen from the diagram, the signal /LPFAIL only indicates OK if both DSPs have acknowledged after power up or reset.

Both DSPs read its hexagonal switch every 51 ms so it can adjust the multiplying D/A Converters accordingly.

Since both DSPs run exactly the same program, the design is made so that they boot simultaneously from one EPROM and only one DSP (QD2) supplies the address information to the EPROM. This only works because both DSPs use the same system clock and the /RESET-pulse is synchronized to this clock. QD13 takes care of this. The buffer QD8 connects the data buses during boot and disconnects them during normal operation.

8.2 Schematic Diagram

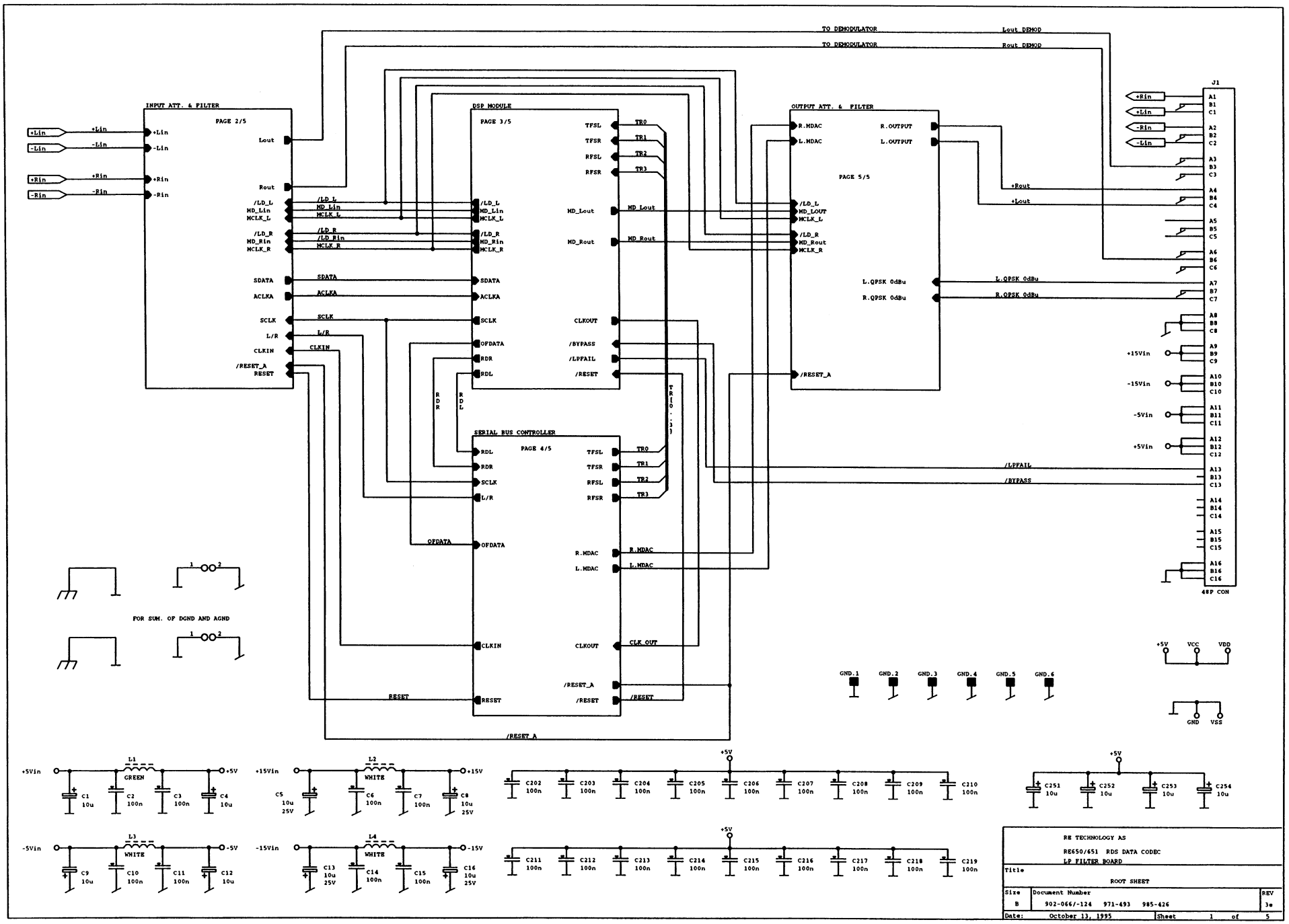
The schematic diagram for the RE 650 Low-pass Filter is located in the following. The diagram number is 985-426.

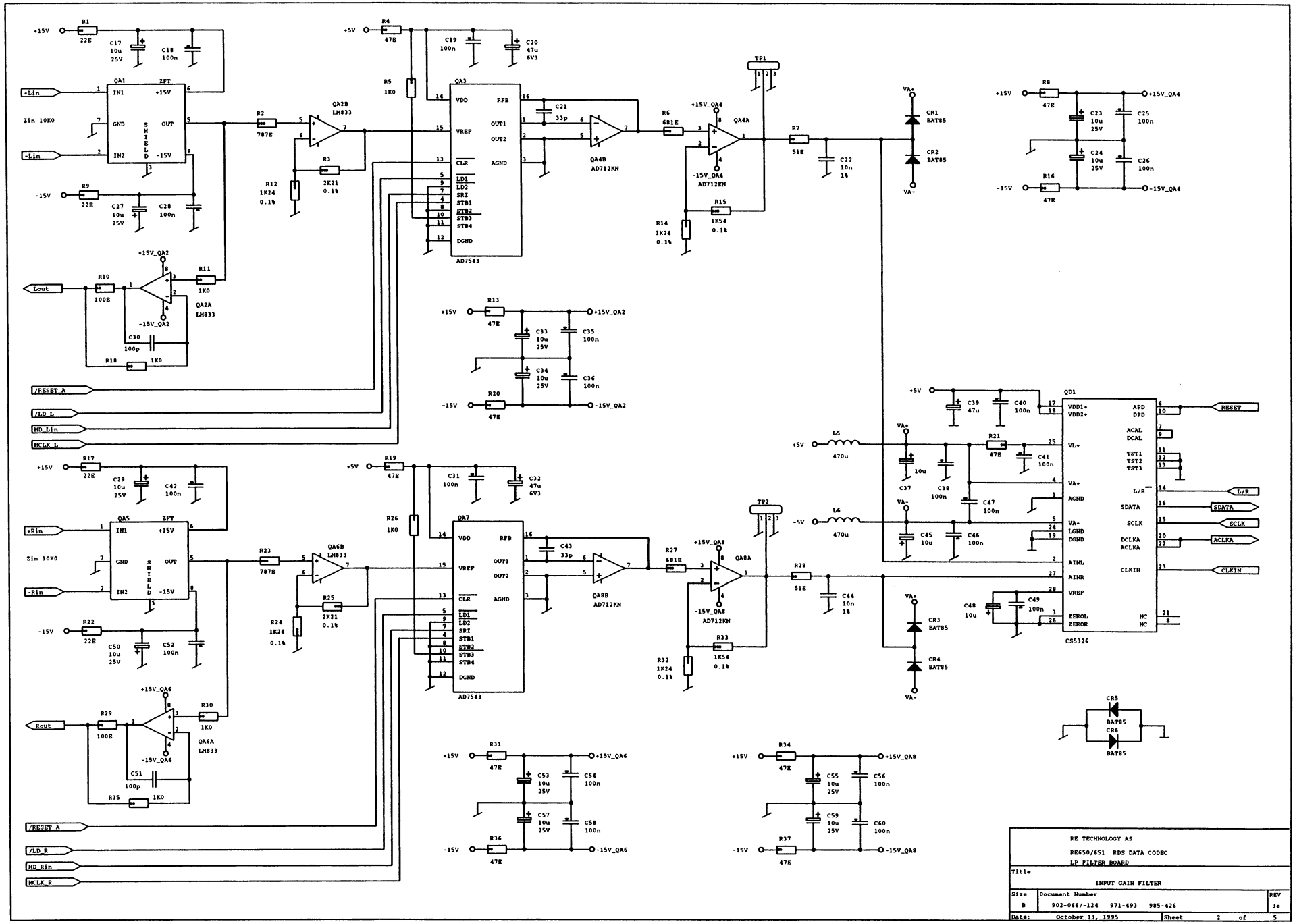
8.3 Component Locations

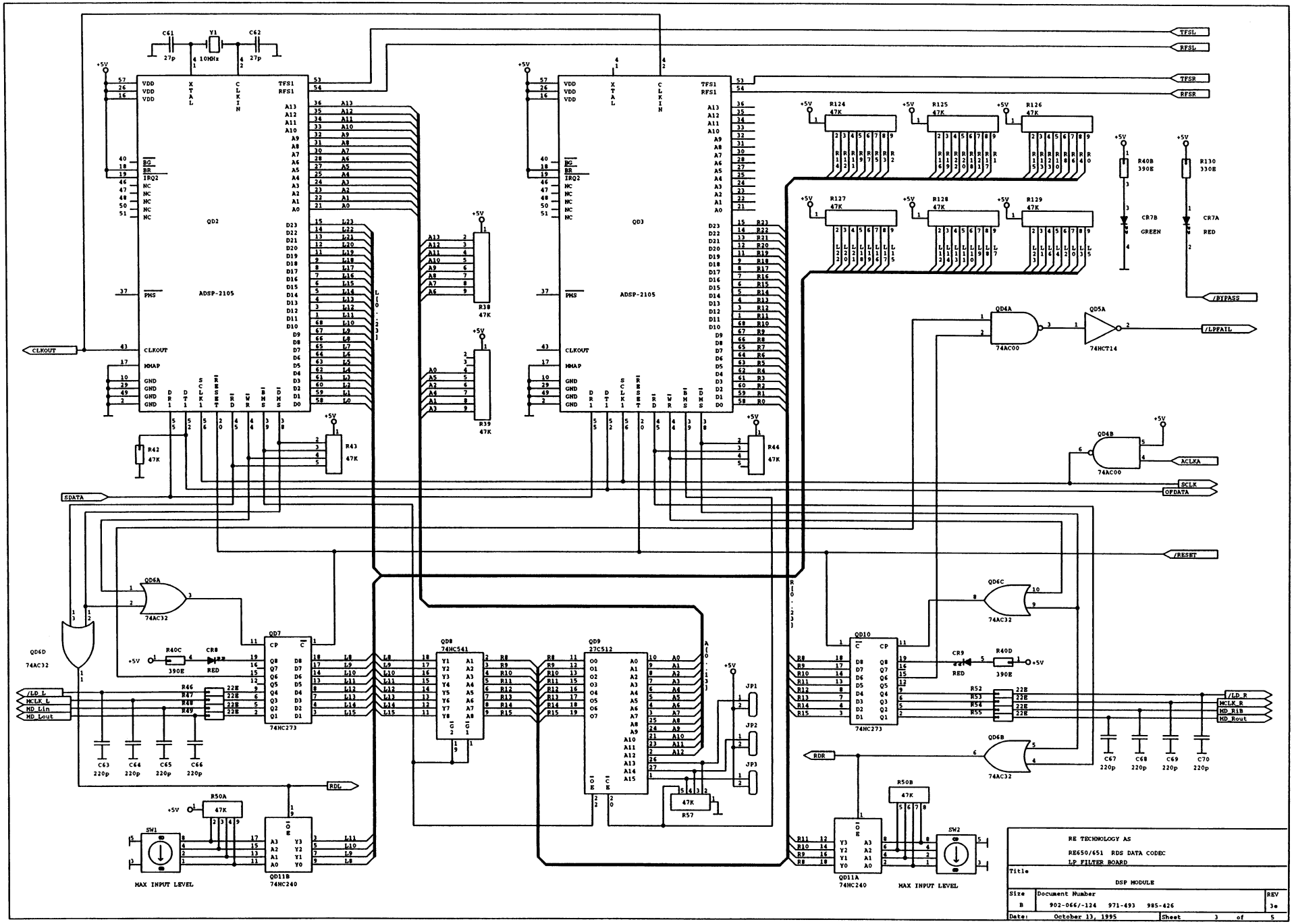
The component locations on the RE 650 Low-pass Filter are shown in the following.

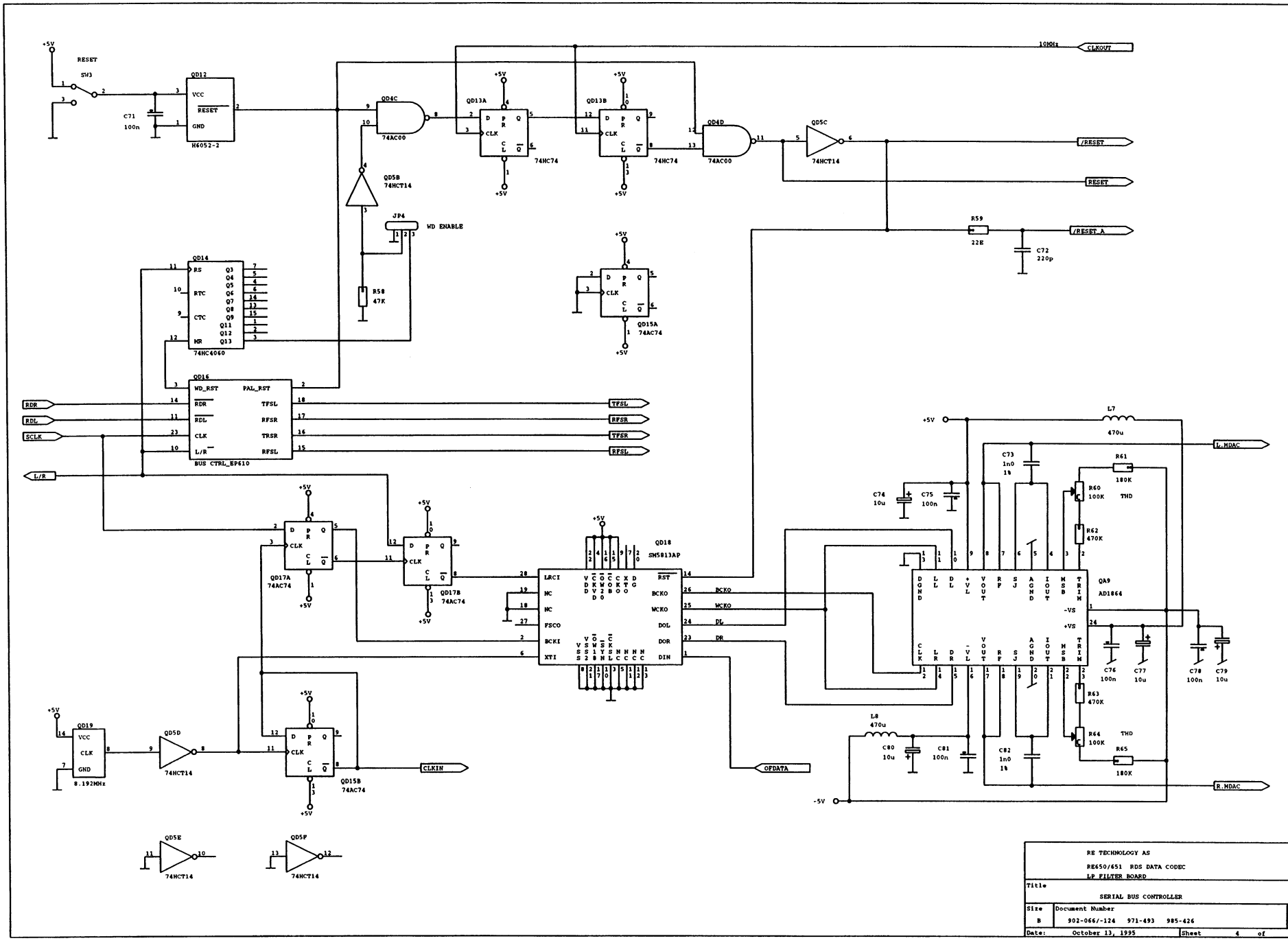
8.4 Parts List

A copy of the parts list from the production documentation is located in the following. The order number of the assembled PCB is 902-066.

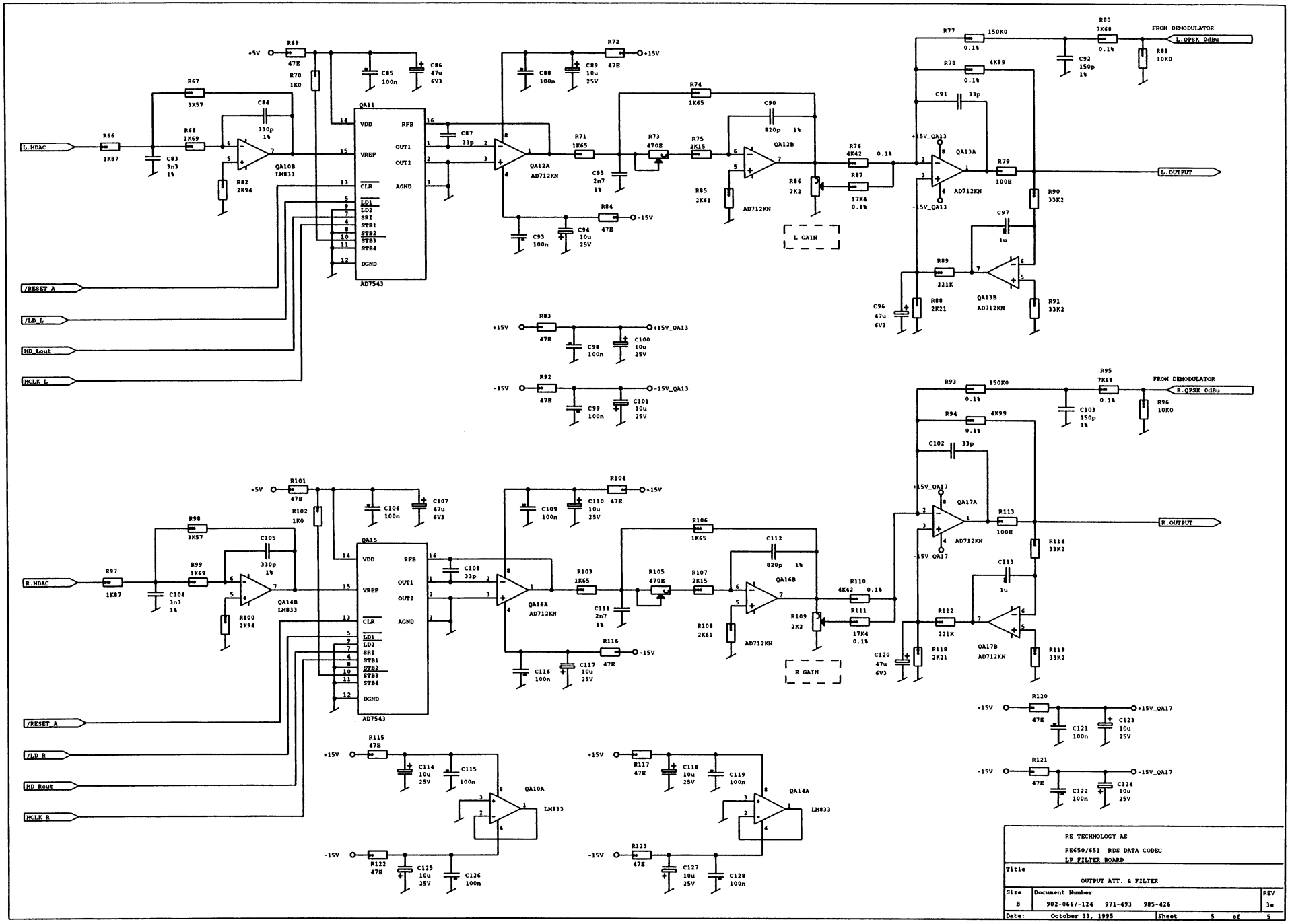

TO DEMODULATOR
Lout DEMOD
TO DEMODULATOR
Rout DEMOD
INPUT ATT. & FILTER
PAGE 2/5
DSP MODULE
PAGE 3/5
OUTPUT ATT. & FILTER
PAGE 5/5
SERIAL BUS CONTROLLER
PAGE 4/5
J1
48P CON
+Lin
-Lin
+Rin
-Rin
Lout
Rout
/LD_L
MD_Lin
MCLK_L
/LD_R
MD_Rin
MCLK_R
SDATA
ACLKA
SCLK
L/R
CLKIN
/RESET_A
RESET
TFSL
TFSR
RFSL
RFSR
TR0
TR1
TR2
TR3
MD_Lout
MD_Rout
CLKOUT
/BYPASS
/LPFAIL
/RESET
RDR
RDL
TR0..31
OFDATA
R.MDAC
L.MDAC
CLK_OUT
R.OUTPUT
L.OUTPUT
MD_LOUT
MD_Rout
L.QPSK 0dBu
R.QPSK 0dBu
+Rout
+Lout
+15Vin
-15Vin
-5Vin
+5Vin
FOR SUM. OF DGND AND AGND
GND.1
GND.2
GND.3
GND.4
GND.5
GND.6
+5V
VCC
VDD
GND
VSS
L1
L2
L3
L4
GREEN
WHITE
C1 10u
C2 100n
C3 100n
C4 10u
C5 10u 25V
C6 100n
C7 100n
C8 10u 25V
C9 10u
C10 100n
C11 100n
C12 10u
C13 10u 25V
C14 100n
C15 100n
C16 10u 25V
C202 100n
C203 100n
C204 100n
C205 100n
C206 100n
C207 100n
C208 100n
C209 100n
C210 100n
C211 100n
C212 100n
C213 100n
C214 100n
C215 100n
C216 100n
C217 100n
C218 100n
C219 100n
C251 10u
C252 10u
C253 10u
C254 10u
RE TECHNOLOGY AS
RE650/651 RDS DATA CODEC
LP FILTER BOARD
Title
ROOT SHEET
Size
B
Document Number
902-066/-124 971-493 985-426
REV
3e
Date: October 13, 1995
Sheet 1 of 5

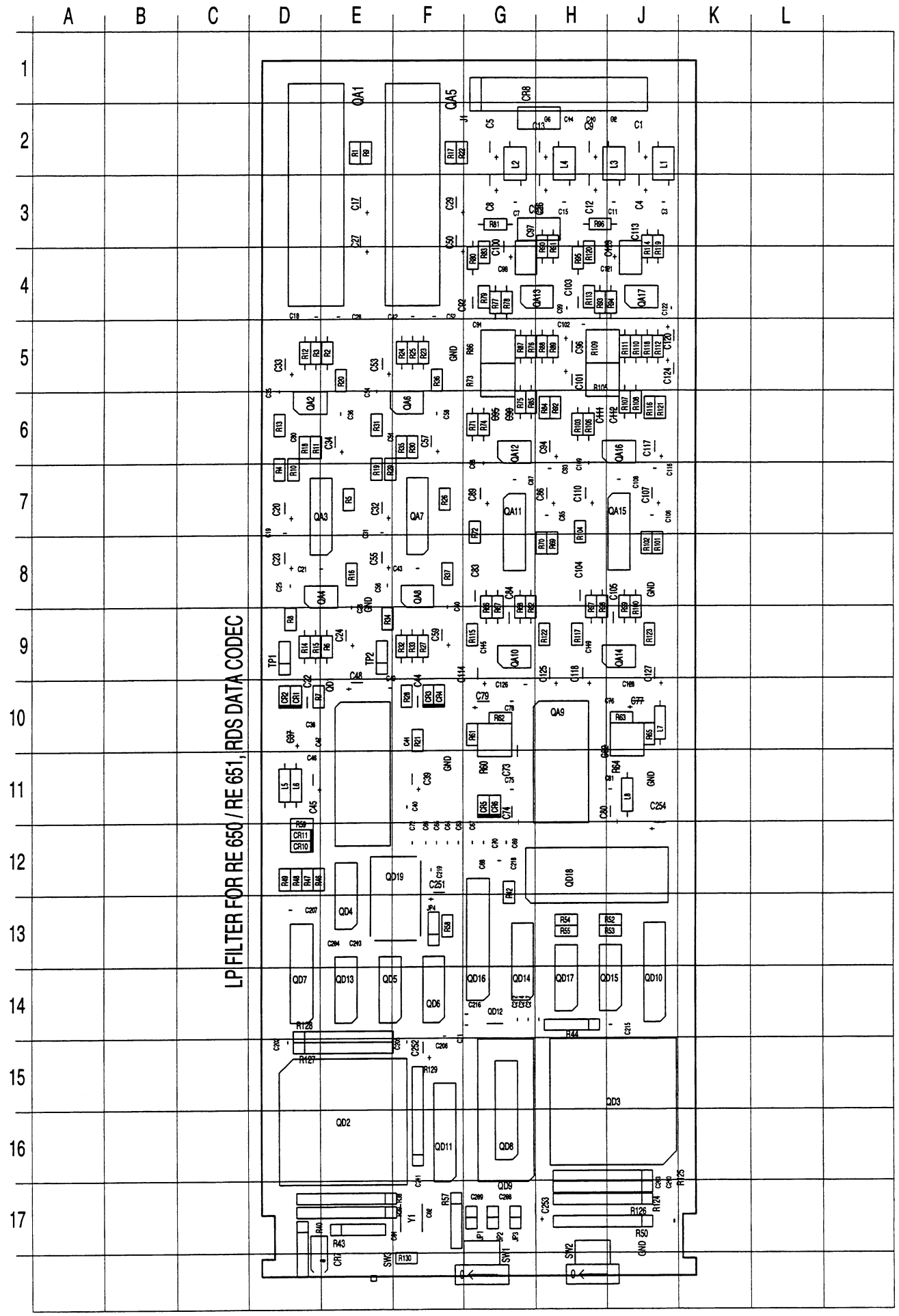

+15V
-15V
+5V
+Lin
-Lin
Zin 10K0
Lout
Rout
+Rin
-Rin
/RESET_A
/LD_L
MD_Lin
MCLK_L
/LD_R
MD_Rin
MCLK_R
QA1 ZFT
QA2A LM833
QA2B LM833
QA3 AD7543
QA4A AD712KN
QA4B AD712KN
QA5 ZFT
QA6A LM833
QA6B LM833
QA7 AD7543
QA8A AD712KN
QA8B AD712KN
QD1 CS5326
TP1
TP2
CR1 BAT85
CR2 BAT85
CR3 BAT85
CR4 BAT85
CR5 BAT85
CR6 BAT85
VA+
VA-
RESET
L/R
SDATA
SCLK
ACLKA
CLKIN
RE TECHNOLOGY AS
RE650/651 RDS DATA CODEC
LP FILTER BOARD
Title
INPUT GAIN FILTER
Size B
Document Number 902-066/-124 971-493 985-426
REV 3e
Date: October 13, 1995
Sheet 2 of 5


C61
27p
Y1
10MHz
C62
27p
QD2
ADSP-2105
QD3
ADSP-2105
TFS1
RFS1
TFSL
RFSL
TFSR
RFSR
R124 47K
R125 47K
R126 47K
R127 47K
R128 47K
R129 47K
R40B 390E
R130 330E
CR7B GREEN
CR7A RED
/BYPASS
QD4A
74AC00
QD5A
74HCT14
/LPFAIL
QD4B
74AC00
ACLKA
SCLK
OPDATA
/RESET
CLKOUT
SDATA
R38 47K
R39 47K
R42 47K
R43 47K
R44 47K
QD6A
74AC32
QD6C
74AC32
QD6D
74AC32
QD6B
74AC32
QD7
74HC273
QD8
74HC541
QD9
27C512
QD10
74HC273
R40C 390E
CR8 RED
CR9 RED
R40D 390E
/LD_L
MCLK_L
MD_Lin
MD_Lout
/LD_R
MCLK_R
MD_RiB
MD_Rout
R46 22E
R47 22E
R48 22E
R49 22E
R52 22E
R53 22E
R54 22E
R55 22E
C63 220p
C64 220p
C65 220p
C66 220p
C67 220p
C68 220p
C69 220p
C70 220p
JP1
JP2
JP3
R57 47K
RDL
RDR
R50A 47K
R50B 47K
SW1
SW2
MAX INPUT LEVEL
MAX INPUT LEVEL
QD11B
74HC240
QD11A
74HC240
RE TECHNOLOGY AS
RE650/651 RDS DATA CODEC
LP FILTER BOARD
Title
DSP MODULE
Size B
Document Number 902-066/-124 971-493 985-426
REV 3e
Date: October 13, 1995
Sheet 3 of 5



RE TECHNOLOGY AS		
RE650/651 RDS DATA CODEC		
LP FILTER BOARD		
Title: SERIAL BUS CONTROLLER		
Size: B	Document Number: 902-066/-124 971-493 985-426	REV: 3e
Date: October 13, 1995	Sheet 4 of 5	


L.MDAC
/RESET_A
/LD_L
MD_Lout
MCLK_L
QA11
AD7543
QA10B
LM833
QA12A
AD712KN
QA12B
L GAIN
QA13A
QA13B
L.QPSK 0dBu
FROM DEMODULATOR
L.OUTPUT
R.MDAC
/LD_R
MD_Rout
MCLK_R
QA15
QA14B
QA16A
QA16B
R GAIN
QA17A
QA17B
R.QPSK 0dBu
R.OUTPUT
QA10A
QA14A
RE TECHNOLOGY AS
RE650/651 RDS DATA CODEC
LP FILTER BOARD
Title
OUTPUT ATT. & FILTER
Size
B
Document Number
902-066/-124 971-493 985-426
REV
3e
Date: October 13, 1995
Sheet 5 of 5


LP FILTER FOR RE 650 / RE 651, RDS DATA CODEC

COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	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	D10	C39	F11	C88	G7	C210	J17	QA17	J4	R30	F6	R83	G4	SW2	H17																				
CR2	D10	C40	F11	C89	G7	C211	F16	QD1	E10	R31	E6	R84	H6	SW3	E18																				
CR3	F10	C41	F10	C90	G6	C212	G14	QD2	E16	R32	F9	R85	G6	TP1	D9																				
CR4	F10	C42	F4	C91	G5	C213	E13	QD3	J15	R33	F9	R86	G5	TP2	E9																				
CR5	G11	C43	F8	C92	F4	C214	G14	QD4	E13	R34	E9	R87	G5	Y1	F17																				
CR6	G11	C44	F10	C93	H7	C215	J14	QD5	E14	R35	F6	R88	H5																						
CR7	E18	C45	D11	C94	H6	C216	G14	QD6	F14	R36	F5	R89	H5																						
CR8	G1	C46	D11	C95	G6	C217	G14	QD7	D14	R37	F8	R90	H4																						
CR9	H3	C47	D10	C96	H5	C218	G12	QD8	G16	R38	F17	R91	H4																						
CR10	D12	C48	E9	C97	G3	C219	F12	QD9	G17	R39	F17	R92	H6																						
CR11	D12	C49	E9	C98	G4	C251	F12	QD10	J14	R40	D17	R93	H4																						
C1	J2	C50	F3	C99	H4	C252	F15	QD11	F16	R42	G12	R94	J4																						
C2	J2	C51	E6	C100	G3	C253	H17	QD12	G14	R43	E17	R95	H4																						
C3	J3	C52	F4	C101	H5	C254	J11	QD13	E14	R44	H14	R96	H3																						
C4	J3	C53	E5	C102	H5	GND.1	J17	QD14	G14	R46	D12	R97	H9																						
C5	G2	C54	E6	C103	H4	GND.2	F11	QD15	J14	R47	D12	R98	H9																						
C6	H2	C55	E8	C104	H8	GND.3	J11	QD16	G14	R48	D12	R99	J9																						
C7	G3	C56	E8	C105	J8	GND.4	E8	QD17	H14	R49	D12	R100	J9																						
C8	G3	C57	F6	C106	J7	GND.5	F5	QD18	H12	R50	J17	R101	J8																						
C9	H2	C58	F6	C107	J7	GND.6	J8	QD19	F12	R52	J13	R102	J8																						
C10	H2	C59	F9	C108	J7	JP1	G17	R1	E2	R53	J13	R103	H6																						
C11	J3	C60	F8	C109	H7	JP2	G17	R2	E5	R54	H13	R104	H7																						
C12	H3	C61	F17	C110	H7	JP3	G17	R3	D5	R55	H13	R105	H5																						
C13	H2	C62	F17	C111	H6	JP4	F13	R4	D7	R57	F17	R106	H6																						
C14	H2	C63	F12	C112	J6	J1	G2	R5	E7	R58	F13	R107	J6																						
C15	H3	C64	F12	C113	J3	L1	J2	R6	E9	R59	D12	R108	J6																						
C16	H3	C65	F12	C114	F9	L2	G2	R7	D10	R60	G11	R109	H5																						
C17	E3	C66	F12	C115	G9	L3	J2	R8	D9	R61	G10	R110	J5																						
C18	D4	C67	G12	C116	J7	L4	H2	R9	E2	R62	G10	R111	J5																						
C19	D7	C68	G12	C117	J6	L5	D11	R10	D7	R63	J10	R112	J5																						
C20	D7	C69	G12	C118	H9	L6	D11	R11	D6	R64	J11	R113	H4																						
C21	D8	C70	G12	C119	H9	L7	J10	R12	D5	R65	J10	R114	J4																						
C22	D10	C71	F14	C120	J5	L8	J11	R13	D6	R66	G9	R115	G9																						
C23	D8	C72	F12	C121	J4	QA1	E1	R14	D9	R67	G9	R116	J6																						
C24	E9	C73	G11	C122	J4	QA2	D6	R15	D9	R68	G9	R117	H9																						
C25	D8	C74	G11	C123	J4	QA3	E7	R16	E8	R69	H8	R118	J5																						
C26	E9	C75	G11	C124	J5	QA4	E8	R17	F2	R70	H8	R119	J4																						
C27	E3	C76	J10	C125	H9	QA5	F1	R18	D6	R71	G6	R120	H4																						
C28	E4	C77	J10	C126	G10	QA6	F6	R19	E7	R72	G7	R121	J6																						
C29	F3	C78	G10	C127	J9	QA7	F7	R20	E5	R73	G5	R122	H9																						
C30	D6	C79	G10	C128	J10	QA8	F8	R21	F10	R74	G6	R123	J9																						
C31	E7	C80	H11	C202	D15	QA9	H10	R22	F2	R75	G6	R124	J17																						
C32	E7	C81	J11	C203	J17	QA10	G9	R23	F5	R76	G5	R125	J16																						
C33	D5	C82	H11	C204	E13	QA11	G7	R24	F5	R77	G4	R126	J17																						
C34	E6	C83	G8	C205	F15	QA12	G6	R25	F5	R78	G4	R127	D15																						
C35	D6	C84	G8	C206	F15	QA13	H4	R26	F7	R79	G4	R128	D14																						
C36	E6	C85	H7	C207	D13	QA14	J9	R27	F9	R80	G4	R129	F15																						
C37	D10	C86	H7	C208	G17	QA15	J7	R28	F10	R81	G3	R130	F18																						
C38	D10	C87	G7	C209	G17	QA16	J6	R29	E7	R82	G9	SW1	G18																						

COMPONENT SIDE 971-493i3

PCB Assy RE 650 Low Pass Filter (902-066)

CAPACITORS

C 1	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 2	C Ceramic 100n 20% 50V	213-401
C 3	C Ceramic 100n 20% 50V	213-401
C 4	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 5	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 6	C Ceramic 100n 20% 50V	213-401
C 7	C Ceramic 100n 20% 50V	213-401
C 8	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 9	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 10	C Ceramic 100n 20% 50V	213-401
C 11	C Ceramic 100n 20% 50V	213-401
C 12	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 13	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 14	C Ceramic 100n 20% 50V	213-401
C 15	C Ceramic 100n 20% 50V	213-401
C 16	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 17	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 18	C Ceramic 100n 20% 50V	213-401
C 19	C Ceramic 100n 20% 50V	213-401
C 20	C Solid Aluminium 47u 20% 6V3 Short Type	265-106
C 21	C Ceramic 33p0 2% 100V NP0	213-208
C 22	C Ceramic 10n 1% 50V NPO RM2	213-629
C 23	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 24	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 25	C Ceramic 100n 20% 50V	213-401
C 26	C Ceramic 100n 20% 50V	213-401
C 27	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 28	C Ceramic 100n 20% 50V	213-401
C 29	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 30	C Ceramic 100p 2% 100V NP0	213-211
C 31	C Ceramic 100n 20% 50V	213-401
C 32	C Solid Aluminium 47u 20% 6V3 Short Type	265-106
C 33	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 34	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 35	C Ceramic 100n 20% 50V	213-401
C 36	C Ceramic 100n 20% 50V	213-401
C 37	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 38	C Ceramic 100n 20% 50V	213-401
C 39	C Solid Aluminium 47u 20% 6V3 Short Type	265-106
C 40	C Ceramic 100n 20% 50V	213-401
C 41	C Ceramic 100n 20% 50V	213-401
C 42	C Ceramic 100n 20% 50V	213-401
C 43	C Ceramic 33p0 2% 100V NP0	213-208
C 44	C Ceramic 10n 1% 50V NPO RM2	213-629

C 45	C Solid Aluminium 10u 20% 16V Short Type	265-108
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 Ceramic 100n 20% 50V	213-401
C 50	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 51	C Ceramic 100p 2% 100V NP0	213-211
C 52	C Ceramic 100n 20% 50V	213-401
C 53	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 54	C Ceramic 100n 20% 50V	213-401
C 55	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 56	C Ceramic 100n 20% 50V	213-401
C 57	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 58	C Ceramic 100n 20% 50V	213-401
C 59	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 60	C Ceramic 100n 20% 50V	213-401
C 61	C Ceramic 27p0 2% 100V NP0	213-207
C 62	C Ceramic 27p0 2% 100V NP0	213-207
C 63	C Ceramic 220p 2% 100V N750	213-218
C 64	C Ceramic 220p 2% 100V N750	213-218
C 65	C Ceramic 220p 2% 100V N750	213-218
C 66	C Ceramic 220p 2% 100V N750	213-218
C 67	C Ceramic 220p 2% 100V N750	213-218
C 68	C Ceramic 220p 2% 100V N750	213-218
C 69	C Ceramic 220p 2% 100V N750	213-218
C 70	C Ceramic 220p 2% 100V N750	213-218
C 71	C Ceramic 100n 20% 50V	213-401
C 72	C Ceramic 220p 2% 100V N750	213-218
C 73	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 74	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 75	C Ceramic 100n 20% 50V	213-401
C 76	C Ceramic 100n 20% 50V	213-401
C 77	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 78	C Ceramic 100n 20% 50V	213-401
C 79	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 80	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 81	C Ceramic 100n 20% 50V	213-401
C 82	C Ceramic 1n0 1% 50V NPO RM2	213-621
C 83	C Ceramic 3n3 1% 50V NPO RM2	213-627
C 84	C Ceramic 330p 1% 50V NPO RM2	213-626
C 85	C Ceramic 100n 20% 50V	213-401
C 86	C Solid Aluminium 47u 20% 6V3 Short Type	265-106
C 87	C Ceramic 33p0 2% 100V NP0	213-208
C 88	C Ceramic 100n 20% 50V	213-401
C 89	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 90	C Ceramic 820p 1% 50V NPO RM2	213-625
C 91	C Ceramic 33p0 2% 100V NP0	213-208
C 92	C ceramic 150p 1% 50V NPO RM2	213-632

C 93	C Ceramic 100n 20% 50V	213-401
C 94	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 95	C Ceramic 2n7 1% 50V NPO RM2	213-628
C 96	C Solid Aluminium 47u 20% 6V3 Short Type	265-106
C 97	MKT, 1/63/10, R:6*11.5*7.2, RM2	241-064
C 98	C Ceramic 100n 20% 50V	213-401
C 99	C Ceramic 100n 20% 50V	213-401
C 100	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 101	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 102	C Ceramic 33p0 2% 100V NP0	213-208
C 103	C ceramic 150p 1% 50V NPO RM2	213-632
C 104	C Ceramic 3n3 1% 50V NPO RM2	213-627
C 105	C Ceramic 330p 1% 50V NPO RM2	213-626
C 106	C Ceramic 100n 20% 50V	213-401
C 107	C Solid Aluminium 47u 20% 6V3 Short Type	265-106
C 108	C Ceramic 33p0 2% 100V NP0	213-208
C 109	C Ceramic 100n 20% 50V	213-401
C 110	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 111	C Ceramic 2n7 1% 50V NPO RM2	213-628
C 112	C Ceramic 820p 1% 50V NPO RM2	213-625
C 113	MKT, 1/63/10, R:6*11.5*7.2, RM2	241-064
C 114	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 115	C Ceramic 100n 20% 50V	213-401
C 116	C Ceramic 100n 20% 50V	213-401
C 117	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 118	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 119	C Ceramic 100n 20% 50V	213-401
C 120	C Solid Aluminium 47u 20% 6V3 Short Type	265-106
C 121	C Ceramic 100n 20% 50V	213-401
C 122	C Ceramic 100n 20% 50V	213-401
C 123	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 124	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 125	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 126	C Ceramic 100n 20% 50V	213-401
C 127	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 128	C Ceramic 100n 20% 50V	213-401
C 202	C Ceramic 100n 20% 50V	213-401
C 203	C Ceramic 100n 20% 50V	213-401
C 204	C Ceramic 100n 20% 50V	213-401
C 205	C Ceramic 100n 20% 50V	213-401
C 206	C Ceramic 100n 20% 50V	213-401
C 207	C Ceramic 100n 20% 50V	213-401
C 208	C Ceramic 100n 20% 50V	213-401
C 209	C Ceramic 100n 20% 50V	213-401
C 210	C Ceramic 100n 20% 50V	213-401
C 211	C Ceramic 100n 20% 50V	213-401
C 212	C Ceramic 100n 20% 50V	213-401
C 213	C Ceramic 100n 20% 50V	213-401

C 214	C Ceramic 100n 20% 50V	213-401
C 215	C Ceramic 100n 20% 50V	213-401
C 216	C Ceramic 100n 20% 50V	213-401
C 217	C Ceramic 100n 20% 50V	213-401
C 218	C Ceramic 100n 20% 50V	213-401
C 219	C Ceramic 100n 20% 50V	213-401
C 251	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 252	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 253	C Solid Aluminium 10u 20% 16V Short Type	265-108
C 254	C Solid Aluminium 10u 20% 16V Short Type	265-108

DIODES

CR 1	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 2	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 3	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 4	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 5	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 6	Diode Schottky BAT85 Vr 30V If 200mA	350-084
CR 7	LED stack unit, dual green/red 3mm	350-824
CR 8	LED stack unit singel, 3mm red	350-818
CR 9	LED stack unit singel, 3mm red	350-818

CONNECTORS

J 1	DIN 41612 48 pol male 90ø with coding, C/2 class II	806-190

RELAYS & JUMPERS

JP 1	Pin header 2 pol straight l:6.7mm with lock	805-951
JP 2	Pin header 2 pol straight l:6.7mm with lock	805-951
JP 3	Pin header 2 pol straight l:6.7mm with lock	805-951
JP 4	Pin header 3 pol straight l:6.7mm with lock	805-894

CHOKES

L 1	RF-choke six-hole core green	731-204
L 2	RF-choke six-hole core white	731-207
L 3	RF-choke six-hole core white	731-207
L 4	RF-choke six-hole core white	731-207
L 5	Choke HF Mini 470uH 10% 124MA	703-014
L 6	Choke HF Mini 470uH 10% 124MA	703-014
L 7	Choke HF Mini 470uH 10% 124MA	703-014
L 8	Choke HF Mini 470uH 10% 124MA	703-014

TRANSISTORS

Q 9	RE650 Prog Eprom 902-066 QD02 LP-Filter	368-463
Q 16	Prog Pal QD17 For LP Module RE650/51	369-365

INTEGRATED ANALOG CIRCUITS

QA 1	Transformer Input Module Zin=10Kohm Low power	910-272
QA 2	IC LM833N Dual Low Noise OPamp	365-037
QA 3	IC AD7543GKN Serial Input 12-Bit Dac	365-191
QA 4	IC AD712K Dual OP.AMP.	364-791
QA 5	Transformer Input Module Zin=10Kohm Low power	910-272
QA 6	IC LM833N Dual Low Noise OPamp	365-037
QA 7	IC AD7543GKN Serial Input 12-Bit Dac	365-191
QA 8	IC AD712K Dual OP.AMP.	364-791
QA 9	IC AD1864N Dual 18 Bit DAC	365-101
QA 10	IC LM833N Dual Low Noise OPamp	365-037
QA 11	IC AD7543GKN Serial Input 12-Bit Dac	365-191
QA 12	IC AD712K Dual OP.AMP.	364-791
QA 13	IC AD712K Dual OP.AMP.	364-791
QA 14	IC LM833N Dual Low Noise OPamp	365-037
QA 15	IC AD7543GKN Serial Input 12-Bit Dac	365-191
QA 16	IC AD712K Dual OP.AMP.	364-791
QA 17	IC AD712K Dual OP.AMP.	364-791

INTEGRATED DIGITAL CIRCUITS

QD 1	IC CS5326 16bit Dual A/D conv.	365-043
QD 2	IC Adsp2105kp-55 Dig.Sig.Proc	365-100
QD 3	IC Adsp2105kp-55 Dig.Sig.Proc	365-100
QD 4	IC 74AC00 quad NAND gate	364-819
QD 5	IC 74HCT14 Hex inverter with Schmitt trigger	364-699
QD 6	IC 74AC32 quad OR gate	364-864
QD 7	IC 74HC273 Octal D-FF.	364-574
QD 8	IC 74HC541 Octal buffer/line driver	364-781
QD 9	RE650 Prog Eprom 902-066 QD02 LP-Filter	368-463
QD 10	IC 74HC273 Octal D-FF.	364-574
QD 11	IC 74HC240 octal inv buff3-st	365-937
QD 12	IC H6052-2 Smart Reset Activ Low	365-168
QD 13	IC 74HC74P dual d ff	364-755
QD 14	IC 74HC4060 BIN Counter With Oscillator	364-817
QD 15	IC 74AC74 dual D ff	364-795
QD 16	Prog Pal QD17 For LP Module RE650/51	369-365
QD 17	IC 74AC74 dual D ff	364-795
QD 18	IC SM5813AP cmos 8-time Oversampling Dig.Filter 9.5Mhz	365-102
QD 19	Hybrid clock oscillator TTL 8.192MHz 50PPM	910-237

RESISTORS

R 1	R Metal Film 22E0 5% 0.2W TC250	107-222
R 2	R Metal Film 787E 1% 0.4W TC50	113-787
R 3	Metal Film 2K21 0.1% 0.25W TC15	141-369
R 4	R Metal Film 47E0 5% 0.2W TC250	107-247

R 5	R Metal Film 1K00 5% 0.2W TC250	107-410
R 6	R Metal Film 681E 1% 0.5W TC50	113-681
R 7	R Metal Film 51E0 5% 0.2W TC250	107-251
R 8	R Metal Film 47E0 5% 0.2W TC250	107-247
R 9	R Metal Film 22E0 5% 0.2W TC250	107-222
R 10	R Metal Film 100E 5% 0.2W TC250	107-310
R 11	R Metal Film 1K00 5% 0.2W TC250	107-410
R 12	Metal Film 1K24 0.1% 0.25W TC15	141-296
R 13	R Metal Film 47E0 5% 0.2W TC250	107-247
R 14	Metal Film 1K24 0.1% 0.25W TC15	141-296
R 15	Metal Film 1K54 0.1% 0.25W TC15	141-254
R 16	R Metal Film 47E0 5% 0.2W TC250	107-247
R 17	R Metal Film 22E0 5% 0.2W TC250	107-222
R 18	R Metal Film 1K00 5% 0.2W TC250	107-410
R 19	R Metal Film 47E0 5% 0.2W TC250	107-247
R 20	R Metal Film 47E0 5% 0.2W TC250	107-247
R 21	R Metal Film 47E0 5% 0.2W TC250	107-247
R 22	R Metal Film 22E0 5% 0.2W TC250	107-222
R 23	R Metal Film 787E 1% 0.4W TC50	113-787
R 24	Metal Film 1K24 0.1% 0.25W TC15	141-296
R 25	Metal Film 2K21 0.1% 0.25W TC15	141-369
R 26	R Metal Film 1K00 5% 0.2W TC250	107-410
R 27	R Metal Film 681E 1% 0.5W TC50	113-681
R 28	R Metal Film 51E0 5% 0.2W TC250	107-251
R 29	R Metal Film 100E 5% 0.2W TC250	107-310
R 30	R Metal Film 1K00 5% 0.2W TC250	107-410
R 31	R Metal Film 47E0 5% 0.2W TC250	107-247
R 32	Metal Film 1K24 0.1% 0.25W TC15	141-296
R 33	Metal Film 1K54 0.1% 0.25W TC15	141-254
R 34	R Metal Film 47E0 5% 0.2W TC250	107-247
R 35	R Metal Film 1K00 5% 0.2W TC250	107-410
R 36	R Metal Film 47E0 5% 0.2W TC250	107-247
R 37	R Metal Film 47E0 5% 0.2W TC250	107-247
R 38	Thick Film SIL 8*47K	146-005
R 39	Thick Film SIL 8*47K	146-005
R 40	Thick Film DIL 4*390E 2% 0.125W TC100	146-035
R 42	R Metal Film 47K0 5% 0.2W TC250	107-547
R 43	Thick Film SIL 4*47K 5% 0.1W	146-018
R 44	Thick Film SIL 4*47K 5% 0.1W	146-018
R 46	R Metal Film 22E0 5% 0.2W TC250	107-222
R 47	R Metal Film 22E0 5% 0.2W TC250	107-222
R 48	R Metal Film 22E0 5% 0.2W TC250	107-222
R 49	R Metal Film 22E0 5% 0.2W TC250	107-222
R 50	Thick Film SIL 8*47K	146-005
R 52	R Metal Film 22E0 5% 0.2W TC250	107-222
R 53	R Metal Film 22E0 5% 0.2W TC250	107-222
R 54	R Metal Film 22E0 5% 0.2W TC250	107-222
R 55	R Metal Film 22E0 5% 0.2W TC250	107-222

R 57	Thick Film SIL 4*47K 5% 0.1W	146-018
R 58	R Metal Film 47K0 5% 0.2W TC250	107-547
R 59	R Metal Film 22E0 5% 0.2W TC250	107-222
R 60	Cermet Trimpot 100K 20% 0.5W TC70	182-311
R 61	R Metal Film 180K 5% 0.2W TC250	107-618
R 62	R Metal Film 470K 5% 0.2W TC250	107-647
R 63	R Metal Film 470K 5% 0.2W TC250	107-647
R 64	Cermet Trimpot 100K 20% 0.5W TC70	182-311
R 65	R Metal Film 180K 5% 0.2W TC250	107-618
R 66	R Metal Film 1K87 1% 0.5W TC50	114-187
R 67	R Metal Film 3K57 1% 0.5W TC50	114-357
R 68	R Metal Film 1K69 1% 0.5W TC50	114-169
R 69	R Metal Film 47E0 5% 0.2W TC250	107-247
R 70	R Metal Film 1K00 5% 0.2W TC250	107-410
R 71	R Metal Film 1K65 1% 0.5W TC50	114-165
R 72	R Metal Film 47E0 5% 0.2W TC250	107-247
R 73	Cermet Trimpot 470E 20% 0.5W TC70	182-302
R 74	R Metal Film 1K65 1% 0.5W TC50	114-165
R 75	R Metal Film 2K15 1% 0.5W TC50	114-215
R 76	Metal Film 4K42 0.1% 0.25W TC15	141-363
R 77	Metal Film 150K 0.1% 0.25W TC15	141-301
R 78	Metal Film 4k99 0.1% 0.25W TC15	140-981
R 79	R Metal Film 100E 5% 0.2W TC250	107-310
R 80	Metal Film 7K68 0.1% 0.25W TC15	141-263
R 81	R Metal Film 10K0 1% 0.5W TC50	115-100
R 82	R Metal Film 2K94 1% 0.5W TC50	114-294
R 83	R Metal Film 47E0 5% 0.2W TC250	107-247
R 84	R Metal Film 47E0 5% 0.2W TC250	107-247
R 85	R Metal Film 2K61 1% 0.5W TC50	114-261
R 86	Cermet Trimpot 2K2 20% 0.5W	182-313
R 87	Metal Film 17K4 0.1% 0.25W TC15	141-330
R 88	R Metal Film 2K21 1% 0.5W TC50	114-221
R 89	R Metal Film 221K 1% 0.5W TC50	116-221
R 90	R Metal Film 33K2 1% 0.5W TC50	115-332
R 91	R Metal Film 33K2 1% 0.5W TC50	115-332
R 92	R Metal Film 47E0 5% 0.2W TC250	107-247
R 93	Metal Film 150K 0.1% 0.25W TC15	141-301
R 94	Metal Film 4k99 0.1% 0.25W TC15	140-981
R 95	Metal Film 7K68 0.1% 0.25W TC15	141-263
R 96	R Metal Film 10K0 1% 0.5W TC50	115-100
R 97	R Metal Film 1K87 1% 0.5W TC50	114-187
R 98	R Metal Film 3K57 1% 0.5W TC50	114-357
R 99	R Metal Film 1K69 1% 0.5W TC50	114-169
R 100	R Metal Film 2K94 1% 0.5W TC50	114-294
R 101	R Metal Film 47E0 5% 0.2W TC250	107-247
R 102	R Metal Film 1K00 5% 0.2W TC250	107-410
R 103	R Metal Film 1K65 1% 0.5W TC50	114-165
R 104	R Metal Film 47E0 5% 0.2W TC250	107-247

R 105	Cermet Trimpot 470E 20% 0.5W TC70	182-302
R 106	R Metal Film 1K65 1% 0.5W TC50	114-165
R 107	R Metal Film 2K15 1% 0.5W TC50	114-215
R 108	R Metal Film 2K61 1% 0.5W TC50	114-261
R 109	Cermet Trimpot 2K2 20% 0.5W	182-313
R 110	Metal Film 4K42 0.1% 0.25W TC15	141-363
R 111	Metal Film 17K4 0.1% 0.25W TC15	141-330
R 112	R Metal Film 221K 1% 0.5W TC50	116-221
R 113	R Metal Film 100E 5% 0.2W TC250	107-310
R 114	R Metal Film 33K2 1% 0.5W TC50	115-332
R 115	R Metal Film 47E0 5% 0.2W TC250	107-247
R 116	R Metal Film 47E0 5% 0.2W TC250	107-247
R 117	R Metal Film 47E0 5% 0.2W TC250	107-247
R 118	R Metal Film 2K21 1% 0.5W TC50	114-221
R 119	R Metal Film 33K2 1% 0.5W TC50	115-332
R 120	R Metal Film 47E0 5% 0.2W TC250	107-247
R 121	R Metal Film 47E0 5% 0.2W TC250	107-247
R 122	R Metal Film 47E0 5% 0.2W TC250	107-247
R 123	R Metal Film 47E0 5% 0.2W TC250	107-247
R 124	Thick Film SIL 8*47K	146-005
R 125	Thick Film SIL 8*47K	146-005
R 126	Thick Film SIL 8*47K	146-005
R 127	Thick Film SIL 8*47K	146-005
R 128	Thick Film SIL 8*47K	146-005
R 129	Thick Film SIL 8*47K	146-005
R 130	R Metal Film 330E 5% 0.2W TC250	107-333

TEST POINTS

TP 1	Pin header 3 pol straight l:6.7mm with lock	805-894
TP 2	Pin header 3 pol straight l:6.7mm with lock	805-894

CRYSTALS

Y 1	Quarts Crystal 10MHz +-100 ppm	910-238

MISCELLANEOUS

Turbular Rivet B •2.3*0.25*3.6		060-312
DIN 41612 Access, coding key for Winchester Type		806-192
Plate Spring 7.5x15x0.1		878-087
PCB For RDS-Coder LP Filter		971-493
GND1	Solder Terminal 0.1 O2	823-303
GND2	Solder Terminal 0.1 O2	823-303
GND3	Solder Terminal 0.1 O2	823-303
GND4	Solder Terminal 0.1 O2	823-303
GND5	Solder Terminal 0.1 O2	823-303
GND6	Solder Terminal 0.1 O2	823-303

JPS4	Female Plug	805-718
JS 1	Tubular Rivet 2.5X10	060-310
QDS2	Socket PLCC 68 pol	816-305
QDS3	Socket PLCC 68 pol	816-305
QDS9	Socket SIL 16 pol	816-210
QDS16	Socket DIL 24 pol, h:4.95 300mil	816-274
SW 1	HEX switch angled	547-004
SW 2	HEX switch angled	547-004
SW 3	Switch Ultra Miniature Pushbottom SPDT	551-170
YS 1	Isolating Plate F.Crystal	816-287

9. RE 650 Subrack

9.1 Circuit Description

The power supply board on the rear contains the 4 power supplies, ±5 V and ±15 V, and a serial communication for the remote control, level-translators for the RS-232 interfaces, bypass logic and an output stage for both channels. The PAL QD6 is programmed to work almost as a UART. TxC is the transmission clock (38.4 kHz) and clock for the PAL. The communication parameters are expected by the PAL to be 8 data bits, no parity and 1 stop bit. The interface works as follows. The first character transferred to the PAL is a command informing the PAL which I/O-port the DSP wants to access and whether it is a read or a write operation. If it is a write operation, the PAL takes the next 8-bit value from the DSP and stores it in the addressed register. If it is a read operation, the PAL reads the addressed 8-bit input port and transfers the value to the DSP.

Via this interface the modulator can read DSR and set DTR on the two RS-232 interfaces, and furthermore it can read the 12 remote input ports.

The error relay (K3 a non-latching type) is set in the error position if power fails, the modulator is in a "not normal" situation, or the bypass function is activated.

The bypass function is made with a bistable relay (K2) so the state is remembered also if power is missing. The state of the relay is also secured during power off and power on. If power is going off, the PSEN (Power Sense) signal gives an early warning and thereby disables driver QD11A so no current can run through the relay when power goes down. When power goes on, QD13 secures that driver QD11B is not enabled until after the +5 V is stable for at least 100 ms. In this way, no current can run through the bypass relay during power on.

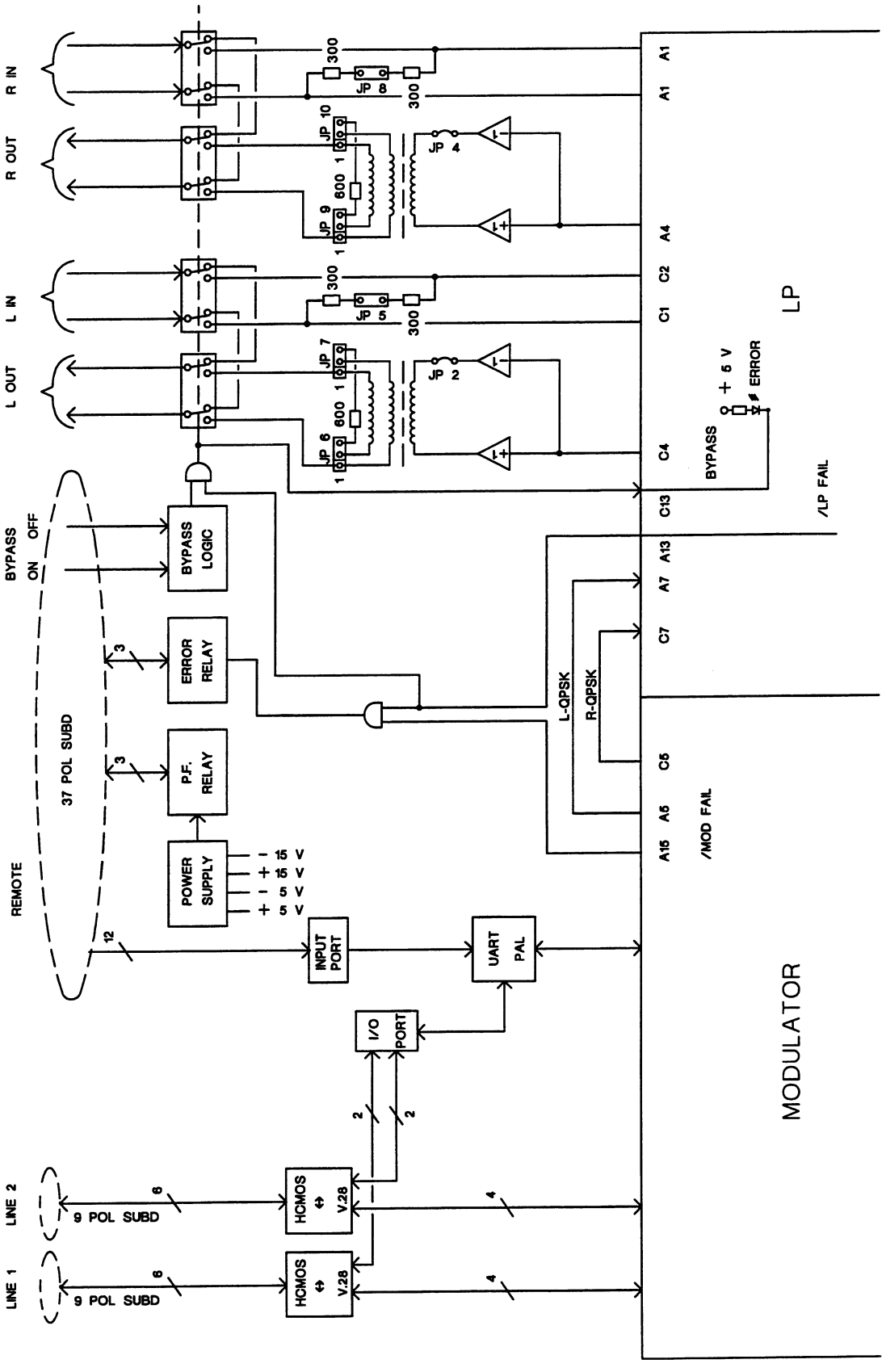


Fig. 9.1 Block Diagram of RE 650 Power Supply

9.2 Schematic Diagrams

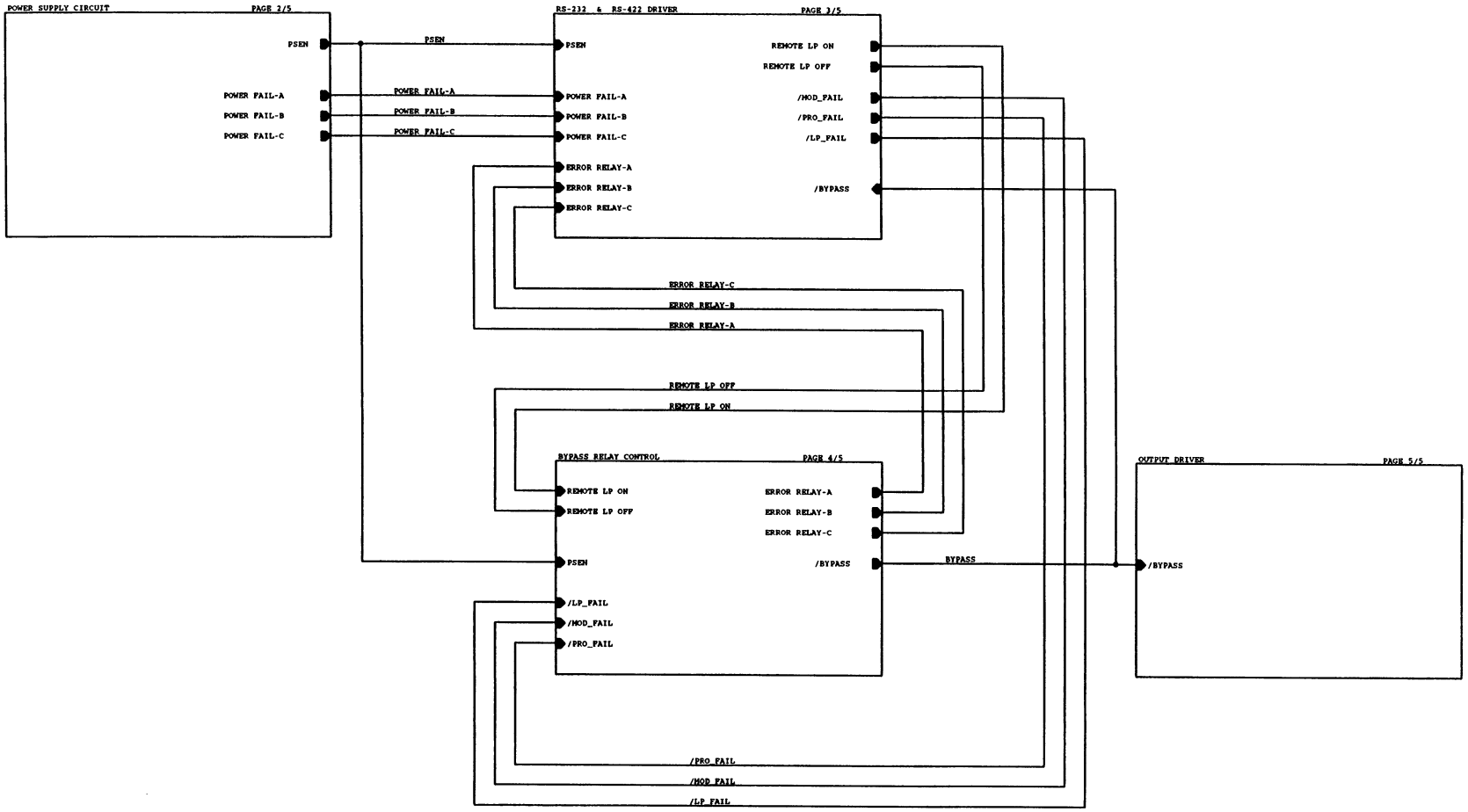
The schematic diagrams for the RE 650 Subrack are located in the following. The diagram numbers are 985-444 and 985-434.

9.3 Component Locations

The component locations on the RE 650 Subrack are shown in the following.

9.4 Parts List

A copy of the parts list from the production documentation is located in the following. The order numbers of the assembled PCB are 902-086 and 902-084.



RR TECHNOLOGY AS		
RR650 RDS DATA CODEC		
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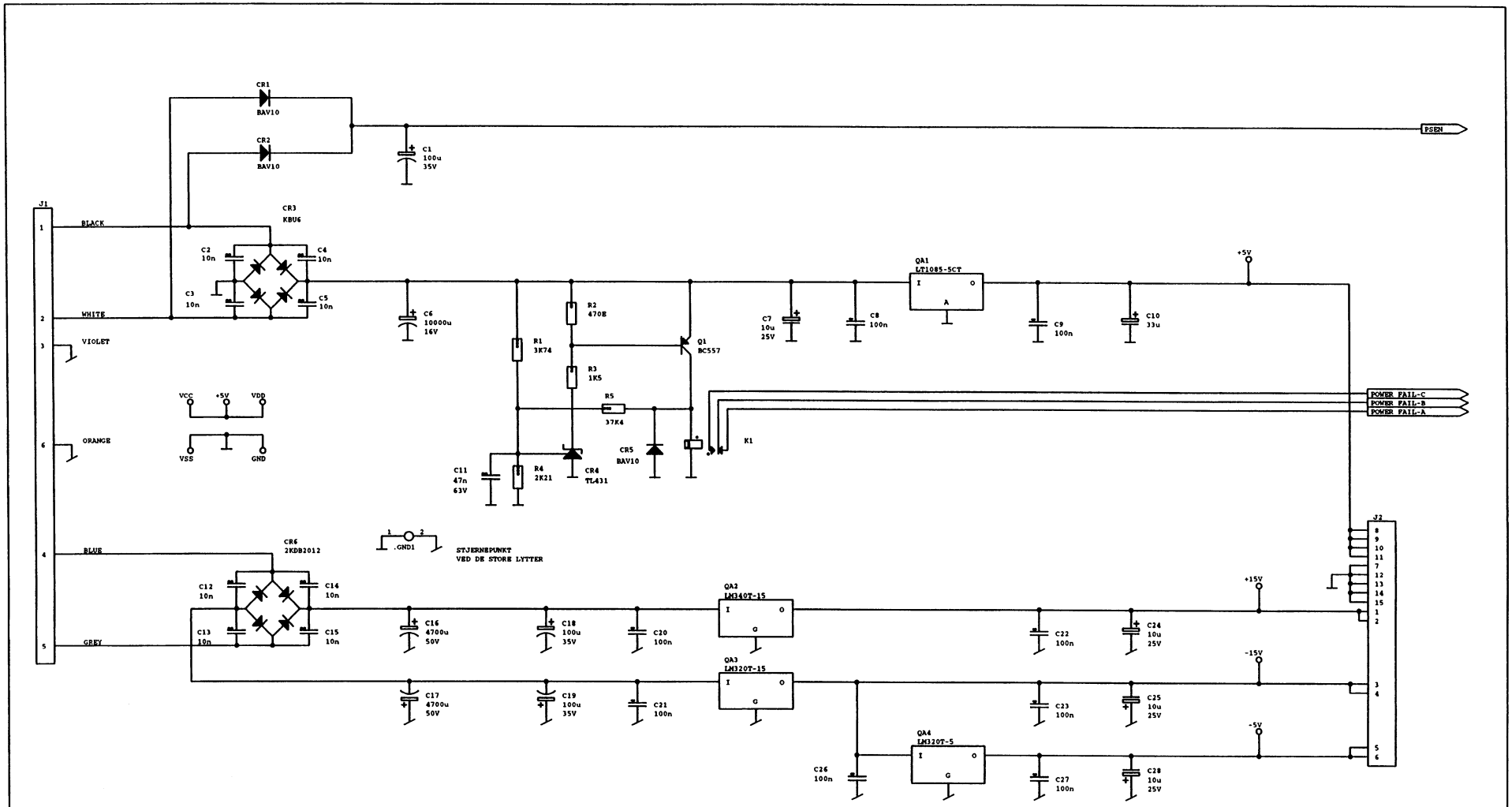
Size: B	Document Number: 902-086 971-505 985-444	REV: 4b
Date: October 31, 1995	Sheet 1 of 5	



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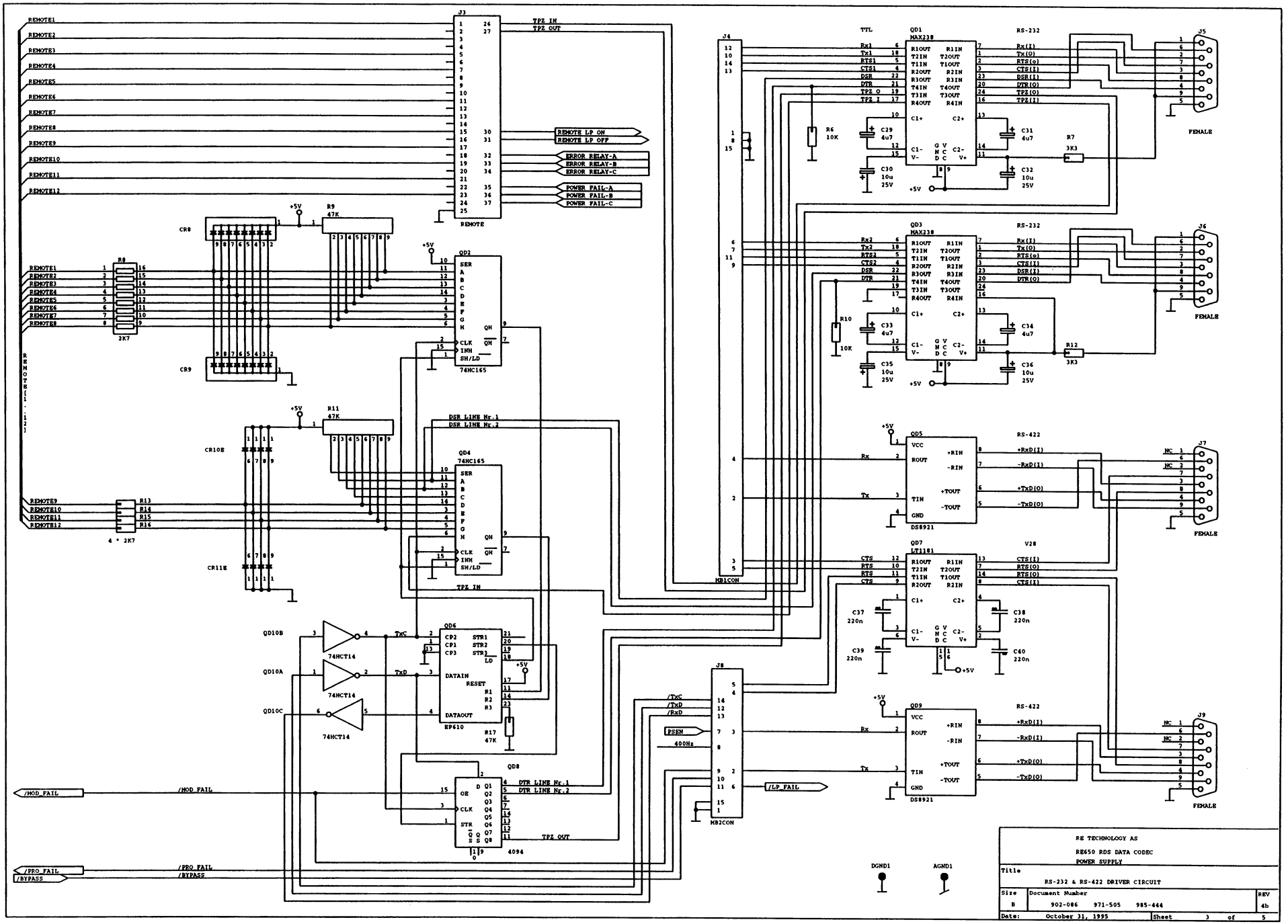
Date: October 31, 1995	Sheet 2 of 5	


REMOTE1
REMOTE2
REMOTE3
REMOTE4
REMOTE5
REMOTE6
REMOTE7
REMOTE8
REMOTE9
REMOTE10
REMOTE11
REMOTE12
J3
REMOTE
TPZ IN
TPZ OUT
REMOTE LP ON
REMOTE LP OFF
ERROR RELAY-A
ERROR RELAY-B
ERROR RELAY-C
POWER FAIL-A
POWER FAIL-B
POWER FAIL-C
+5V
R9
47K
CR8
CR9
R8
2K7
QD2
74HC165
SER
CLK
INH
SH/LD
QH
R11
47K
CR10E
CR11E
QD4
74HC165
R13
R14
R15
R16
4 * 2K7
DSR LINE Nr.1
DSR LINE Nr.2
TPZ IN
QD10B
QD10A
QD10C
74HCT14
TxC
TxD
QD6
EP610
DATAIN
RESET
DATAOUT
R17
47K
QD8
4094
DTR LINE Nr.1
DTR LINE Nr.2
TPZ OUT
/MOD_FAIL
/PRO_FAIL
/BYPASS
J4
MB1CON
J8
MB2CON
/TxC
/TxD
/RxD
PSEN
400Hz
/LP_FAIL
TTL
QD1
MAX238
RS-232
R6
10K
R7
3K3
C29
4u7
C30
10u
25V
C31
4u7
C32
10u
25V
J5
FEMALE
QD3
MAX238
R10
10K
R12
3K3
C33
4u7
C34
4u7
C35
10u
25V
C36
10u
25V
J6
FEMALE
QD5
DS8921
RS-422
J7
FEMALE
QD7
LT1181
V28
C37
220n
C38
220n
C39
220n
C40
220n
QD9
DS8921
RS-422
J9
FEMALE
DGND1
AGND1
RE TECHNOLOGY AS
RE650 RDS DATA CODEC
POWER SUPPLY
Title
RS-232 & RS-422 DRIVER CIRCUIT
Size
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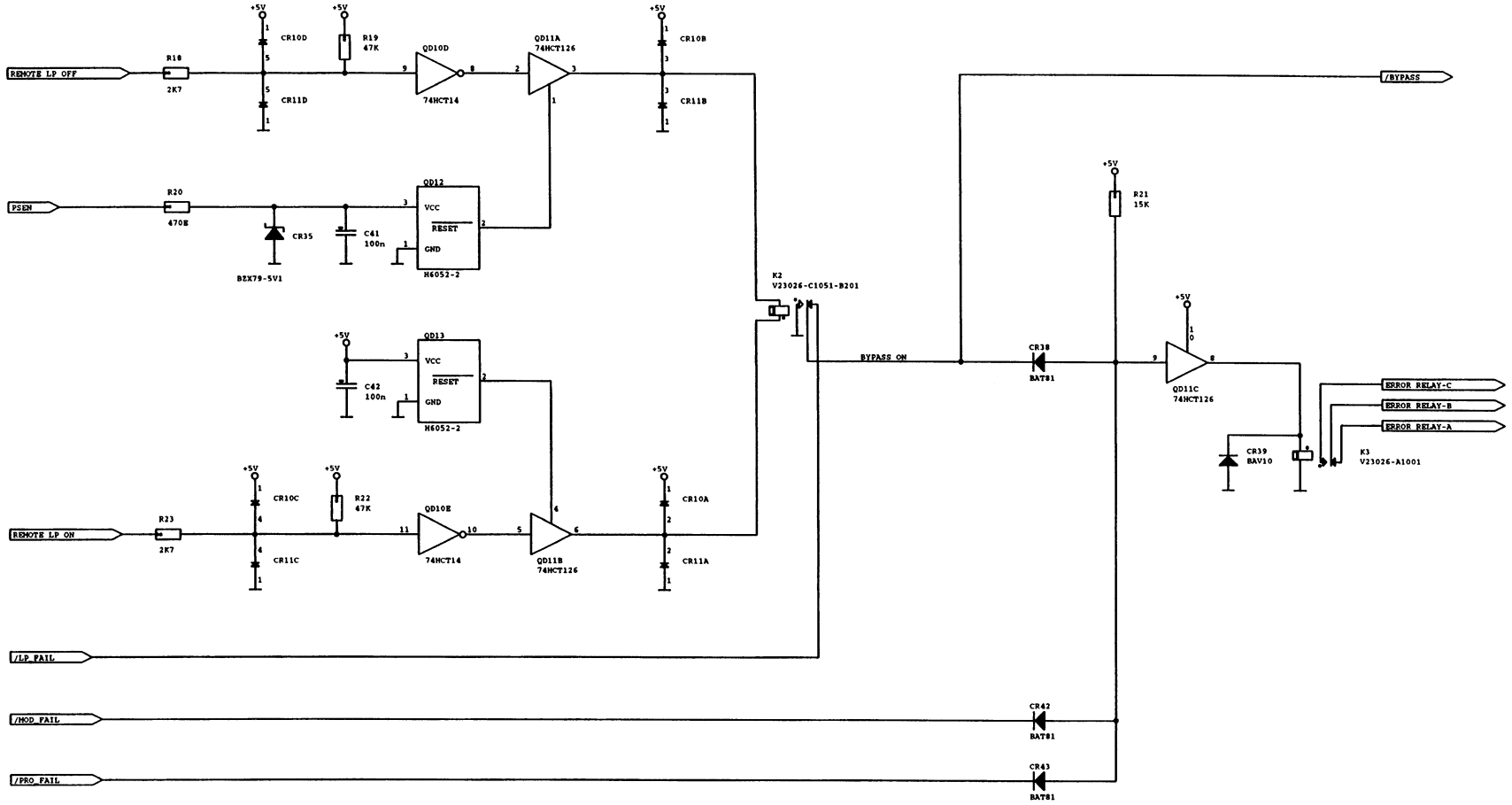
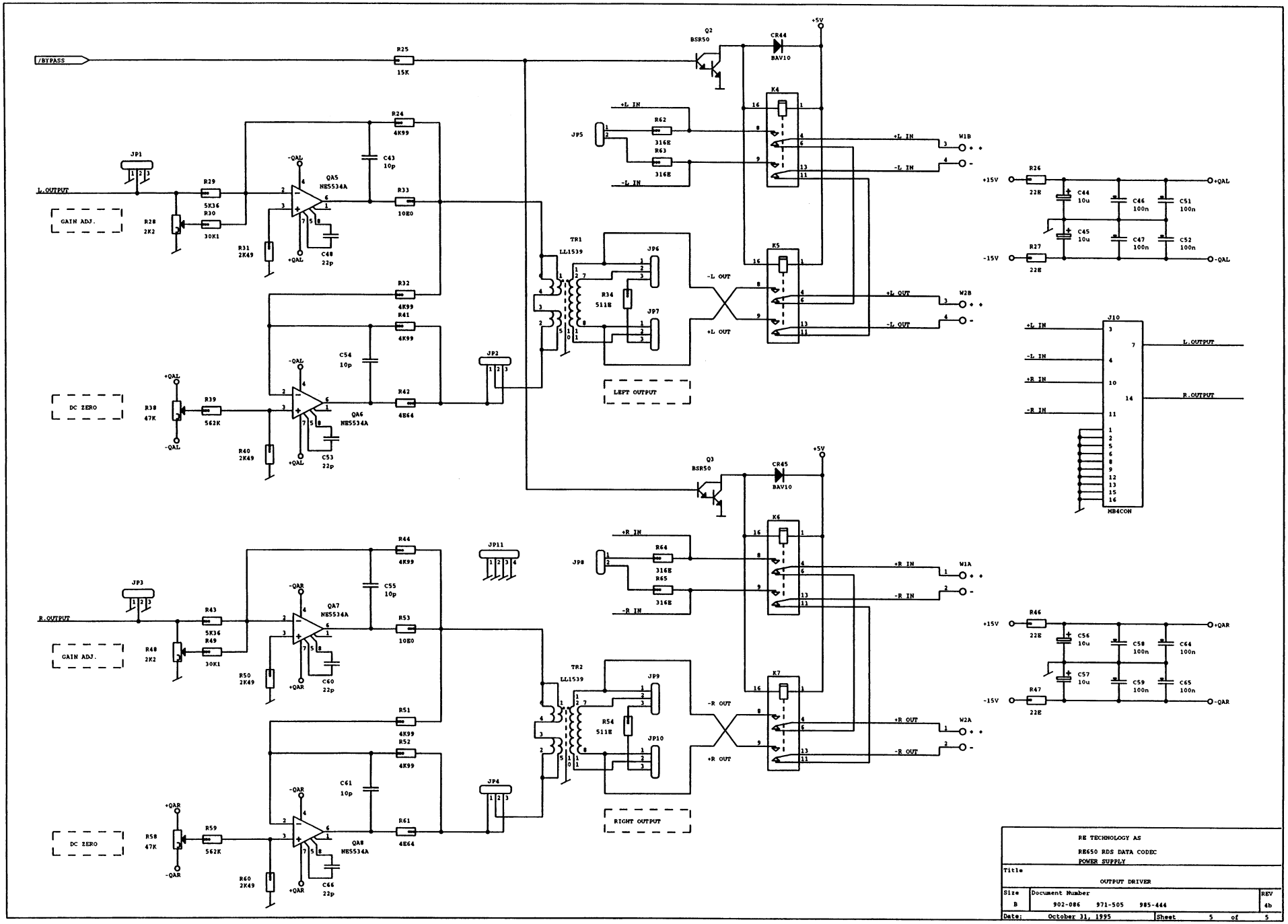
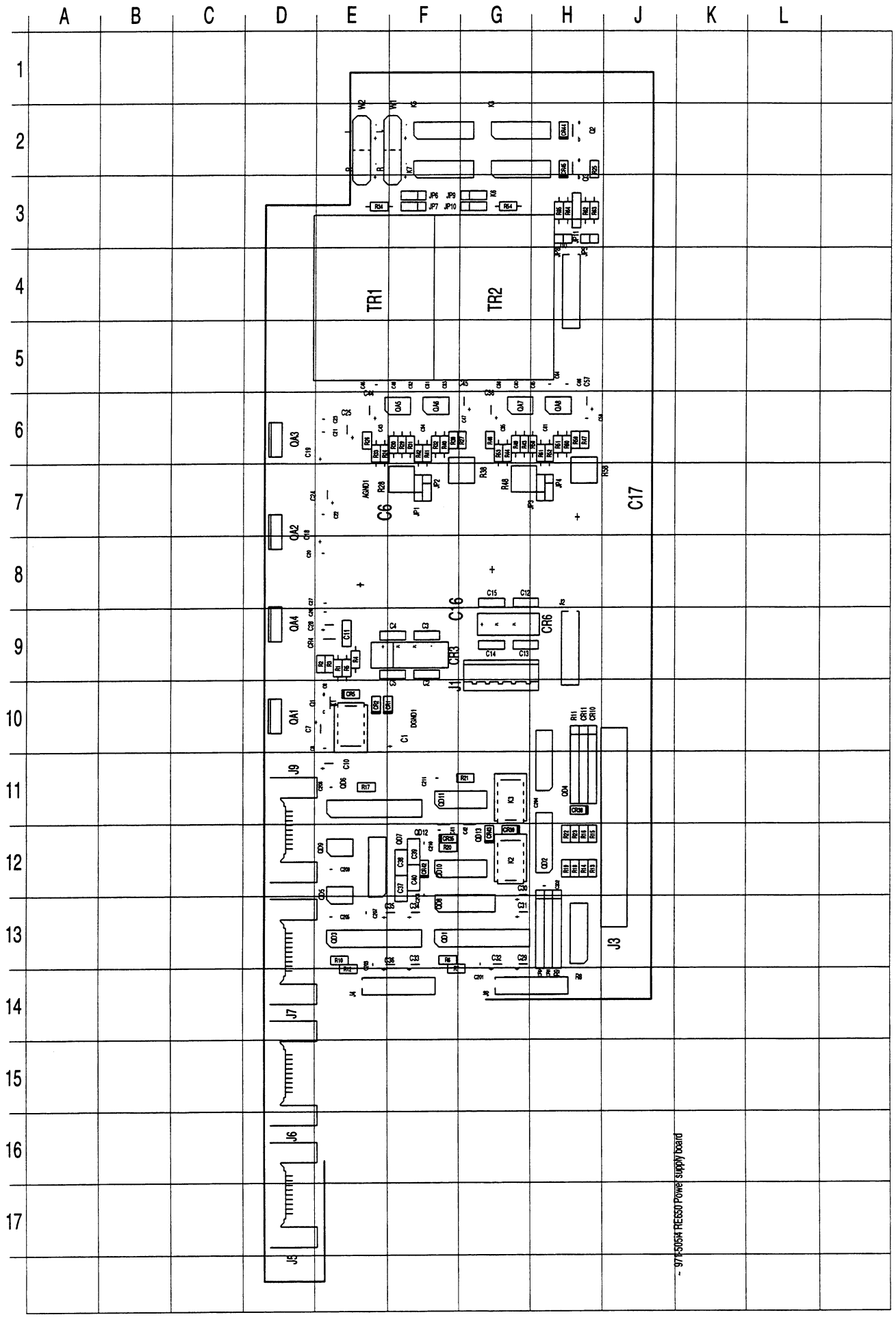
Document Number
902-086 971-505 985-444
REV
4b
Date:
October 31, 1995
Sheet 3 of 5



RE TECHNOLOGY AS		
RE650 RDS DATA CODEC		
POWER SUPPLY		
Title: BYPASS RELAY CONTROL		
Size: B	Document Number: 902-086 971-505 985-444	REV: 4b
Date: October 31, 1995	Sheet 4 of 5	



RE TECHNOLOGY AS		
RE650 RDS DATA CODEC		
POWER SUPPLY		
Title: OUTPUT DRIVER		
Size: B	Document Number: 902-086 971-505 985-444	REV: 4b
Date: October 31, 1995	Sheet 5 of 5	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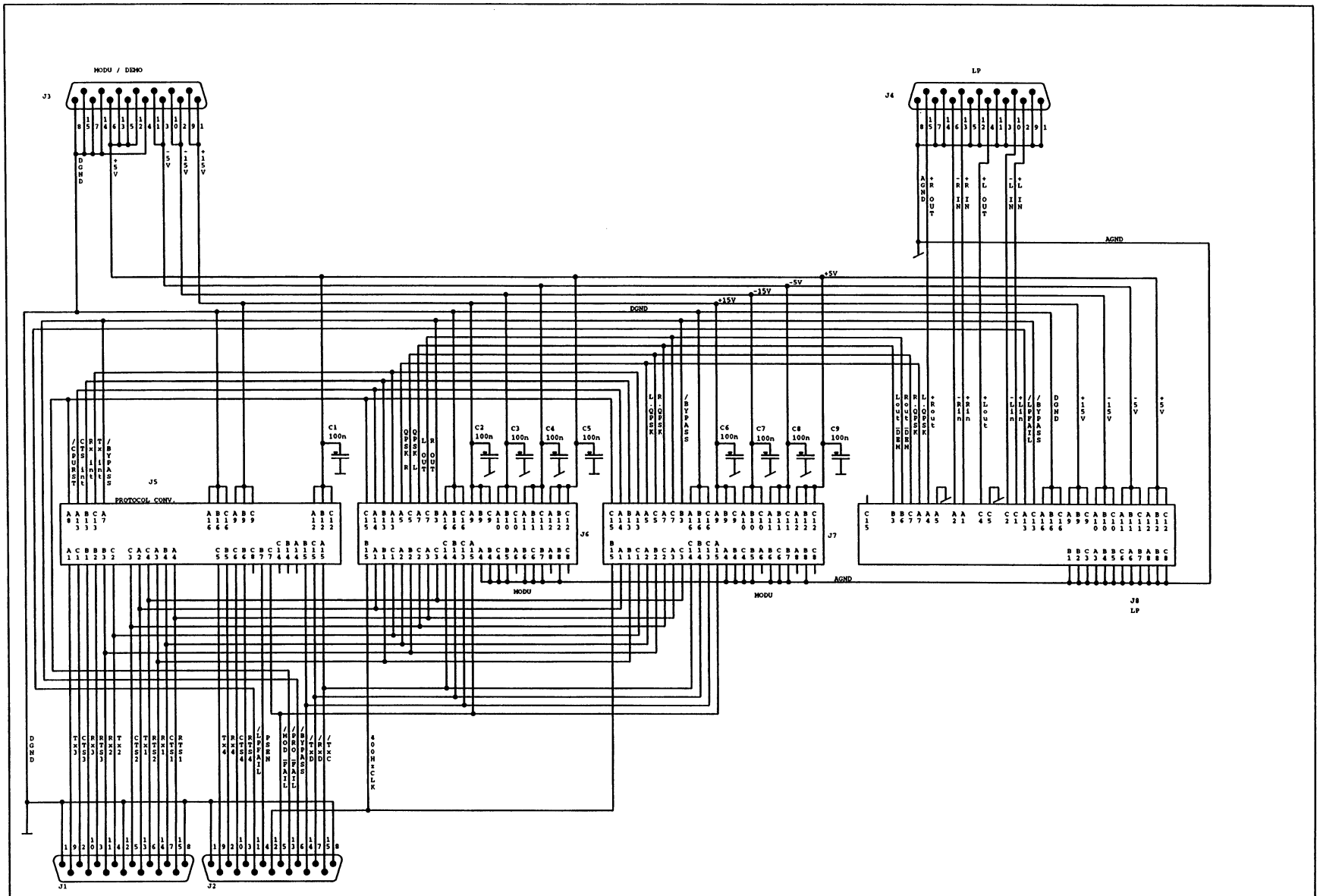
TR1
TR2
C6
C16
C17
J1
J2
J3
J4
J5
J6
J7
J9
CR3
CR6
OA1
OA2
OA3
OA4
DGND1
AGND1
~ 97A5054A RE650 Power supply board

COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC
AGND1	E7	C32	G13	JP7	F3	R4	E9	R60	H6																												
CR1	F10	C33	F13	JP8	H3	R5	E9	R61	H6																												
CR2	E10	C34	F13	JP9	F3	R6	F13	R62	H3																												
CR3	F9	C35	F13	JP10	F3	R7	F14	R63	H3																												
CR4	D9	C36	F13	JP11	H3	R8	H14	R64	H3																												
CR5	E10	C37	F12	J1	F10	R9	H14	R65	H3																												
CR6	H9	C38	F12	J2	H8	R10	E13	TR1	E4																												
CR8	H14	C39	F12	J3	J13	R11	H10	TR2	G4																												
CR9	H14	C40	F12	J4	E14	R12	E14	W1	F2																												
CR10	H10	C41	F12	J5	D18	R13	H12	W2	E2																												
CR11	H10	C42	G12	J6	D16	R14	H12																														
CR35	F12	C43	E6	J7	D14	R15	H12																														
CR38	H11	C44	E6	J8	G14	R16	H12																														
CR39	G12	C45	G5	J9	D11	R17	E11																														
CR42	F12	C46	E5	J10	H3	R18	H12																														
CR43	G12	C47	G6	K1	E10	R19	H12																														
CR44	H2	C48	F5	K2	G12	R20	F12																														
CR45	H2	C51	F5	K3	G11	R21	G11																														
C1	F10	C52	F5	K4	G2	R22	H12																														
C2	F10	C53	F5	K5	F2	R23	H12																														
C3	F9	C54	F6	K6	G3	R24	E6																														
C4	F9	C55	G6	K7	F2	R25	H2																														
C5	F10	C56	G6	QA1	D10	R26	E6																														
C6	E7	C57	H5	QA2	D7	R27	G6																														
C7	D10	C58	G5	QA3	D6	R28	E7																														
C8	E10	C59	H6	QA4	D9	R29	F6																														
C9	D10	C60	G5	QA5	F6	R30	F6																														
C10	E11	C61	H6	QA6	F6	R31	F6																														
C11	E9	C64	H5	QA7	G6	R32	F6																														
C12	G8	C65	H5	QA8	H6	R33	E6																														
C13	G9	C66	H5	QD1	F13	R34	E3																														
C14	G9	C201	G14	QD2	H12	R38	G7																														
C15	G8	C202	H12	QD3	E13	R39	F6																														
C16	F8	C203	E13	QD4	H11	R40	F6																														
C17	J7	C204	H11	QD5	E12	R41	F6																														
C18	D7	C205	E13	QD6	E11	R42	F6																														
C19	D6	C206	E11	QD7	F12	R43	G6																														
C20	D8	C207	E13	QD8	F13	R44	G6																														
C21	E6	C208	F13	QD9	E12	R46	G6																														
C22	E7	C209	E12	QD10	F12	R47	H6																														
C23	E6	C210	F12	QD11	F11	R48	G7																														
C24	D7	C211	F11	QD12	F12	R49	G6																														
C25	E6	DGND1	F10	QD13	G12	R50	H6																														
C26	D9	JP1	F7	Q1	D10	R51	H6																														
C27	D8	JP2	F7	Q2	H2	R52	H6																														
C28	D9	JP3	H7	Q3	H3	R53	G6																														
C29	G13	JP4	H7	R1	E9	R54	G3																														
C30	G12	JP5	H4	R2	E9	R58	J7																														
C31	G13	JP6	F3	R3	E9	R59	H6																														

COMPONENT SIDE 971-505i4


MODU / DEMO
J3
LP
J4
AGND
+5V
-5V
+15V
-15V
DGND
C1 100n
C2 100n
C3 100n
C4 100n
C5 100n
C6 100n
C7 100n
C8 100n
C9 100n
J5
PROTOCOL CONV.
J6
J7
MODU
J8
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PROTOCOL CONV.
J2
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RE TECHNOLOGY AS
RE650/651 RDS DATA CODEC
Title
MOTHER BOARD
Size
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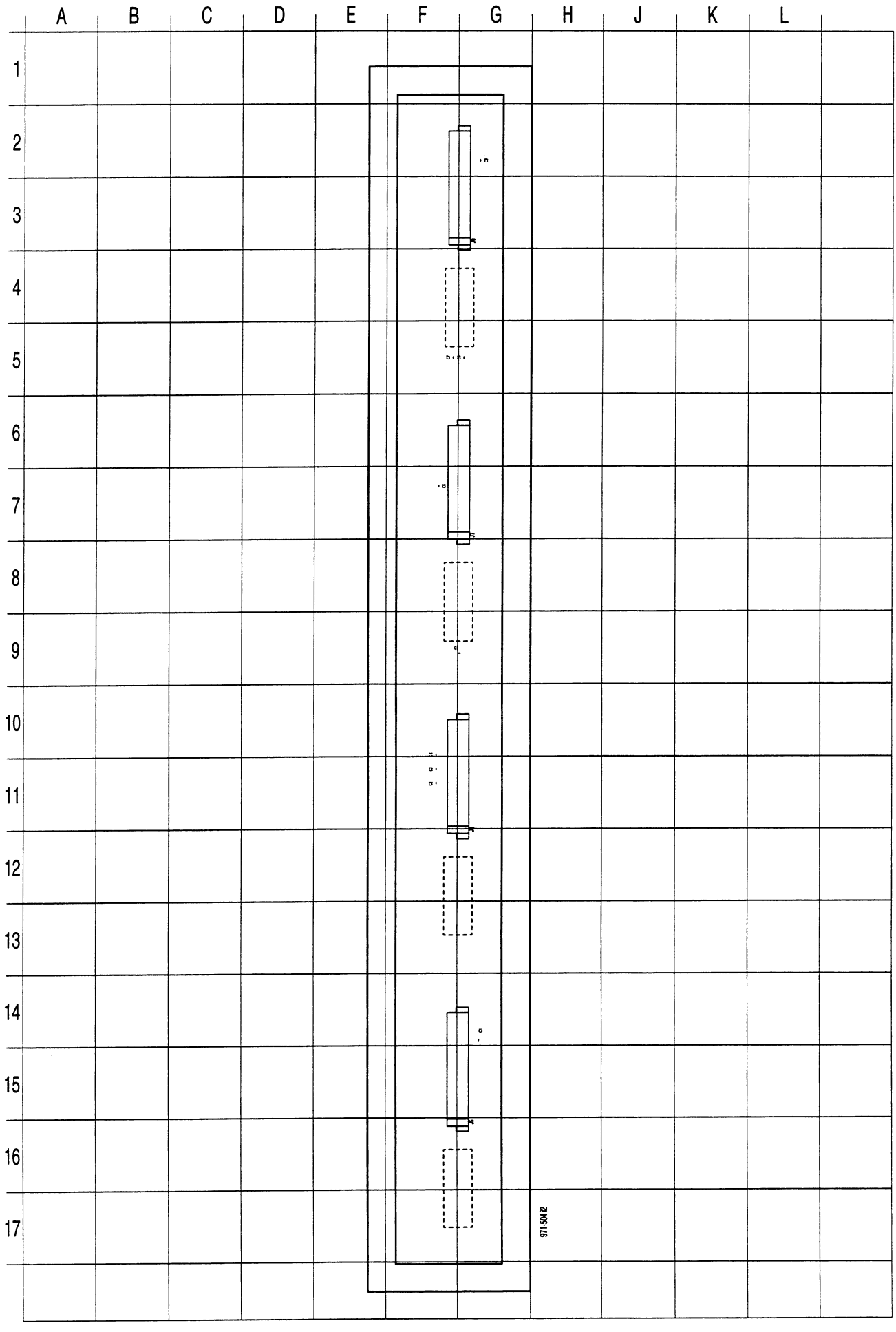
Document Number
902-084 971-504 985-434
REV
2d
Date: June 8, 1995
Sheet 1 of 1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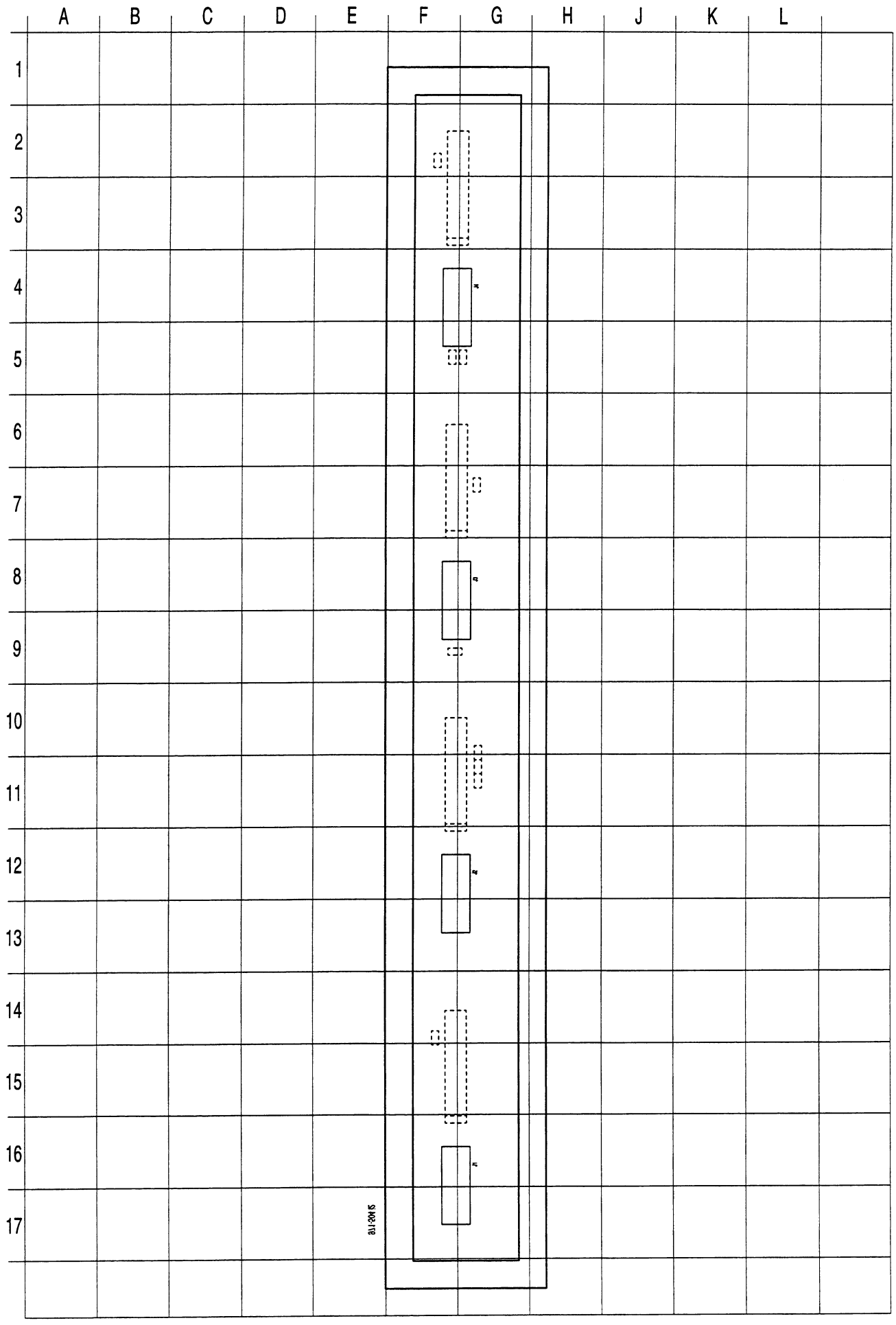
COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC
C1	G14																																		
C2	F11																																		
C3	F11																																		
C4	F10																																		
C5	F9																																		
C6	F7																																		
C7	F5																																		
C8	G5																																		
C9	G2																																		
J5	G16																																		
J6	G12																																		
J7	G7																																		
J8	G3																																		

COMPONENT SIDE 971-504i2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COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	COMP	LOC	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	G16																																				
J2	G12																																				
J3	G8																																				
J4	G4																																				

SOLDER SIDE 971-504i2

PCB Assy RE 650 Power Supply (902-086)

CAPACITORS

C 1	Electrolytic 100/40 2000h/85ø R:8*12 RM 3.5mm	261-097
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	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 6	Electrolytic 10000/16, 2000h/105ø, snap-in 30*30, RM4	261-105
C 7	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 8	C Ceramic 100n 20% 50V	213-401
C 9	C Ceramic 100n 20% 50V	213-401
C 10	C Solid Aluminium 33u 20% 10V Short Type	265-105
C 11	MKT, 0.047/63/10, R:2.5*6.5*7.2, RM2	241-083
C 12	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 13	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 14	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 15	MKT, 0.01/250/10, R:2.5*6.5*7.2, RM2	241-069
C 16	Electrolytic 4700/40, 2000h/105ø, snap-in 30*30, RM4	261-106
C 17	Electrolytic 4700/40, 2000h/105ø, snap-in 30*30, RM4	261-106
C 18	Electrolytic 100/40 2000h/85ø R:8*12 RM 3.5mm	261-097
C 19	Electrolytic 100/40 2000h/85ø R:8*12 RM 3.5mm	261-097
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 Solid Aluminium 10u 20% 25V Short Type	265-110
C 25	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 26	C Ceramic 100n 20% 50V	213-401
C 27	C Ceramic 100n 20% 50V	213-401
C 28	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 29	C Solid Aluminium 4u7 20% 25V Short Type	265-100
C 30	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 31	C Solid Aluminium 4u7 20% 25V Short Type	265-100
C 32	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 33	C Solid Aluminium 4u7 20% 25V Short Type	265-100
C 34	C Solid Aluminium 4u7 20% 25V Short Type	265-100
C 35	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 36	C Solid Aluminium 10u 20% 25V Short Type	265-110
C 37	MKT, 0.22/63/10, R:3.5*8*7.2, RM2	241-071
C 38	MKT, 0.22/63/10, R:3.5*8*7.2, RM2	241-071
C 39	MKT, 0.22/63/10, R:3.5*8*7.2, RM2	241-071
C 40	MKT, 0.22/63/10, R:3.5*8*7.2, RM2	241-071
C 41	C Ceramic 100n 20% 50V	213-401
C 42	C Ceramic 100n 20% 50V	213-401
C 43	C Ceramic 10p0 2% 100V NP0	213-205
C 44	C Solid Aluminium 10u 20% 25V Short Type	265-110

C 45	C Solid Aluminium 10u 20% 25V Short Type		265-110
C 46	C Ceramic 100n 20% 50V		213-401
C 47	C Ceramic 100n 20% 50V		213-401
C 48	C Ceramic 22p0 2% 100V NP0		213-206
C 51	C Ceramic 100n 20% 50V		213-401
C 52	C Ceramic 100n 20% 50V		213-401
C 53	C Ceramic 22p0 2% 100V NP0		213-206
C 54	C Ceramic 10p0 2% 100V NP0		213-205
C 55	C Ceramic 10p0 2% 100V NP0		213-205
C 56	C Solid Aluminium 10u 20% 25V Short Type		265-110
C 57	C Solid Aluminium 10u 20% 25V Short Type		265-110
C 58	C Ceramic 100n 20% 50V		213-401
C 59	C Ceramic 100n 20% 50V		213-401
C 60	C Ceramic 22p0 2% 100V NP0		213-206
C 61	C Ceramic 10p0 2% 100V NP0		213-205
C 64	C Ceramic 100n 20% 50V		213-401
C 65	C Ceramic 100n 20% 50V		213-401
C 66	C Ceramic 22p0 2% 100V NP0		213-206
C 201	C Ceramic 100n 20% 50V		213-401
C 202	C Ceramic 100n 20% 50V		213-401
C 203	C Ceramic 100n 20% 50V		213-401
C 204	C Ceramic 100n 20% 50V		213-401
C 205	C Ceramic 100n 20% 50V		213-401
C 206	C Ceramic 100n 20% 50V		213-401
C 207	C Ceramic 100n 20% 50V		213-401
C 208	C Ceramic 100n 20% 50V		213-401
C 209	C Ceramic 100n 20% 50V		213-401
C 210	C Ceramic 100n 20% 50V		213-401
C 211	C Ceramic 100n 20% 50V		213-401

DIODES

CR 1	Diode BAV10 Si Vr-60V If-600mA		350-022
CR 2	Diode BAV10 Si Vr-60V If-600mA		350-022
CR 3	Bridge Rectifier Vin:140 Io:6A		340-212
CR 4	IC TL431 ADJ. Precision Shunt Regulators		364-849
CR 5	Diode BAV10 Si Vr-60V If-600mA		350-022
CR 6	Bridge Rectifier Vin:140V Io:1.9A	NND	340-208
CR 8	Diode Array Sil 9Pin Commen K 80V-0.025A		350-901
CR 9	Diode Array Sil 9Pin Commen A 80V-0.025A		350-902
CR 10	Diode Array Sil 9Pin Commen K 80V-0.025A		350-901
CR 11	Diode Array Sil 9Pin Commen A 80V-0.025A		350-902
CR 35	Diode Zener BZX79-C5V1 0.4W		350-615
CR 38	Diode Bat81 schottky Vr-40V If-30mA		350-066
CR 39	Diode BAV10 Si Vr-60V If-600mA		350-022
CR 42	Diode Bat81 schottky Vr-40V If-30mA		350-066
CR 43	Diode Bat81 schottky Vr-40V If-30mA		350-066
CR 44	Diode BAV10 Si Vr-60V If-600mA		350-022
CR 45	Diode BAV10 Si Vr-60V If-600mA		350-022

CONNECTORS

J 1	6 pin Snap IN PCB Male Conn pitch 3.96	806-153
J 2	Socket 16 pol miniature	806-050
J 3	DIN 41651 Low Profile Headers 40Pol Str.Male PCB	806-015
J 4	Socket 16 pol miniature	806-050
J 5	D-Sub 9 pol female 90ø with UN4-40 and filter 1000pF	806-188
J 6	D-Sub 9 pol female 90ø with UN4-40 and filter 1000pF	806-188
J 7	D-Sub 9 pol female 90ø with UN4-40 and filter 1000pF	806-188
J 8	Socket 16 pol miniature	806-050
J 9	D-Sub 9 pol female 90ø with UN4-40 and filter 1000pF	806-188
J 10	Socket 16 pol miniature	806-050

RELAYS & JUMPERS

JP 1	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 2	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 3	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 4	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 5	Pin header 2 pol straight l:6.7mm with lock	805-951
JP 6	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 7	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 8	Pin header 2 pol straight l:6.7mm with lock	805-951
JP 9	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 10	Pin header 3 pol straight l:6.7mm with lock	805-894
JP 11	Pin header 4 pol straight l:6.7mm with lock	805-901
K 1	Relay Miniature V23026-A1001-B201	570-097
K 2	Relay Miniature V23026-C1051-B201	570-091
K 3	Relay Miniature V23026-A1001-B201	570-097
K 4	Relay Double Throw 5 V0lt	570-090
K 5	Relay Double Throw 5 V0lt	570-090
K 6	Relay Double Throw 5 V0lt	570-090
K 7	Relay Double Throw 5 V0lt	570-090

TRANSISTORS

Q 1	Transistor BC557B pnp	360-160
Q 2	Transistor BSR50 npn	360-201
Q 3	Transistor BSR50 npn	360-201

INTEGRATED ANALOG CIRCUITS

QA 1	IC LT1085-5CT Low Dropout +5V/3A Reg TO220	365-133
QA 2	IC LM340T-15 3-terminal positive regulators	364-210
QA 3	IC LM320T-15 3-terminal negative regulators	364-211
QA 4	IC L7905CT - 5V regulator	364-884
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 5534A op amp	364-639

INTEGRATED DIGITAL CIRCUITS

QD 1	IC MAX238 Quad TX and RX RS232 Line Driver	365-132
QD 2	IC 74HC165 Shift Register	365-013
QD 3	IC MAX238 Quad TX and RX RS232 Line Driver	365-132
QD 4	IC 74HC165 Shift Register	365-013
QD 5	RS-422 Driver/Receiver, DS8921	365-195
QD 6	RE650/51 Prog EP610 902-086 QD11 Power Supply	369-367
QD 7	IC LT1181 5V RS232 Dual Driver Rec.W.Small Cap	365-190
QD 8	IC 74HC4094 8 stage shift REG.	364-811
QD 9	RS-422 Driver/Receiver, DS8921	365-195
QD 10	IC 74HCT14 Hex inverter with Schmitt trigger	364-699
QD 11	IC 74HCT126 QUAD buffer	364-973
QD 12	IC H6052-2 Smart Reset Activ Low	365-168
QD 13	IC H6052-2 Smart Reset Activ Low	365-168

RESISTORS

R 1	R Metal Film 3K74 1% 0.5W TC50	114-374
R 2	R Metal Film 470E 5% 0.2W TC250	107-347
R 3	R Metal Film 1K50 5% 0.2W TC250	107-415
R 4	R Metal Film 2K21 1% 0.5W TC50	114-221
R 5	R Metal Film 37K4 1% 0.5W TC50	115-374
R 6	R Metal Film 10K0 5% 0.2W TC250	107-510
R 7	R Metal Film 3K30 5% 0.2W TC250	107-433
R 8	Thick Film DIL 8*2K7 2% 0.25W TC250	146-028
R 9	Thick Film SIL 8*47K	146-005
R 10	R Metal Film 10K0 5% 0.2W TC250	107-510
R 11	Thick Film SIL 8*47K	146-005
R 12	R Metal Film 3K30 5% 0.2W TC250	107-433
R 13	R Metal Film 2K70 5% 0.2W TC250	107-427
R 14	R Metal Film 2K70 5% 0.2W TC250	107-427
R 15	R Metal Film 2K70 5% 0.2W TC250	107-427
R 16	R Metal Film 2K70 5% 0.2W TC250	107-427
R 17	R Metal Film 47K0 5% 0.2W TC250	107-547
R 18	R Metal Film 2K70 5% 0.2W TC250	107-427
R 19	R Metal Film 47K0 5% 0.2W TC250	107-547
R 20	R Metal Film 470E 5% 0.2W TC250	107-347
R 21	R Metal Film 15K0 5% 0.2W TC250	107-515
R 22	R Metal Film 47K0 5% 0.2W TC250	107-547
R 23	R Metal Film 2K70 5% 0.2W TC250	107-427
R 24	Metal Film 4k99 0.1% 0.25W TC15	140-981
R 25	R Metal Film 15K0 5% 0.2W TC250	107-515
R 26	R Metal Film 22E0 5% 0.2W TC250	107-222
R 27	R Metal Film 22E0 5% 0.2W TC250	107-222

R 28	Cermet Trimpot 2K2 20% 0.5W	182-313
R 29	R Metal Film 5K36 1% 0.5W TC50	114-536
R 30	R Metal Film 30K1 1% 0.5W TC50	115-301
R 31	Metal Film 2K49 0.1% 0.25W TC15	141-297
R 32	Metal Film 4k99 0.1% 0.25W TC15	140-981
R 33	R Metal Film 10E0 1% 0.4W TC50	112-100
R 34	R Metal Film 511E 1% 0.5W TC50	113-511
R 38	Cermet Trimpot 50K 10% 0.5W	182-441
R 39	R Metal Film 562K 1% 0.4W TC50	116-562
R 40	Metal Film 2K49 0.1% 0.25W TC15	141-297
R 41	Metal Film 4k99 0.1% 0.25W TC15	140-981
R 42	R Metal Film 4E64 1% 0.4W TC50	111-464
R 43	R Metal Film 5K36 1% 0.5W TC50	114-536
R 44	Metal Film 4k99 0.1% 0.25W TC15	140-981
R 46	R Metal Film 22E0 5% 0.2W TC250	107-222
R 47	R Metal Film 22E0 5% 0.2W TC250	107-222
R 48	Cermet Trimpot 2K2 20% 0.5W	182-313
R 49	R Metal Film 30K1 1% 0.5W TC50	115-301
R 50	Metal Film 2K49 0.1% 0.25W TC15	141-297
R 51	Metal Film 4k99 0.1% 0.25W TC15	140-981
R 52	Metal Film 4k99 0.1% 0.25W TC15	140-981
R 53	R Metal Film 10E0 1% 0.4W TC50	112-100
R 54	R Metal Film 511E 1% 0.5W TC50	113-511
R 58	Cermet Trimpot 50K 10% 0.5W	182-441
R 59	R Metal Film 562K 1% 0.4W TC50	116-562
R 60	Metal Film 2K49 0.1% 0.25W TC15	141-297
R 61	R Metal Film 4E64 1% 0.4W TC50	111-464
R 62	R Metal Film 316E 1% 0.4W TC50	113-316
R 63	R Metal Film 316E 1% 0.4W TC50	113-316
R 64	R Metal Film 316E 1% 0.4W TC50	113-316
R 65	R Metal Film 316E 1% 0.4W TC50	113-316

MISCELLANEOUS

Screw Pozidrive panhead M3x6	008-306
Screw Pozidrive Panhead M3X10	008-310
Screw Pozidrive panhead M3*12	008-312
Screw Pozidrive panhead M4x5	008-405
Screw Pozidrive countersunk M3x8	009-308
Hexagon cylinder screw M5x30	010-530
Nut Rectangular M3 for to220	035-909
Lock washer D3,2/5,5x0,45	046-405
Lock washer D4,3/7x0,5	046-407
Lock washer D5,3/9x0,6	046-408
Lock washer D6,4/10x0,7	046-409
Tubular rivet D2,5x6	060-260
Soldering lug 4,3x12-3	061-341
Ground Wire For RE8720/8730	618-104

RE650/651, 40 pol remote control cable 130mm		618-134
Wire AWG 16 green/yellow		630-145
Sleewing shrink clr. 3,2		692-011
Line Transformer F.RE651 230V/+-21V/7.6V		770-709
Power Line Filter With Fuse		802-216
Conn Banana Receptable		803-241
Flat plug, red 6.3*0.8		804-618
D-Sub access, screw lock for chassis		805-470
Female Plug		805-718
Lemo Triaxial Male For Chassis		806-076
6 pin Snap IN Cabel Female Conn pitch 3.96		806-155
Mounting Acc. for TO-220		816-163
Insulation Bushing F. TO-220		816-214
Heat Sink 150x25x37.5		816-321
Ty-Wrap 100*2,5MM		832-203
CHASSIS FOR RE651		933-237
PCB For RE650 Power Supply		971-505
Chassis For RE650/51 Iss3		973-004
QDS1	Socket DIL 24 pol, h:4.95 300mil	816-274
QDS3	Socket DIL 24 pol, h:4.95 300mil	816-274
QDS5	Socket DIL 8 pol, h:4.95 300mil	816-132
QDS6	Socket DIL 24 pol, h:4.95 300mil	816-274
QDS7	Socket DIL 16 pol, h:4.95 300mil	816-133
QDS9	Socket DIL 8 pol, h:4.95 300mil	816-132
TR 1	Transformer Audio PCB Mounting	772-017
TR 2	Transformer Audio PCB Mounting	772-017

PCB Assy RE 651 Motherboard (902084)

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

CONNECTORS

J 5	DIN 41612 48 pol female straight with coding, C/2 class II	806-191
J 6	DIN 41612 48 pol female straight with coding, C/2 class II	806-191
J 7	DIN 41612 48 pol female straight with coding, C/2 class II	806-191
J 8	DIN 41612 48 pol female straight with coding, C/2 class II	806-191

MISCELLANEOUS

Tubular rivet D2,5x6	060-260
D-Sub access, screw lock for chassis	805-470
DIN 41612 Access, coding key for Winchester Type	806-192
Socket 1 pol for D-Sub Conn.	816-299
PCB For RE650/51 Motherboard	971-504

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