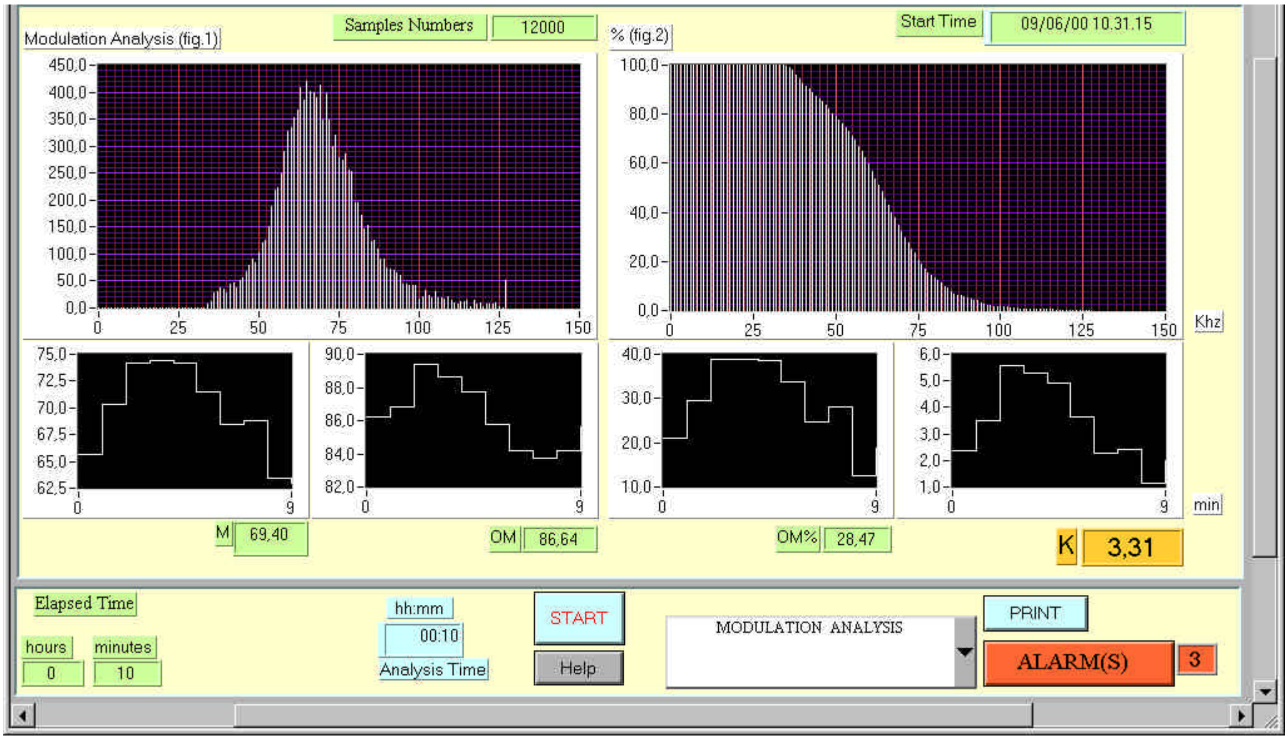
TECHNICAL , MAINTENANCE AND INSTALLATION MANUAL

TX50S FM TRANSMITTER



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CTE international
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ITALY

OWNERS MANUAL
MAINTENANCE MANUAL
TX50S FM TRANSMITTER
Printed : 06-05-2000 Rev. A
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IN ACCORDING TO **R&TTE** RULES
NOTIFIED BODY : **0523**

ITALY RESTRICTIONS : "L'uso dell'apparato è soggetto a concessione
Potenza RF 50 Watt
Canalizzazione 100 Khz (solo mod. TX50S)"

CONTENTS

CHAPTER 1 - SAFETY INSTRUCTIONS

CHAPTER 2 - ELECTRICAL SPECIFICATIONS

CHAPTER 3 - DESCRIPTION OF THE DEVICE

CHAPTER 4 - INSTALLATION

CHAPTER 5 - CIRCUITS DESCRIPTION

CHAPTER 6 - ADJUSTAMENTS

CHAPTER 7 - MODULATION MEASUREMENTS

CHAPTER 8 - REMOTE CONTROL

CHAPTER 9 - INTERNAL AND REAR WIEW

CHAPTER 10 - DIAGRAMS AND LAYOUTS

SAFETY INSTRUCTIONS

1.1 Introduction

CTE has always managed to improve the safety standard if its transmitting and receiving equipment. All produced systems are tested in compliance with international EN60950 and EN60215 rules.
Obviously this is not sufficient to avoid any accident during the installation and the use of our equipment in compliance with EN60215 rule, the radio transmitters and the auxiliary equipment must be used by qualified technical staff only and CTE declines any responsibility for damages caused by an improper use or improper setting up performed by inexperienced staff, not qualified or operating with instruments or tools not in compliance with safety set of rules.

WARNING

CURRENT AND VOLTAGE WORKING IN THIS EQUIPMENT ARE DANGEROUS. THE STAFF MUST ALWAYS OBSERVE THE SAFETY RULES, INSTRUCTIONS AND NORMS CONTAINED HEREIN.

WARNING

THE INSTRUCTIONS CONTAINED IN THIS MANUAL MUST BE READ BEFORE SWITCHING ON OR SETTING THE TRANSMITTER

WARNING

ANY TRANSMITTER SERVICING, REPAIRING OR CHECKING OPERATION REQUIRING THE OPENING OF THE TOP OR BOTTOM COVER, MUST BE PERFORMED AFTER THE MAINS SUPPLY DISCONNECTION WITHOUT REMOVING THE EARTH CONNECTION WHICH THE EFFICIENCY MUST BE VERIFIED: THE CABLE MUST BE IN GOOD CONDITIONS AND WELL CONNECTED.

WARNING

STAFF OPERATING UPON THE TRANSMITTER SYSTEM MUST NOT BE TIRED: AFTER HEAVY WORKS OR CARRYING HEAVY MACHINES BY HAND, IT IS NECESSARY TO RESPECT A PERIOD OF REST BEFORE WORKING WITH SYSTEMS WHICH COULD HAVE DANGEROUS ELECTRIC VOLTAGE IF THEY ARE NOT DISCONNECTED.

WARNING

SEVERAL SYMBOLS, INSIDE THE TYPICAL TRIANGLE SHOWING DANGER, HAVE BEEN PRINTED ON SEVERAL TRANSMITTER PARTS. ATTENTION SHOULD BE PAID, BECAUSE THERE COULD BE THE DANGER DUE TO HOT SURFACES, ELECTRIC VOLTAGE HIGHER THAN 50VOLT OR OTHER SPECIFIED DANGERS.

Certain devices (for example the RF final circuits mosfets) contain Beryllium Oxide BeO; these components must not be broken, crashed or heated. This oxide passes through the common systems of filtering, including the respiratory apparatus. The prolonged inhalation at high degrees causes poisoning with respiratory apparatus paralysis, till death.

WARNING

ALL THE MODULES CONTAINING BeO ARE MARKED WITH THE TRIANGULAR WARNING SYMBOL INDICATING THE NOTICE:

WARNING ! **TOXIC HAZARD**
THESE DEVICES CONTAIN BERYLLIUM OXIDE
OBSERVE SAFETY INSTRUCTIONS !

The staff in charge, besides being technically qualified, must have a practice of the first aid in case of emergency or accident (reanimation, heart massage, mouth to mouth respiration, etc.).
Before going on with the operations to be performed, it is necessary to know the position of the general electric switch and the one of the extinguishers, which are to be used very quickly if necessary.

TX50S FM BROADCASTING TRANSMITTER

ELECTRICAL SPECIFICATION

2.1 FREQUENCY - POWER

Frequency range	87.6 to 107.9MHz
Frequency setting	in 100KHz steps (model TX50S-S have 10 Khz steps)
Internal setting mode	by keys
External setting mode	by remote control (RS232-RS485)
Frequency stability	±1000Hz/year
Frequency generation	PLL synthesizer
Modulation type	direct VCO frequency modulation
Nominal frequency deviation	±75KHz
Deviation linearity in all frequency range	±0.2dB
Peak detector error	<0.1dB
RF output power	0 to 50W
Power resolution setting	0.1W
Power control limit setting	1 to 50W
Power control stability	< 0.1dB
Reverse output power control limit	1 to 9.9W
Reverse output power steps control	0.1W
Harmonics emission	<-70dBc
Spurious emission	<-95dBc
Carrier reduction power (carrier enable off)	>60dBc

2.2 MODULATION CAPABILITY

MONO (left and right)	30Hz to 15KHz
STEREO (by internal stereo generator)	30Hz to 53KHz
SCA (two channels)	30Hz to 100KHz
COMPOSITE	MONO or STEREO + SCA

2.3 CHARACTERISTICS IN MONO

Signal input	Left + Right
Input impedance	600Ω (balanced) or 10kΩ
Unbalance rejection	>40dB
Input level	–6 to +12dBm
Pre-emphasis	75 or 50µs
Audio frequency response (30Hz to 15KHz)	<0.15dB
Audio frequency response (19KHz to 100KHz)	<-40dB
Modulation distortion	<0.03%
Signal to noise ratio	>85dB

2.4 CHARACTERISTICS IN STEREO

Signal inputs -- Left or Right
Input impedance-- 600Ω (balanced) or 10kΩ
Unbalance rejection--->40dB
Input level---–6 to +12dBm
Pre-emphasis -- 75 or 50µs
Audio frequency response (30Hz to 15KHz) --<0.15dB
Audio frequency response (19KHz to 100KHz)---<40dB
cross-talk between left and right channel--->50dB
Distortion at frequency deviation of 75KHz-- <0.03%
Distortion at frequency deviation of 100KHz --- <0.03%
Signal to noise referred at deviation of 75KHz--->80dB
Suppression of 38KHz -->80dB
Spurious suppression outside band-- .in according to ETS 300-384
Pilot reference for RDS encoder (19 Khz out)-- 1Vpp

2.5 SCA CHARACTERISTICS

Input (SCA1, SCA2) -- BNC unbalanced
Input impedance-- 10KΩ
Frequency response (50KHz to 100KHz) ---<0.1dB
Distortion ---<0.1%
Modulation capability ---0 to 10%

2.6 READOUT ON LCD DISPLAY (40x4 character)

Forward power resolution-- 0.1W
Reverse power resolution -- 0.1W
Modulation resolution--1KHz
Line voltage resolution --- 1V
Power amplifier voltage resolution -- 1V
Power amplifier current resolution--0.1A
Heatsink temperature resolution-- 1°C

2.7 REMOTE CONTROL

COM1 (front panel)--RS232
COM2 (rear panel)---RS232
COM3 (rear panel)---RS485
Personal computer software --National Instruments LAB-VIEW ®
Transmission protocol---AES-EBU SP 490

2.8 POWER SUPPLY AND TEMPERATURE RANGE

Operating voltage -- 115 or 230V_{AC} ±10 %
Line power-- <150VA
Nominal temperature range--- -5° to 45°C
Operating temperature range ---10° to 50°C
Storage temperature range -- -40° to 50°C

2.9 MECHANICAL SPECIFICATION

19" rackmount--- 485x88x500mm
Weight--- 12Kg

2.10 OPTIONS

Option A -- Stereo generator
Option B ---Automatic Audio Level Control
Option C -- Remote Control
TX50S-S ---10 Khz frequency steps

2.11 STANDARDS COMPLYS (**R&TTE**)

Electrical characteristics -- ETSI 300-384
EMC characteristics --- ETSI 300-447
Safety characteristics -- EN-60950–EN-60215
Notified Body ---0523

GENERAL DESCRIPTION

3.1 Main features

TX50S is a FM band broadcasting transmitter with modern conceiving and technology, which by a simple design produces an output radio signal with high characteristics of quality, reliability and security.

The simple manufacturing obtained with a hi integration of functions, has allowed to create a machine with few controls and connections. Most printed circuits are multilayer with a surface mounting technology component assembling. The eventual repairing can be done by simply changing the fault involved board, without searching the defective component.

One of the most important characteristics is done by the high quality of the frequency modulation and the high signal-to-noise ratio; moreover, the modulation is typically constant within 0.1dB throughout the whole FM band (88–108MHz). A proper peak detector allows to perform both traditional modulation measurements (usual bar-graph with peak), and modulation and power modulation ones with long observation periods (even with many hours or days) according to the latest international regulations, which properly cared to fix a limit scientifically measurable to the peak and modulation power (CEPT 54-01).

An particular audio circuit can control the input audio level with a ±6dB dynamics referred to the nominal value: this can be extremely useful when the audio signal level is not fixed or when this one can be subject to fluctuations (usually very slow) due to thermal driftsbad systems maintenance, possible damages along radio link paths etc. A proper board can be inserted to obtain this function and a proper microprocessor follows constantly the modulation value correcting through proper algorithms, implemented in its memory, the value of the modulator gain, keeping this way the modulation very close to the maximum allowed value. The corrections take place at very long periods of time; the board does not perform the audio compressing-limiting functions, but just compensates possible drifts occurring on the systems carrying the audio channel before entering in the FM transmitter. No measurable phase or amplitude distortion is introduced in the modulation when the automatic gain control circuit is enabled. In addition an alarm which switches the power off in case of modulation absence can be inserted since the unmodulated carrier transmission is forbidden in many countries, with no chance to identify the radio.

The transmitter can be set like a modern signals generator so the output power is completely managed by a device which guarantees that the values of forward power, reflected power, maximum output power versus the temperature and loading conditions, are always the ones set or the ones allowed by maximum limits. A directional wide band coupler with remarkable directivity and large on board memory allows to obtain a power accuracy worthy of a good measurement instrument.

All parameters (frequency, levels, mono/stereo, pre-emphasis, power) can be set by the keyboard and stored in E^2PROM in order to be kept even without electric supply. A great number of events can be stored: each alarm is distinguished by a starting and an ending alarm date. The controlled parameters are: modulation absence, heatsink temperature, mains supply voltage, RF power final stage voltage and current, main oscillator fault.

Besides the keyboard, the transmitter can be remotely controlled in different ways. A personal computer can be connected as monitor to the DB9 socket placed on the front panel and by a special program, to be load easily on the PC, all the transmitter parameters can be set and seen. Furthermore it's possible to perform all the modulation analysis provided by the CEPT 54-01 regulations and create the related graphics which can be stored as a file in the PC.

A second RS232 port placed in the transmitter rear part can be connected to the power amplifier connected in series to the exciter, thus allowing the power data display on the same PC connected to the front RS232.

A third RS485 port placed in the rear part can be connected to a MODEM which is connected to the phone line thus assuring the transmitter telecontrol, remotely or from the studio.

The same RS485 port can be used for the connection N+1 of more transmitters (max 32). In this case a transmitter acts as a "joker", so it replaces the faulty equipment, automatically adapting to all its parameters. Each transmitter is also provided with an output port (IN/OUT) suitable to drive the antenna cable multiplexer and the one for the input audio signals switching.

3.2 Available options

a)	STEREO ENCODER	: additional board allowing the internal encoding of the stereophonic signal
b)	AGC	: additional board allowing a frequency modulation control
c1)	REMOTE CONTROL	: software for the PC connection
c2)	N+1 system	: software to obtain N+1 system

Model TX50S-S have 10 Khz frequency steps

3.3 Block diagram

The transmitter can be modulated by five different audio signal.

The first two ones are made by monophonic left and right channels, which can be balanced or unbalanced. The input dynamic goes from –6 to +12dBm with an input impedance which can be high or low. On these channels either the European or American pre-emphasis value can be inserted. A low pass filter on each of the two inputs assures a good attenuation of audio frequencies higher than 15KHz which could interfere, in case of stereophonic transmission, with higher band and with la subcarrier of the Multiplex signal; the out-of-band attenuation of the filter is not excessive in order not to increase then phase distortion (group delay) of the in band audio signal: 60–70dB of attenuation, even with 0.1dB of amplitude linearity up to 15KHz, unavoidably creates a distortion on the analogue signal that an experienced ear can perceive. Right or left signals can be combined to generate monophonic transmission (should you only have one of the two signals, it will be necessary to externally put in parallel the two inputs); in case of stereophonic transmission, the two channels are fed inside the stereo code board.

The mono signal or the stereo one, thus obtained, is combined with the other three possible input audio signals: an external Multiplex signal and two SCA signals, one of which can be the RDS one, which can be synchronized with a 19KHz one connected on the IN/OUT rear connector.

The composite signal can enter the AGC board, which has the task to check the its amplitude and consequently to keep the modulation at the correct value, or it can follow its path and enter into the frequency modulator after having passed through a limiter circuit (CLIPPER). This circuit must became active just in cases of faults of previous circuits or in case of mistake in the setting of the low frequency input nominal levels; this is to avoid to interfere with the adjacent channels. For not activating this “fuse”, which produces remarkable distortions on the modulation, it is necessary to take all proper cautions, that is the use of external compressor-limiters or by inserting the internal AGC circuit which protects a lot against damages and drifts.

The oscillator, directly modulated by the composite signal, covers the whole FM band and it’s synthesized in steps of 10KHz . The reference frequency is obtained by a 10MHz crystal kept at constant temperature of 55°C, whilst the output frequency is set by the main microcontroller. The oscillator phase noise is very good and it is in compliance with ETSI 300-384 regulations (<-145dBc for a shifting of 1MHz from the carrier). The modulation linearity is typically contained within 0.1dB without complicated corrections.

The RF final power circuit is wide band and it provides 50W RF output controlled with high accuracy; directional coupler has a directivity higher than 25dB on the whole band and an error which is lower than 0.2dB, it is also compensated in temperature and totally shielded.

The power supply is of a switching type and it gives the four essential voltages, all obtained with this technique. A small voltage measurement transformer allows to check the effective value of mains supply voltage with accuracy and to interrupt the output power in case this value exits from the normal operating window of the transmitter (15% respect the nominal value of 115V_{AC} or of 230V_{AC}). The mechanical position of the power supply and the final circuits of RF power allow to obtain a vent flu just for cooling of the involved circuits, obtaining this way a really remarkable efficiency of that function. In normal running conditions, when the transmitter is working in a full power at environmental temperature, the radiator temperature is lower than 35°C, whereas the other circuits temperature does not exceed 30°C. No components are involved with the air flow, so it isn’t requested a filter on the aspiration fan, which replacing is rather simple. The power supply is completely shielded both for internal circuits and for its unavoidable emissions toward the outside.

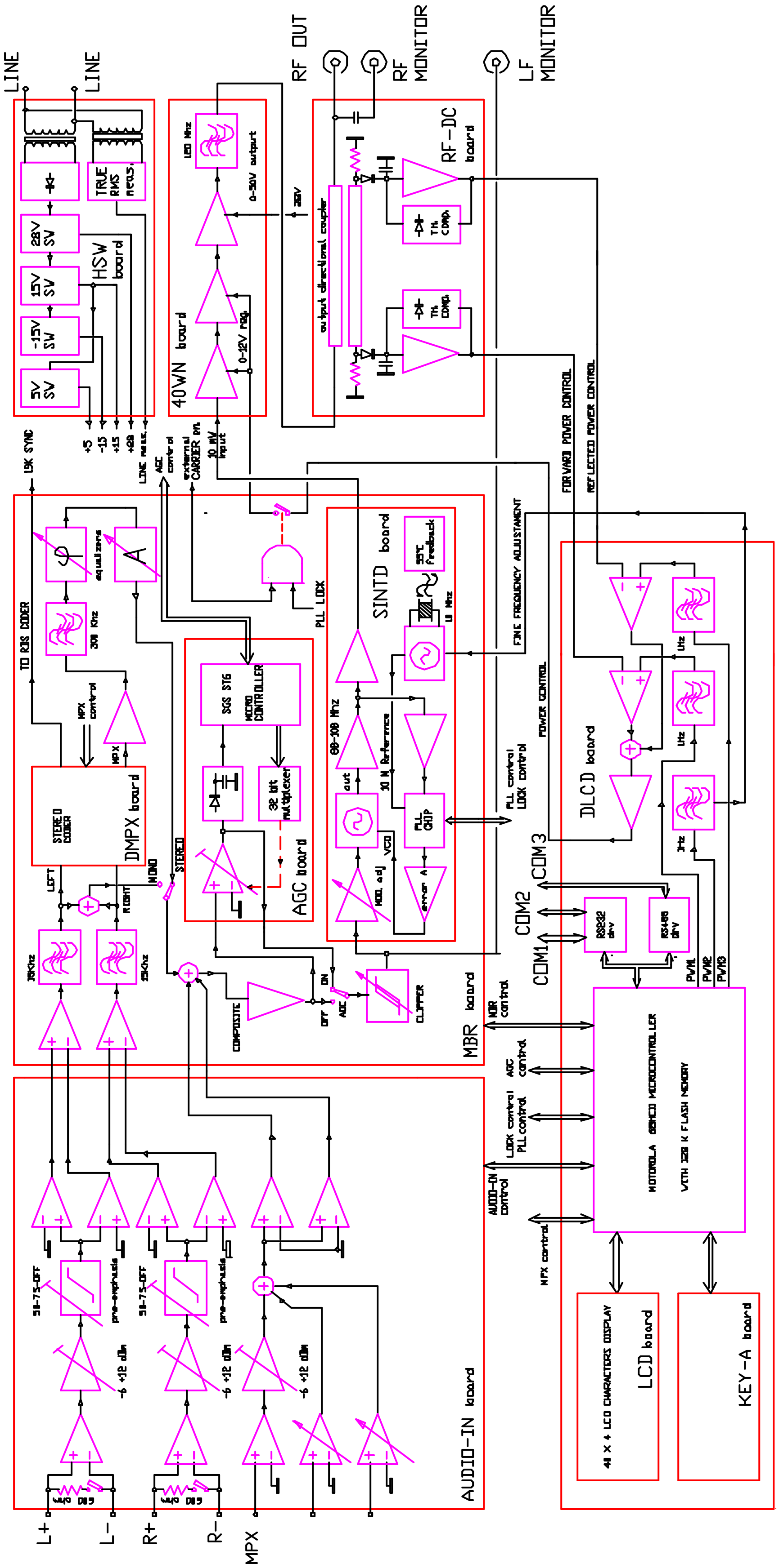
Data displaying and setting is obtained by a board which is placed directly on the front panel containing a microprocessor, memory, keyboard, LCD display. The displaying area is wide so allowing to display and set needed data in a very easy way, thus making the transmitter-user technician interaction extremely user friendly.

It’s possible to protect the transmitter input and output parameter settings with a password, while all measurements can be done by whoever without interfering on its operation.

Two communication RS232 ports and a RS485 port can make possible the communication between the transmitter and a PC, with the power amplifier and the driver exciter, or with a modem connected with the telephone line.

Maintenance or repairing of damages do not require the soldering use for the replacement of the parts to be changed; only six flat cables link all different boards.

TX50S BLOCK DIAGRAM



INSTALLATION

4.1 Unpacking and inspection

Immediately, after the transmitter has been delivered, please carefully check the package to verify possible damages caused by shipment. Should be found some damages, please immediately contact the CTE dealer.

It is recommended to keep the original package for a future shipment due to, for instance, repairing or setting. A return with a package which is different from the original one will make the warranty rights lost.

4.2 Installation

The transmitter TX50S is composed of a 19 inches width rack which takes 2 units in height in a vertical rack mount.

It is recommended to use 4 fixing plastic washers in order to avoid damages to the front panel varnishing. We remind to carefully connect the earth both to the transmitter and to the rack mount-never disconnect it without having switched the supply voltage off by the mains switch.

Design has considered the new rules concerning the electromagnetic compatibility so there aren't problems to locate systems CE marked nearby.

4.3 Power supply

AC power supply at 50/60Hz can be at 115V_{AC} or 230V_{AC}.

The switching on control is placed for security reasons on the rear panel with the protection fuse, which must have the value 1.6A for the higher voltage and 3.15A for the lower one and it must be a delayed type. To change the value of the mains supply voltage, the small PCB placed inside the mains supply socket must be switched, taking care to place it in the position allowing to read of the needed voltage.

BEFORE SWITCHING THE TRANSMITTER ON, MAKE SURE THAT THE POWER SUPPLY IS CORRECT AND CONNECT THE RIGHT LOAD OR ANTENNA!

4.4 Ground loops

Sometimes connecting various ground sockets having different potentials may produce some unwanted loops, which may create hum in the modulation: in this case it is essential to firstly identify the origin of these currents, which normally spring from the antenna ground, mains supply ground or from the input low frequency signals ground.

If the inconvenience can not be removed, the balanced input of the two channels LEFT and RIGHT can be used, thus obtaining common mode noise rejection of 40dB approximately.

All the inputs and outputs are protected by diodes against the electrostatic discharges and they are provided with filters against the RF noise.

4.5 Transmitter power up

After making sure about the proper earth socket connection, correct power supply and connection of the load on the antenna output, the equipment can be switched on.

If there is the first switching on, problems of wrong setting can't occur since the transmitter contains some standard values and **the output power will be set to 0.5W**, in order to avoid any problem of interference or driving for possible following amplifiers. The set values will be displayed and changed according to your need before the RF power is emitted from the transmitter. The equipment is provided with a memory which holds all settings even when the electric supply is off, however it is recommended to set the power at 0.5 W when uninstalling the transmitter itself to avoid any problem in case of a new setting up.

REMEMBER THE PASSWORD !

To enter the setting menu, knowing the password is mandatory. It's a four digits number written on the transmitter delivery document. Should it be forgotten, it will be possible to perform the set up by setting the Z2 jumper placed on the board DLCD (vertical board placed behind the rear panel) on the soldering side; the jumper is easy to identify through the close capture: PASSWORD ON/OFF.

In this case, this operation must be performed with the equipment switched off and it requires also the opening of the top cover which, at ended operation, must be closed again with all its screws; it is essential to use a proper cross point screwdriver.

4.6 Transmitter settings

4.6.1 At the switching on, the display will glow giving for few seconds the following screen shot

```
         CTE international
 TX50S                FM transmitter
-----------------------------------------
 software :  CTE1.B     serial N : 0003
```

4.6.2 Afterwards another page will appear for few seconds allowing to change the mains supply voltage value; the value setting operation to 115 or 230V_{AC} by switching the network socket, and eventually changing the fuse value, allows the transmitter to operate correctly, but it doesn't allow the microprocessor controlling the equipment to know the mains supply voltage value. For this reason, if the value appearing on the said screen shot doesn't match with the one set on the rear voltage changer, it will be necessary to type ENTER to update to the changing; if the set value unmatched with the one read on the mains supply switch, the transmitter will turn to MAINS SUPPLY VOLTAGE ALARM, for example reading a 220V_{AC} voltage when it is set for a 115V_{AC} value: in this case the alarm is obviously given since the read voltage exceeds 15% of the nominal value (220V is almost the double of 115V).

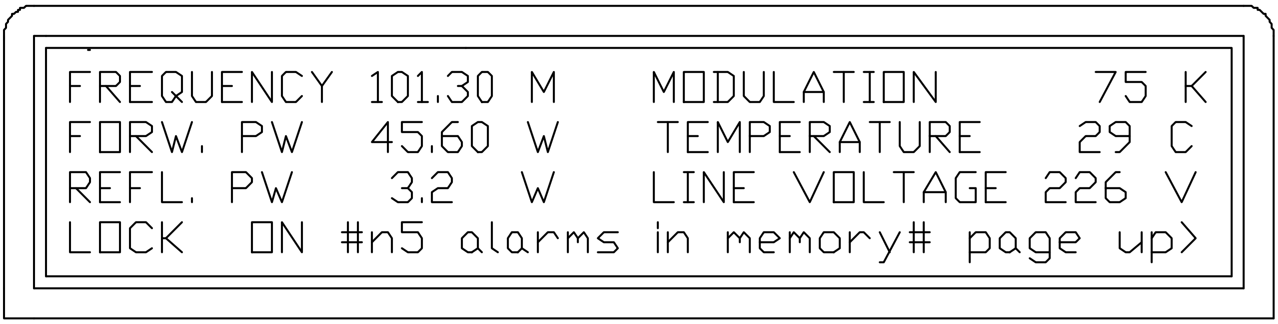
```
OPT : stereo cod - agc - remote control
LAST POWER ON   :  06/02/00  16:03
LINE  VOLTAGE   :  230Vac  (115 or 230)
press ENTER only for change LINE VOLT.>
```

If the line voltage appearing on the display matches with the one reading on the mains supply switch, it isn't necessary to type anything. On the opposite ENTER is required.

On the screenshot the options contained in the transmitter and the hour of the last switching on will also appear and it will correspond to the current hour and date. If one finds out a discrepancy between the hour given and the current one, it will be necessary to correct the error in the clock setting.

If this screenshot is accessed from another menu, the indication LAST POWER ON will show the last switching on date and it will be able to give the operator some indications about accidental switching off.

4.6.3 If all the indications are right, after a while the first page will be shown; which with the second one will contain all the most important measurements of the transmitter:



The display is explanatory enough

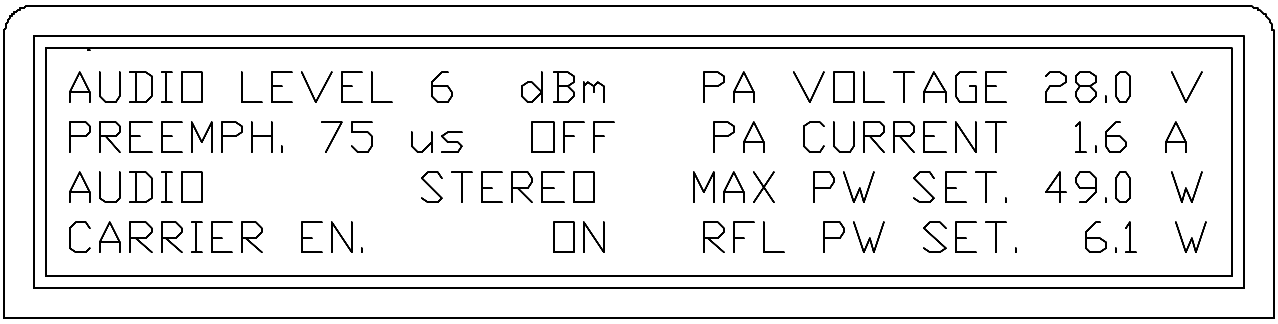
FREQUENCY	is the output frequency set in MHz
FORW. PW	is the forward output RF power
REFL. PW	is the input reflected power on the RF connector
LOCK ON	shows that main oscillator is locked the programmed frequency
MODULATION	shows the modulation value of the COMPOSITE signal
TEMPERATURE	shows the radiator temperature value of the RF power final mosfet
LINE VOLTAGE	shows the mains supply voltage

Moreover, in the lower part of the display, at the middle there is the indication of the number of alarms eventually set in the memory which have taken place after the last clearing of the memory.
These ones will be displayed automatically by a continuous enter of PAGE UP.

If one enters PAGE DOWN in this screen shot, the previous one returns and it will be possible to see once again the date of the last switching on or to change the mains supply voltage value.

If an alarm is on, always in the same position of the display, the intermitting message **ALARM** will be pointed out.

4.6.4 By entering PAGE UP, it's possible to see the second screen shot of the most important measures:



AUDIO LEVEL	is the nominal audio signal set on the setting window placed on the rear panel: if this value doesn't match to the needed one, it's possible to choose 0 , 4.1 , 6dBm or, by placing the jumper on **var,** it's possible to choose a value between –6 and +12dBm.
PREEMPH. 75	is the chosen pre emphasis value, always on the rear window, also the value 50μs can be selected; the inclusion or the disabling may be performed by the keyboard in a following screen shot.
AUDIO	shows whether the transmitter is set to **mono** or **stereo.**

CARRIER EN	shows if the output power is enabled either by a keyboard command or by an external command through the IN/OUT rear connector.
PA VOLTAGE	is the supply voltage of the RF power final mosfet.
PA CURRENT	is the voltage drained by the mosfet final power.
MAX PW SET	is the maximum power value which can be programmed by the keyboard in the screen shot Forward PW adj (1–50W) to avoid accidental over drivings of the following amplifiers.
RFL PW SET	is the maximum allowed output reflected power. Should this limit be reached, the direct power will be reduced to keep constant the limit value of the reflected power

4.6.5 By entering again PAGE UP, eventual alarms present in the memory will be displayed:

```
pA-------- alarm number 1 -------- TOT7
ALARM FOR MODULATION ABSENCE  (T>2min)
05/27/00   09 :46
mm/dd/yy  hh :mm            press page up>
```

They are stored in a chronological order ordered by number, type and date.

Besides the real alarm, also the complementary event is stored (return to normality), in order to know the alarm period time:

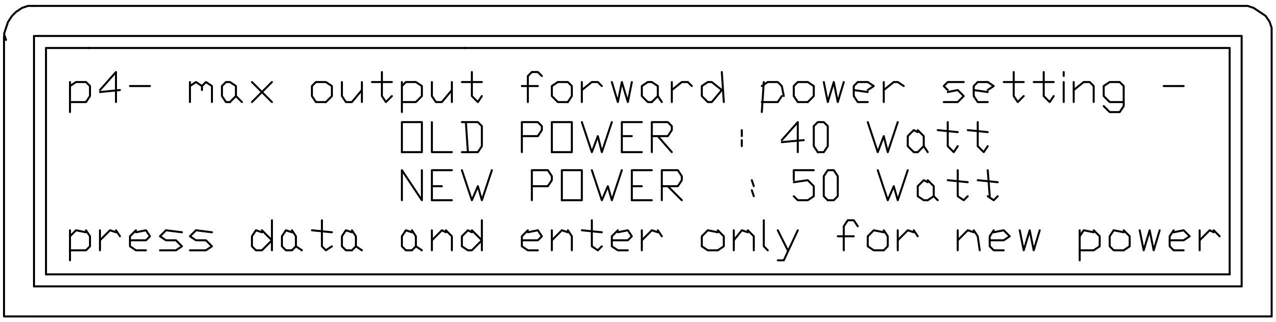
```
pA-------- alarm number 1 -------- TOT7
MODULATION RETURNED TO NORMAL VALUE
05/27/00   09 :58
mm/dd/yy  hh :mm            press page up>
```

By entering PAGE UP, the next alarm is displayed, or, if in the last screen shot of main measures there was not any alarm, it will be displayed the screen shot for the PASSWORD request to access the measures. If inside the transmitter the Z2 jumper placed on the DLCD board (in the rear of the front display panel board) is placed to OFF, this request is skipped, so it's possible to directly set the transmitter.

4.6.6 The screen shot for the password request is the following:

To go on, it is essential entering the four numbers which can be known by reading the transmitter delivery document. If the password is unknown or it is too difficult to open the top cover by unscrewing the 20 locking screws, it is just possible to surf among the previous screen shots which give all the information about the transmitter.

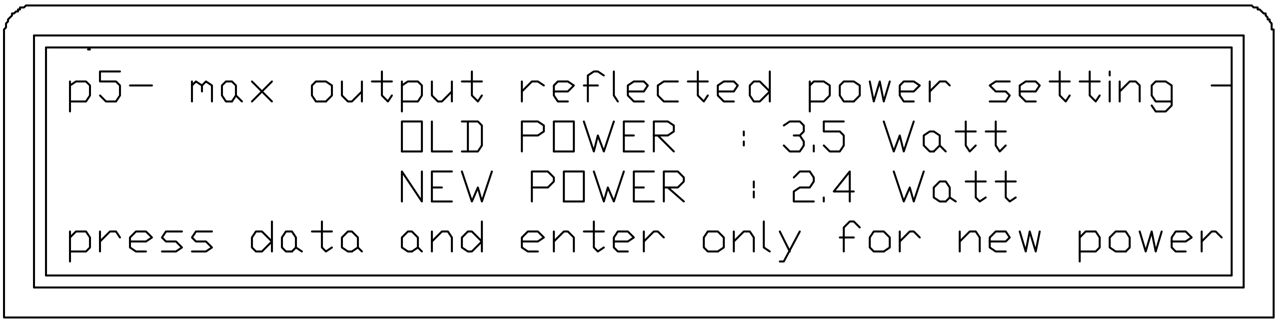
4.6.7 By entering the right combination and then ENTER, the first setting of the transmitter is accessed:



In this screen shot i the maximum value of the direct power setting can be changed by the keyboard with the limit of 50W, this to avoid to drive an eventual following amplifier, which could bear an input maximum power of few Watts, with an excessive power and harmful consequences; therefore in this screen shot output power can't be adjusted, but a remedy is taken to solve a quite common error in the output power adjustment of the exciter-amplifier systems.

The change and entry of new data may be performed by pressing the horizontal and vertical cursors and the ENTER button.

4.6.8 **E**ntering instead PAGE UP, the following screen shot is accessed:



In this screen shot, like in the previous one, it's possible to set the higher limit of the allowed maximum reflected power. If the set limit tends to be exceeded, for a bad antenna operation or a bad load connected to the RF connector, the direct power is reduced proportionally so that this limit won't be exceeded, thus protecting the RF power final mosfet. Usually the reflected power limit is set to a value equal to 10% of the set direct power. Therefore, if the output power is adjusted at 50W, the reflected one can be 5W.
The higher limit of this parameter is 10W and the resolution is 0.1W.

4.6.9 By entering PAGE UP, the following screen shot is accessed:

```
p6---- forward power adjustament -----
FORW PW meas: 10.2 W  REF PW meas.: 0.1W
NEW F.PW adj: 10.2 W   CARRIER EN:   ON
press data and enter only for new power
```

In this screen shot the output power can be set by means of NEW F. PW adj.. The resolution is 0.1W and the new direct power data are entered by the horizontal and vertical cursors and ENTER. After the new power has been set, it will be possible to read the power measurement really present on the antenna connector (forward and reflected), which may be slightly different from the set one due to the control circuit error or it may be very different in case of standing waves on the output circuit which forces the power control circuits to reduce the power in order not to exceed the reflected power limits.

By means of the horizontal cursor, the power enable can be set, this software command doesn't operate if the transmitter is externally disabled through a CARRIER EN control placed on the rear IN / OUT connector.

Each output power variation command is softly performed with the achievement of the final value in 3 seconds approximately.

4.6.10 By entering PAGE UP the following screen shot is accessed :

```
p7---- output frequency setting ------
OLD FREQUENCY  101.300 MHZ --- lock ON
NEW FREQUENCY  103.400 MHZ
press data and enter only for new value
```

In this screen shot the output frequency can be set by the usual cursors with a resolution of 10KHz. On the display the current frequency and the new value appear.

After the ENTER key has been pressed for the new value, the output power is disabled for a few seconds, allowing the oscillator to exactly reach the new value.

4.6.11 By entering PAGE UP, the following screen shot is accessed:

```
p8--output fine frequency adjustament -
OLD VALUE : 100            NEW VALUE : 102
      number must be >0 and <255
press data and enter only for new value
```

All the rules concerning the radio transmitters in FM band include some limits of accuracy and stability of the output frequency. These limits usually depend on parameters of internal crystal reference, which are at the same time connected firstly to the temperature and ageing of the crystal itself. For this reason the crystal is heated at a constant temperature of 55°C, which guarantees a considerable thermal stability, however a frequency correction due to ageing is easily implemented just manually.

The present screen shot allows a very fine adjustment of the frequency value assigned to the radio station without the need to open the transmitter. By entering a correction factor between 0 and 255, the transmitter frequency can be corrected with a 20Hz step only; this operation can be performed during the normal periodical check of the transmitter or, as it is shown below, through a remote telecontrol.

By entering the new correction value, it's possible to reach a 2KHz offset in comparison to the central value.

4.6.12 PAGE UP for a new screen shot :

```
p9-------- audio signal setting --------

PREEMPHASIS 75 us : OFF mono/st : STEREO
press cursor and enter only for change
```

In this case it's possible to insert the pre-emphasis or to set the transmitter from mono to stereo and vice versa.

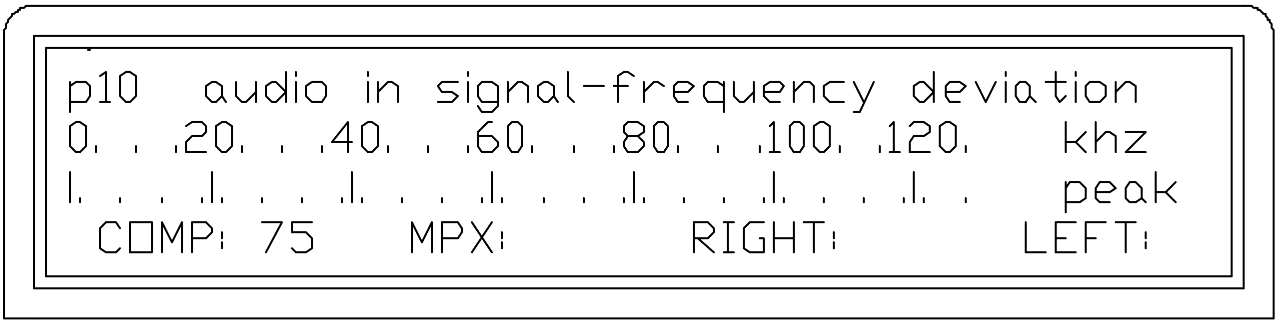
The pre-emphasis value (50 or 75µs) is switched by a jumper placed on the rear window of the rack. The pre-emphasis operates on the LEFT and RIGHT channels only.

By choosing the STEREO option, the LEFT and RIGHT channels are encoded with the stereo subcarrier addition, from which it's possible to get a synchronism in the IN/OUT rear connector (1Vpp sine wave).

On the opposite, if an external stereophonic source is already available, the LEFT and RIGHT inputs must be kept free by using the MPX input (rear BNC); in this case **the transmitter must be set to MONO even if the transmission is STEREOPHONIC.**

When the transmission is monophonic, if one enters by the two LEFT and RIGHT channels, the transmitter is modulated at the nominal value; if only one channel is available, this one must enter at the same time both in the LEFT and RIGHT channel inputs, so **they must be put in parallel otherwise the deviation would be half of the nominal one.**

4.6.13 By entering PAGE UP the following screen shot appears **:**



Here it's possible to see the frequency deviation value and the input signal values.

When the composite signal is chosen (addition of all the modulating signals), the numerical and visual indication appearing is the frequency modulation expressed in KHz while on the LEFT, RIGHT MPX signals, the level is measured and displayed as value 100 when it matches the nominal value.

The indication states the peak and the chosen measurement will be flashing displayed on the LCD.

By modulating the transmitter through the nominal level input signals and with fixed tone (i.e.. 400Hz), the deviation must not exceed 75KHz (COMP) and the input signal level must not exceed 100%. But if a music signal is available at the input, indication can also exceed this value and the exact rules for this check will be seen in the screen shot 11.

Besides, if the automatic audio gain control is off, the 75KHz deviation value is equivalent to 100% of the input signal values. On the opposite, if the AGC is on 75KHz deviation can be obtained by an input signal which is variable, as level, from half to the double of the nominal value.

4.6.14 By entering PAGE UP the following screen shot will appear:

```
p11----Automatic Audio Gain Control -----
Range: +/- 6dB referred to nominal value
GAIN CONTROL: ON  Mod.absence ALARM: ON
  press data and enter only for change>
```

In this screen shot it's possible to enter, if installed, the option of the modulation level automatic control due to the audio signals: when the AGC is on, the maximum modulation value is checked at 75KHz varying the audio amplifiers gain; the dynamic is ±6dB and this is useful when the input signal level is not sure.

For a wider explanation about the AGC operating see paragraph **4.4**.

There is also a control on the modulation presence, since everywhere it isn't allowed to transmit by unmodulated carrier; after two minutes of modulation absence an alarm can be given and the power can be disabled. When the modulation returns to the normal value, the alarm stops and the usual operation is restored; in case of stereophonic transmission, the threshold for the modulation absence is 10KHz, because of the subcarrier value.

4.6.15 By entering PAGE UP the following screen shot appear :

```
p12       Measuring maximum FM deviation
of transmitter emission in according to
REC-CEPT/ERC 54-01E (1998) - [ ANNEX 2 ]
page up to skip>      enter to continue>
```

```
p13--------- CEPT/ERC 54-01 -----------
     modulation analysis over 60 sec
OVERMODUL. PEAK FACTOR K press page up>
POWER MODULATION             press enter>
```

```
p14--------CEPT/ERC 54-01 -------------
0. . .20. . .40. . .60. . .80. . .100. .120.   khz
 over modulation factor K (must be<0.2)
      press ENTER to measurement start>
```

```
p14--------CEPT/ERC 54-01 -------------
0. . .20. . .40. . .60. . .80. . .100. .120.   khz
  WAIT 60 sec FOR MEASUREMENT RESULT
K= ?
```

```
p14--------CEPT/ERC 54-01 -------------
0. . .20. . .40. . .60. . .80. . .100. .120.   khz
             K= 2.7
     page up/down to exit or continue
```

```
p14--------CEPT/ERC 54-01 -------------
0. . .20. . .40. . .60. . .80. . .100. .120.   khz
      modulation power  PM  (must be <0)
      press ENTER to measurement start>
```

```
p14--------CEPT/ERC 54-01 -------------
0. . .20. . .40. . .60. . .80. . .100. .120.    khz
  WAIT 60 sec FOR MEASUREMENT RESULT
PM = ?
```

```
p14--------CEPT/ERC 54-01 -------------
0. . .20. . .40. . .60. . .80. . .100. .120.    khz
              PM = -1,6  dB
    page up/down to exit or continue
```

The previous eight screen shots, if selected, allow to perform the measurement of the modulation analysis according to the CEPT 54-01rule. For an exhaustive explanation of this new measurement method see chapter 7.

Briefly, it can be said that a music signal can exceed the limit threshold of 75kHhz, provided that this exceeding is contained in a certain percentage. The rules concerning this topic are contained in the above mentioned regulation and in the IEC-244. Thus it's possible to quantify the excess of over modulation peak and it's possible to show, as in the appendix, that the numerical factor K fixing this limit can not be greater than 0.2. Modulation power on the opposite can not be higher than the one relating to a sine signal deviating 19KHz (reference =0dB)

The observation period, for the measurement and the calculation of these factors, is 1 minute, after that the result will be displayed.

For the calculation of the K over modulation peak factor, 1200 samplings are performed during a 60 sec measurement, and the value factor is obviously 0 if no peaks exceed 75KHz. The value 0.2 is acceptable as a higher over modulation limit; the value 0.5 shows that the modulation must be reduced of 1dB at least, values higher than K indicates strong over modulations.

For the modulation power, over 10 millions of samplings are performed during the minute of examination and power integral defined in the measurement segment is calculated; the result is compared to the one equivalent to a sine signal which deviates 19KHz; the result of the comparison is expressed in dB and it must not be higher than 0, in order to make the measurement complying with the rule. This limit is debatable and, as it has been described in chapter 7, normally in on-field measurements the values of 2,3dB are found which, after all, we estimate don't cause over modulations.

Since the peak modulation values are random (they depend, besides on the set levels, on the type of musical pieces as well), K or PM values can remarkably vary during the day relating to the type of the transmitted program; it's useful to do many measurements at different times by trying to measure dance-music rather than spoken. By using the Personal-Computer interfaced with COM1 placed on the front panel it's possible to perform this measurement with many hours of observation periods as it will further be seen.

4.6.16 By entering PAGE UP the following screen shot is accessed:

```
p16---------- clock setting ----------
OLD ---- date 06/03/00    time 08:41:34
NEW ---- date 06/03/00    time 00:00
    press data and enter for change>
```

Here the transmitter internal clock which is used for the memorisation of all the events can be set. At the top the current date appears, the new date at the bottom; in left to right order **month, day, year, hours, minutes, seconds** appear.

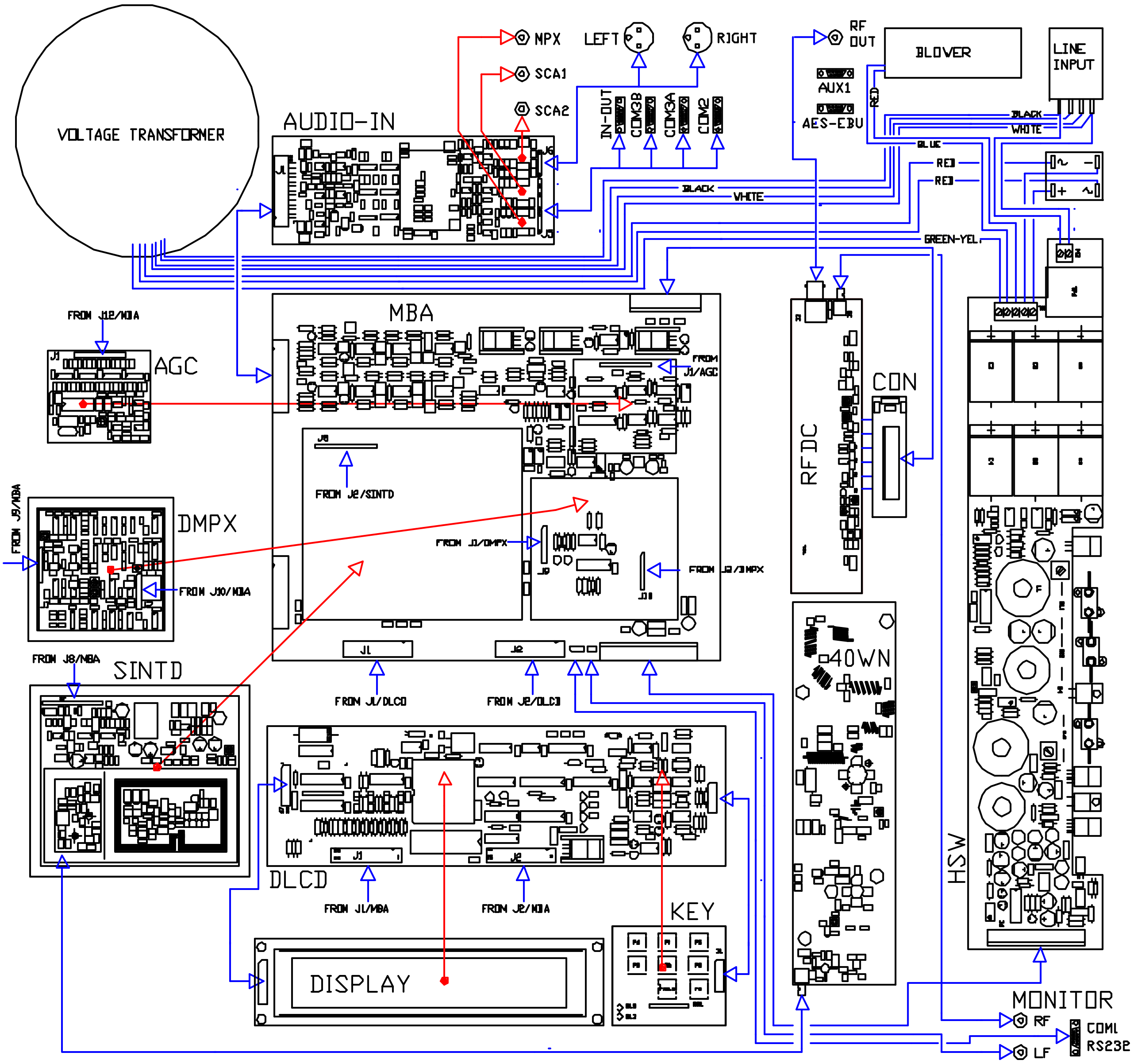
4.6.17.1 By entering PAGE UP the next page is accessed:

```
pCA--------- alarms erase -------------
IF YOU WANT ERASE ALARMS
press ENTER tree times               >>>
                         page up to exit >
```

By pressing three times the ENTER button, all the alarms in the memory are erased.

By entering PAGE UP, the start position is restored.

CONNECTION DIAGRAM



CIRCUITS DESCRIPTION

5.1 AUDIO-IN board

The AUDIO-IN board has the task to interface the input audio signals with the modulator. Level adjustments are performed on them, as well as pre-emphasis insertion and input impedance selection. The outputs, going through a flat-cable to the mother board, are raised to a high level and made balanced in order not to be interfered with the transformer flow dispersion.

The LEFT and RIGHT signals available on the connectors placed on the rear panel enter, after a first RF noise filter, respectively into U6 and U1. By the U11 switch and the Z1 jumper accessible at the back, the input impedance can be selected (600Ω or 10kΩ). A similar function is performed by the jumpers Z3, Z4, Z5, Z6, which allow to select the input nominal value level; on the two channels MONO examined, the switches U13 and U12 change the gain by switching three resistances or a trimmer to put the input level to 0, 4.1, 6dBm or by RT3 and RT4 to a level between –6 and +12dBm. The signal is then the pre-emphatized; the value 50µs or 75µs is chosen by the jumper Z2, while the possible inserting is controlled by the front keyboard. Through U3 and U4 the LEFT and RIGHT channels output is made differential.

The MULTIPLEX external signal path is simpler. On it, it's only adjusted the level at the nominal value by U16, still controlled by Z3, Z4, Z5, Z6. U9 adds up the MPX signal with the two SCA signals and generates the balanced output signal.

Normally, on the SCA signals it's difficult to establish an input nominal level since their contribution to the frequency deviation is variable and depends both on the number of subcarriers between 53 and 100KHz and on the difference about MONO or STEREO transmission. In any case, the total deviation of all the subcarriers (19KHz, SCA1, SCA2) must not exceed 10% of the maximum nominal deviation, which in most cases is ±75KHz. If the transmitter is monophonic and only the RDS signal placed in one of the two SCA inputs is present, the deviation level of the transmitted data can reach ±7,5KHz; whereas if the transmitter is stereophonic and besides the RDS signal also a lower quality audio channel on a subcarrier is present, for example at 76KHz, the total of each subcarrier deviations can't exceed ±7,5KHz. The stereo driving carrier will deviate ±4KHz, the RDS signal and the other audio channel will have to deviate, for example, ±1,75KHz.
For this reason, it has been preferred to make the SCA channel levels independent between the nominal input one of the audio channels. The adjustment is obtained by RT1 and RT2 trimmers always placed on the rear panel.

All the set levels are showed in the display and the choice to adopt a parameters manual setting related to the input signals level has been preferred to an easier keyboard setting to avoid a non standard levels setting which makes the servicing or the transmitter replacement problematical. The audio signal level errors must not be cleared on the transmitter, but at a former stage. Normally, every broadcasting station fixes a nominal level for all signals and all the adopted equipment must respect this sole value. As higher is this value, as higher will be the noise immunity, and the signal-noise ratio as well.

5.2 SINTD board

SINTD board is placed at the rack centre, directly connected to the mother board from which it can be quickly removed. It has the function of frequency synthesized oscillator (88–108MHz) modulated by the audio composite signal.

The FET Q1 is the core of the board and oscillates at the set and controlled frequency. All the techniques to obtain high performances in terms of noise and modulation linearity have been adopted. Moreover for a decade EL.CA already have been adopting these circuits solutions (oscillators with coaxial line) for frequencies even till 3GHz for FM transmitters and audio links. Eight varicaps DV1-DV8 modulate the oscillator being driven by the Q2 low output impedance which reduces Nyquist this way wide band noise produced by the variable capacity diodes; at 1MHz between the carrier, the SSB noise is already better than –145dBc, in accordance to ETS-ETSI-300-384. The Q3 transistor reduces the flicker-noise due to the power supply; the D3-D4 series doesn't allow the Q1 saturation, while Q4 and Q5 uncouple the oscillator from the following amplification stages. The U14 output has a power of 10dBm.

The Q6 transistor leads the oscillator signal into the prescaler of the PLL circuit (U4); this integrated circuit performs all the frequency synthesis functions: it's set by U1 ports through the main microprocessor placed on the DLCD board. The reference frequency (10MHz) is produced by Q7; the crystal is kept at a constant temperature by a feedback obtained through U5 and U6; the value 55°C is 5°C higher than the maximum operating temperature, so allowing to obtain a frequency stability lower than a part per million at the environmental working range 0-45°C.

The error amplifier of the phase comparator internal to the PLL chip is composed by U13 and U2 and it has a closed loop cut frequency lower than one Hertz, so that the lowest frequencies of the modulating stereophonic signal can maintain a separation higher than 50dB between the two channels. The modulation, coming from the mother board and from the AUDIO-IN board, is simply added to the VCO error voltage, no linearization has been provided to make the deviation constant versus the output frequency; typically the deviation error is contained within 0,1 dB all over 20 MHz band.

The oscillator has been carefully shielded to avoid that close transmitters could induce spurious frequencies on the output.

5.3 MBA board

The central board has the task to distribute the power supplies and the input and output signals; moreover, the audio filters and the peak-to-peak detector for the different modulation level measurements are implemented in it.

Both the left and the right channel signals coming from the AUDIO-IN board through the J7 connector, pass through an elliptic filter made of precision active components; the bandwidth at 0.1dB is 15KHz and the attenuation over 19KHz is higher than 40dB; no adjustment is provided, the resistances have a precision of 0.1% and the capacitors are selected and high quality type. U3, U4, U5 and U6 make the left channel filter, the right one is symmetrical.

Another elliptic filter of an lower order clean the MULTIPLEX signal by removing the surious signals created by the switching over 600KHz; however this is a typical L-C placed between the two sections of U1. The two further stages formed of U2 make a phase equalizer (RT2) and a amplitude equalizer (RT3) to compensate the DMPX board errors and the previous filter.

The operational amplifier U12 generates the composite signal by adding all the signals; the output of the first section can either enter in the automatic gain control optional board or, in its absence, it enters the U12 second section which acts as a clipper using the saturation and the interdiction of the operational amplifier output circuit. The threshold value is regulated by RT6, this output of this stage enters directly into the frequency modulator placed on the SINTD board.

The U17 switch selects the audio signal to be measured which the level is detected by a peak-to-peak detector made by U13, U14, U15. Through the U18 switch, controlled by the DLCD board, the measurement can be of peak or envelope, in accordance to the peak measurements or modulation power.

A circuit made of U22 and U23 disables the output power in case of external command (CE) or synthesizer fault. This function is performed through software also and this circuit represents a security guarantee for such an important function.

5.4 AGC board

The task of this board is to guarantee the maximum allowed modulation where is not sure that the input audio signal has a fixed value. This option can be added to the transmitter at any time and, when it's present, the Z3 jumper placed on the MBA board must be set to ON. Its adjustment, when enabled, is 6dB around the nominal value and it uses 32 gain variation steps of 0.3dB each approx.

The operation is quite simple: a wide band amplifier (U6) has the gain which depends on the R2 - … - R33 resistive value; these are switched by U2, U3, U4 and U5, they are controlled at their time by the microcontroller U1. The AGCO output audio signal is detected by U7, U8 and U9 and the peak-to-peak value is measured by the microcontroller, which consequently decides which gain must be given to the amplifier.
The intervention time of the gain variations is not constant, but it's for the input signal value; the gain variation algorithm versus the time is complex in order not to distort the signal, anyhow it's possible to say that, when the signal has a level equal to half of the nominal one, in a couple of minutes approximately or little bit more it's restored to the nominal value. On the opposite, when it has a value which is the double of the set value, it takes just few seconds to reach the nominal value.

On the board it's possible to activate an alarm signal which takes place when the modulation is lower than 10KHz for a period of time longer than two minutes (the level 10KHz has been selected because is a little higher than the value due to the stereo subcarrier). When the modulation absence alarm is on, the output power is removed and the transmitter remains in stand-by until the modulation will be restored.

5.5 HSW board

This circuit provides all the needed voltages for the transmitter operation.

The voltage coming from the rectified output of the power transformer (48V peak) is filtered by the capacitor group C1 - … - C6 then it's reduced at the 28 Volt value by the switching regulator Q3 which is driven by U2 and U3. RT1 regulates the current limitation from 1A to 5A, while RT2 regulates the output voltage at 28V. U1 and Q2 protect the circuit against accidental short circuits, by switching off the driver supply.
U1, operational amplifier with low offset, measures the current absorbed by the final through the shunt R40 (PAC output).

From the $+28V_{DC}$ voltage which supplies the final by three switching regulators in series, it's obtained $+15V_{DC}$ (U5),$-12V_{DC}$ (U7), $+5V_{DC}$ (U6). The first and the second voltage feed all the transmitter analogue circuits, whereas the third one feeds the LCD display backlight only. The voltage ($+5V_{DC}$) which feeds all the logic circuits is obtained in place, for the low CMOS circuits consumption.

A small voltage transformer TF1 is directly connected to the power, its 9V output is measured by U9 (MX536a), which detects the true effective value and send it through the second section of U6 to the main microprocessor for the control and visualization. The trimmer RT6 is a fine regulation of the measurement.

5.6 40WN and RFDC boards

These board represent the RF power amplifier and the output stage with the directional coupler.

The first two stages adopt typical class A polarized bipolar transistors; here the power adjustment is made by acting on the collector supply. So, by a $0\text{-}12V_{DC}$ control, a constant power adjustment in Watt/Volt is obtained, which is very important for a control stability.

The final stage (Q3) is a MOSFET which can deliver more than 60W output; it's B class polarized through RT2. It's neutralized against unwanted oscillations by R21 and R14, R15 and R16. All the circuits are wide band and they do not require any alignment. The adoption of air-coiled inductors has allowed to remarkably reduce the space took by the circuits; moreover all the capacitors used in the output circuit are high quality type. The elliptic low pass filter placed at the output, after the power final stage, removes the harmonics by typically attenuating them more than 80dB.
The inductor L19 short-circuits the final transistor, providing an accurate protection in case of discharges coming from the antenna.

The J2 output of the 40WN module enters the RFDC directional coupler placed in another next metal box. This is made of two lines which are strip-line coupled at –30dB. The forward and reflected power are detected by compensating with accuracy the frequency response of the directional coupler. The continuous voltages so obtained are amplified by U1, which introduces also a thermal compensation to the detecting diodes.

5.7 DLCD board

All the input and output data concerning the transmitter are controlled by the DLCD board, to which also the keyboard and the LCD display control and visualisation board are connected.

A Motorola microprocessor 68HC11 controls the whole transmitter through the J1 and J2 connectors: the keyboard is multiplexed by U6 and U9.

All the values to be measured are fed to the E port with the proper protections against overvoltages or polarity inversions (DZ1 - … - DZ8 diodes).

A self supplied clock (U21) is connected to the D port through three lines.

The microcontroller serial port is switched by U2 and U25 on the RS232 connector placed on the front panel, on the rear one and on the RS485 port on the rear as well; the driver for RS232 is made of U18 (MAX232), while the one for RS485 is U19 (SN75176).

The ports B, C and F of the µP are connected to an external 128KB flash memory, where the XPT management program is present, which at any time can be loaded through the front COM1 by any PC.

The G port is for all the outputs (pre-emphasis enabling, mono-stereo, alarms, measurement selection, etc.). The two external outputs for the alarms are uncoupled by two reed relays with closed or opened contacts selected by two jumpers placed on the MBA board (Z1 and Z2).

A part of the H port is used, as output in PWM, to control the forward and reflected power and the fine correction of the transmission frequency. The PWM mean value is detected with accuracy, to avoid errors due to supply voltage variations or saturation and interdiction of the H port outputs.

The operational amplifiers U11, U12, U13 and U14 are part of the powers control circuit The control loop has a cut frequency of several hundreds Hertz, so in few milliseconds the power can be controlled and eventually reduced or eliminated in extreme events. The microprocessor therefore provides to the loop the forward and reflected power reference values, the quantities to be checked are PWR and PWD, coming from the directional coupler, while the over stated operational amplifiers represent the error amplifier.

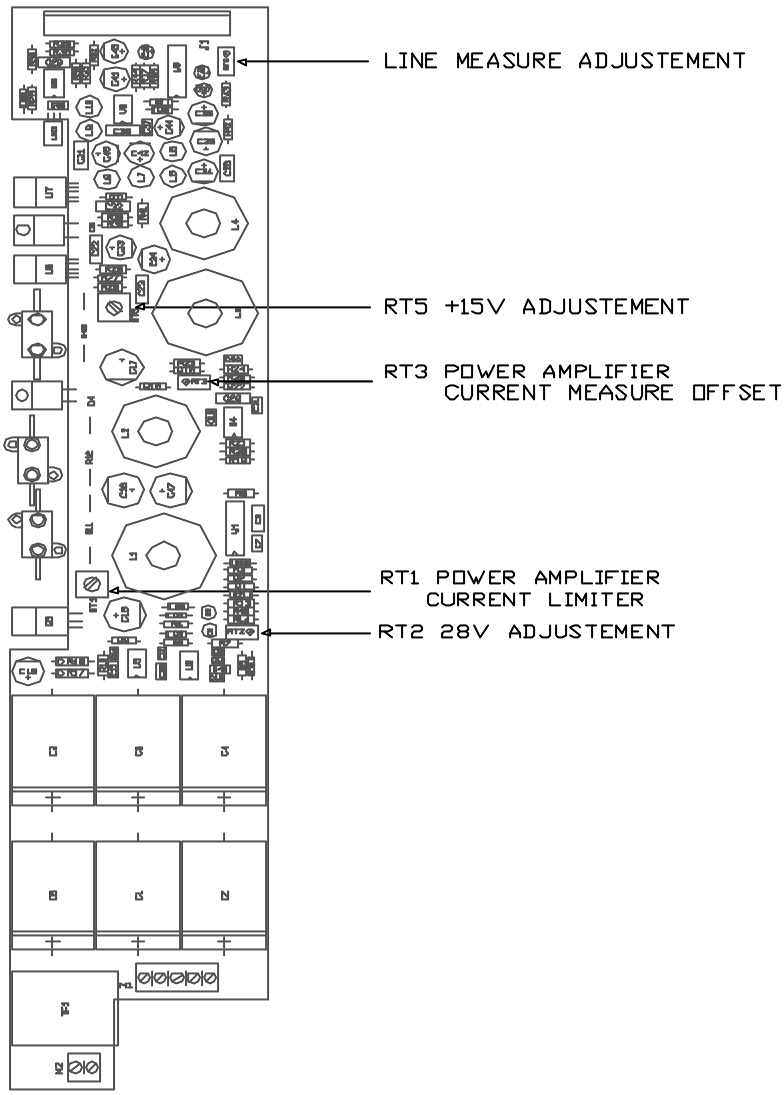
The LCD display, driven by the A port, is a 40x4 alphanumerical characters type and allows an useful displaying of data and transmitter settings.

ADJUSTMENTS

6.1 Module HSW – power supply

The HSW module, which feeds the whole equipment, has an input voltage of 48Vdc provided from the rectified output of the power transformer, and it provides in output all the needed voltages: +28Vdc, +15Vdc, +5Vdc, -15Vdc.

Before switching on for the first time the equipment it's necessary to switch off the output connector J1 to adjust and verify all the output voltages. The power supply is placed on the radiator in a vertical position, parallel the transmitter right side. For its adjustment it's necessary to dismantle the right lateral by keeping off the two screws which connect it to the front panel and also the other two screws which connect it to the rear panel.



After the transmitter has been switched on the voltmeter is to be kept on the pin 12 of J1 (output connector) and RT2 will be adjusted to have 28Vdc.

Leading the voltmeter pointer on the pin 13 of J1 RT5 is to be adjusted to have +15Vdc.

Then it must be check that the voltages +5Vdc on the pin 6 and –12Vdc on the pin 7 are right.

Then the voltmeter is to be connected to the 1 of J1 and RT3 is to be adjusted to have offset void (0 V): this is the output for the current measurement absorbed by the RF final.

RT1 must be placed at middle run and it will be adjusted as to limit the final current over 55W output.

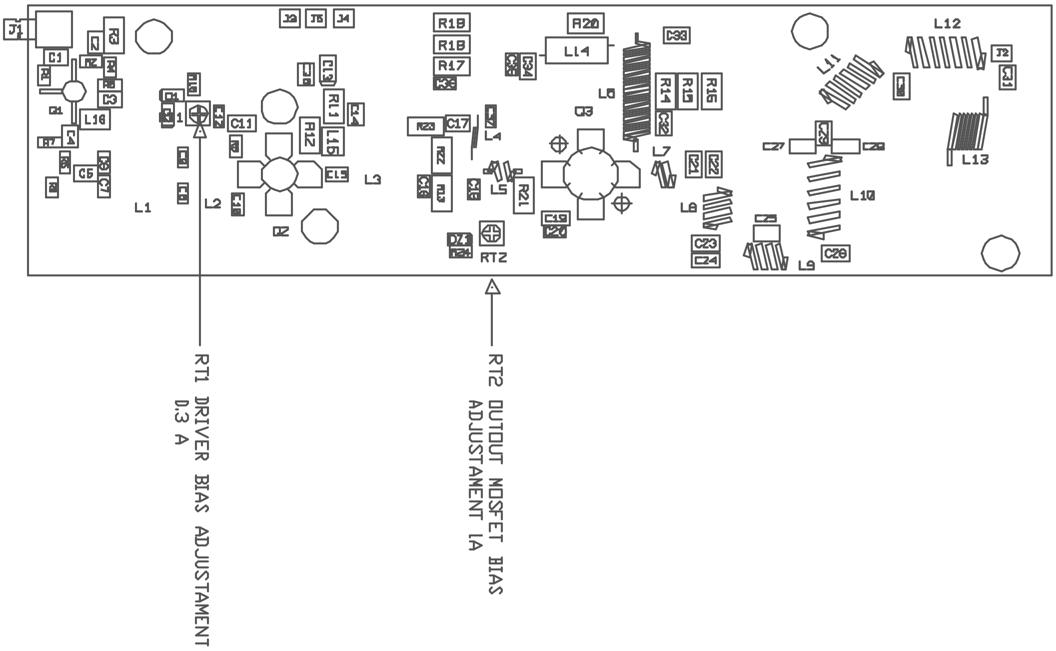
Once the adjustments have been done J1 will be connected again observing the XPT normal operating.

The trimmer RT6 is adjusted so that the mains supply voltage measurement (230 or 115Vac) is displayed coinciding to the one that is measured directly on the external line AC power supply.

6.2 40WN Module - RF final power

The RF power module is placed in a vertical position on the radiator, enclosed in a metal box. It's completely in wide band and it doesn't require any component alignment which adapt the input and output impedance of the different stages and antenna.

The only required adjustment is for the final and driver bias current.

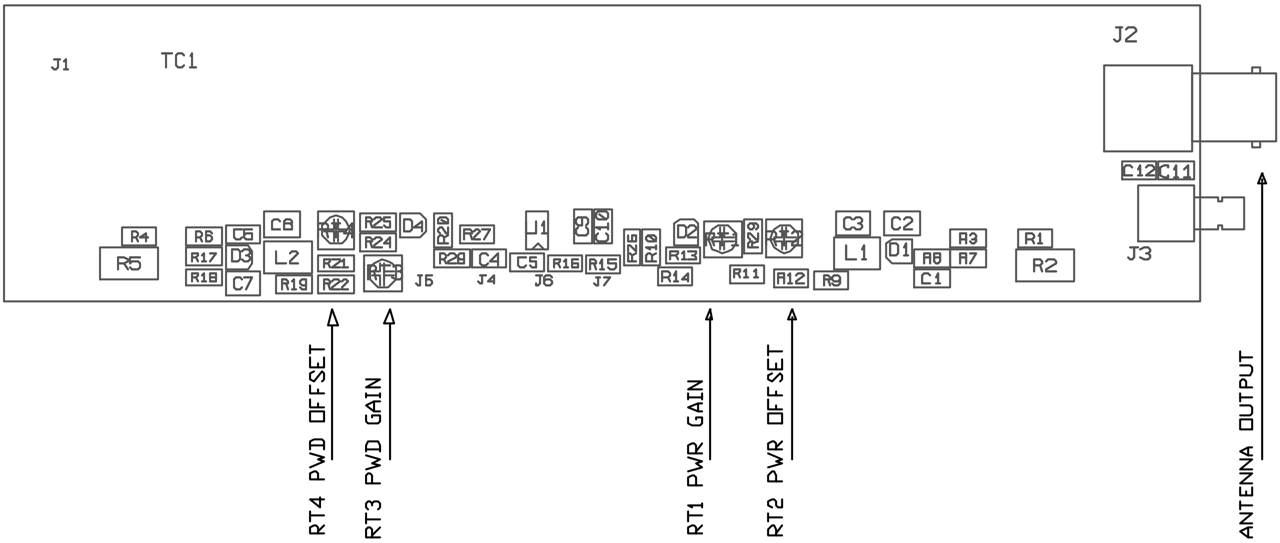


The SMB connector at 90° which leads the RF input signal to the power amplifier module must be taken off and the trimmer RT1 is adjusted to have a voltage of 0.3V at the resistance ends R11, which corresponds to a 0.3A current.

Then the RT2 trimmer is adjusted to have a reading of 1A on the display at the correspondence of the PA value visualisation in second page of the main measurements.

6.3 RFDC module- directional coupler

On the directional coupler, which is the module connected to the antenna connector and enclosed in a metal box placed on the radiator, four trimmers must be adjusted.



The SMB at 90° angle which drives the RF input signal to the power module is to be disabled and RT4 and RT2 are adjusted, so that the value 0 is displayed on the LCD at the correspondence of the forward and reflected power measurement.

At this moment the input power is to be connected, at 98MHz frequency with a 25W power will be set, it must be connected a thermal wattmeter at the antenna output and RT3 is set to read on the display, at the correspondence of the direct power, the 25W value, read also on the thermal wattmeter.

Then the thermal wattmeter is to be disconnected and replaced with a directional Wattmeter connected without 50Ω charge as to have all the reflected power. A 5W reflected power is to be set and RT2 adjusted to have the same reading on the measurement instrument.

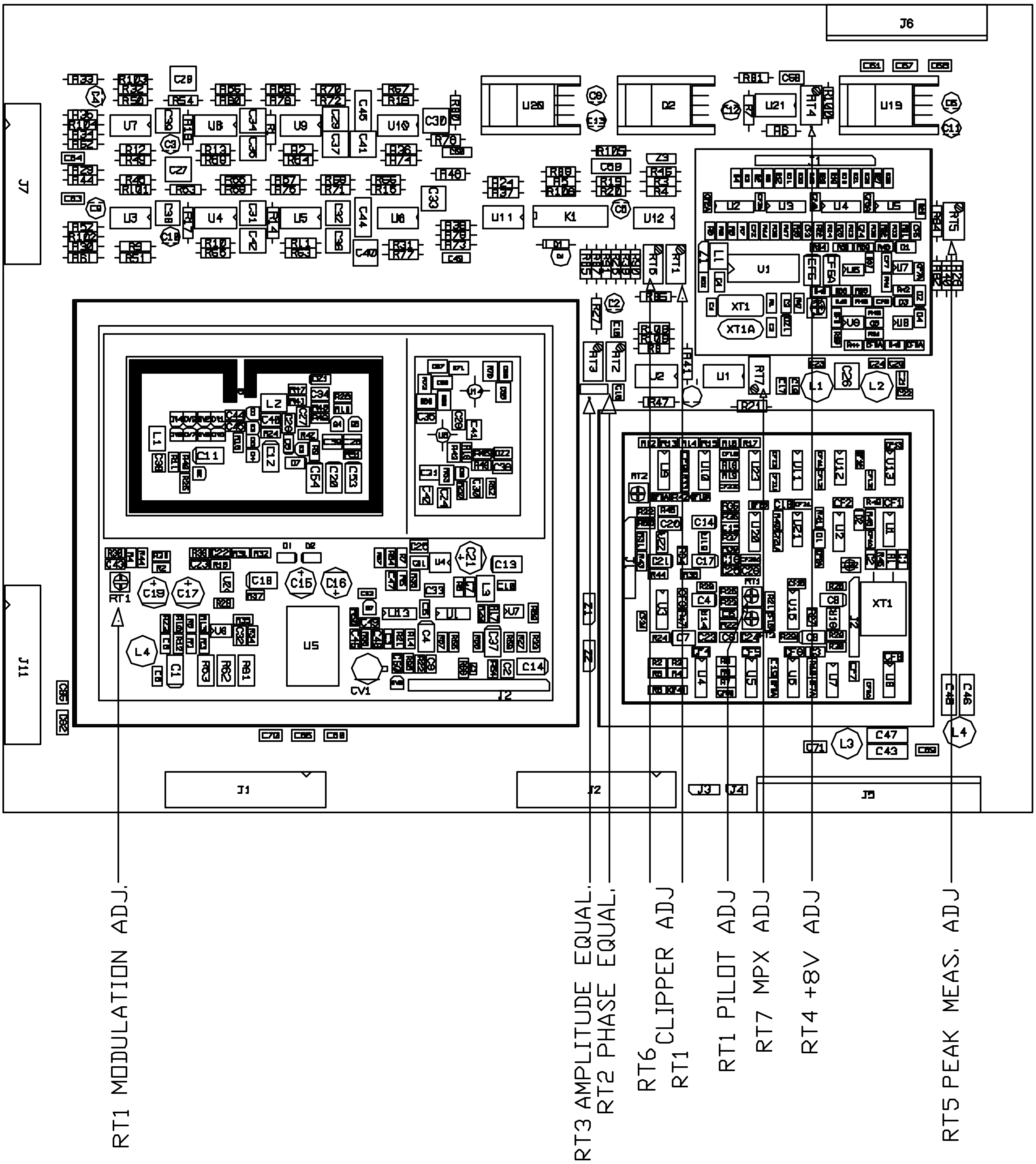
6.4 MBA module - mother board

On the mother board it's possible to perform the modulation width setting, of the stereophonic coded signal levels, the automatic check gain regulation threshold, and the phase compensation and the multiplex signal width.

The mother board receives on three connectors the VCO oscillator module (SINTD), the stereophonic coded module and the automatic check gain module.

Adjust the trimmer RT4 of the MBA board as to have +8Vdc at R7 ends.

Inject a +6dBm signal into the rear MPX input, after the same level in the settings window has been selected, then adjust the RT5 trimmer to read 75KHz on the measurement main page at the modulation correspondence, by TX in MONO.



Inject a 400Hz signal and +6dBm level in the LEFT input, switch into STEREO and adjust RT7 of the MBA board to read still 75KHz deviation also for MPX channel.

Adjust also RT1 if the subcarrier deviation at 19KHz is not the 10% of the total and adjust again the previous RT7 trimmer.

Adjust the RT1 trimmer of the MBA board so that the limitation is symmetrical, on the upper and lower part of the wave form injected with a level higher than 6dB over the nominal.

Adjust the RT6 trimmer of the MBA board to fix the clipper intervention threshold at the required value over 75KHz.

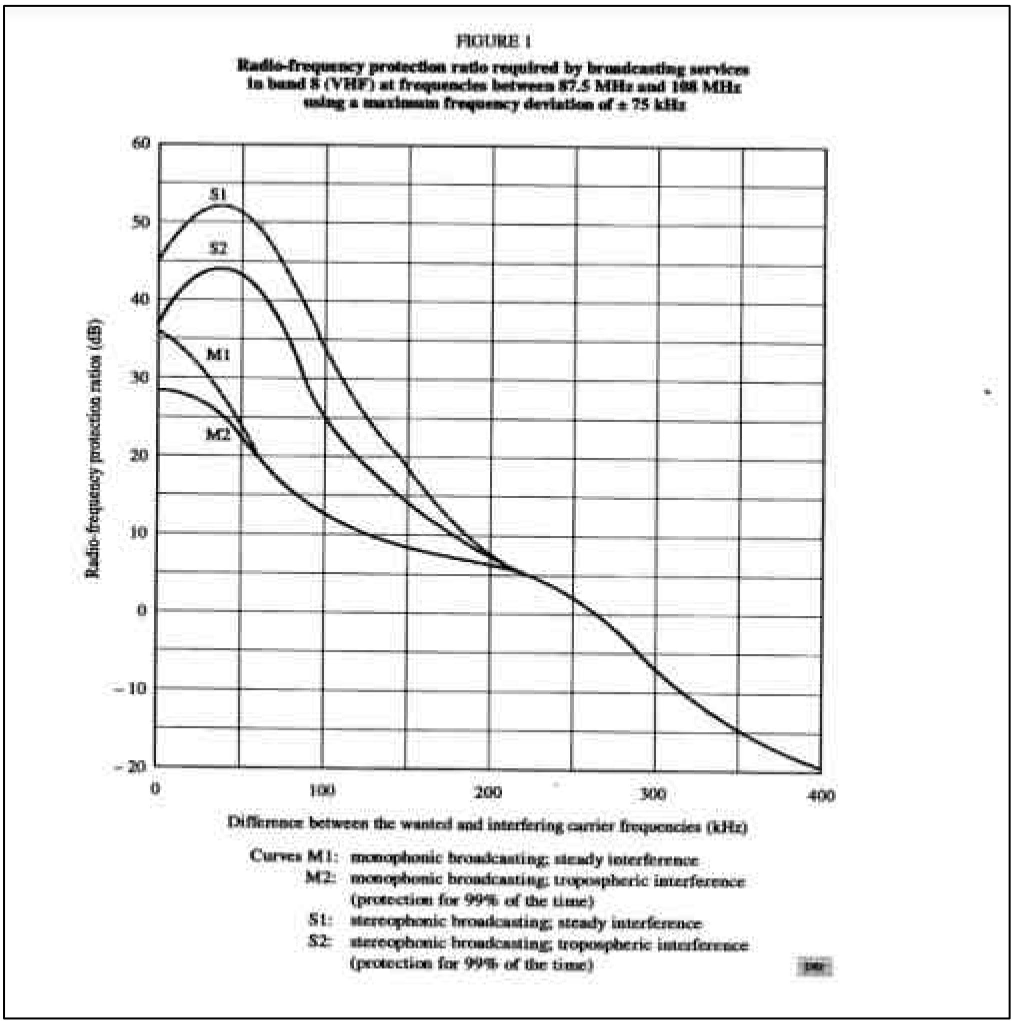
Adjust the RT1 trimmer of the synthesis board to have the exact frequency deviation with the input nominal level presence.

Adjust the RT2 and RT3 trimmer of the MBA board for the maximum stereophonic division.

MODULATION MEASUREMENT

7.1 General information

The broadcast reception at frequency modulation is often made difficult because of the networks exceeding crowding; the interferences due to the adjacent channels makes the listening unpleasant. This inconvenient may be caused by an ignoring of the protection rules mentioned in the REC. ITU-R BS.412-7 of which the remarkable graphs reported below:



The graph shows that if the interfering network is at 300KHz far from the program we are listening, it must have a level higher than the maximum of 7dB, if it's at 200KHz the field intensity level at the point of listening, will be 6dB lower in monophonic or 7dB in stereophonic.

These values, expressed in dB as protection ratio, assume that the interfering network is broadcasting with the maximum allowed spectrum width and this reaches the maximum at the correspondence of peaks and the maximum modulation power. In a laboratory it's possible to simulate the worst example of modulation by modulating the transmitter, instead of dance-music, with coloured noise as mentioned in the CCIR 559 rule (annex B). The process is described in the IEC 244-13 standard and consists of modulating the transmitter with noise as above, with a deviation equal to 32KHz. This work condition corresponds to the maximum allowed band occupation and to a radio broadcast spreading dance-music which modulates ±75KHz.

At these conditions (modulated transmitter with coloured noise in accordance to CCIR-559) there is the chance to have a reference of a radiophonic transmitter at frequency modulation which occupies the maximum allowed spectrum and on which it's possible to perform all the modulation measurements repeatedly, having some parameters as results which can be applied and compared on the field to modulation measurements of a network which is broadcasting a normal music program.

The music signal can not be surely measured by a normal detector with effective or peak value, differently from a fix tone signal. The measurement must be done, being not sinusoidal or other periodical form, detecting the power of the signal self (function proportional to its instantaneous value square) or the peak with very long observation periods.

7.2 Modulation peak analysis measurement

The CEPT 54-01 rule shows, in its paragraph **4.2,** how the peak measurement must be performed on the modulation of a frequency modulation transmitter.

The maximum deviation peak must be found in a 50msec window, to be sure of catching also modulating frequencies till 20Hz. At each minute 1200 representative peak modulation samples are available.

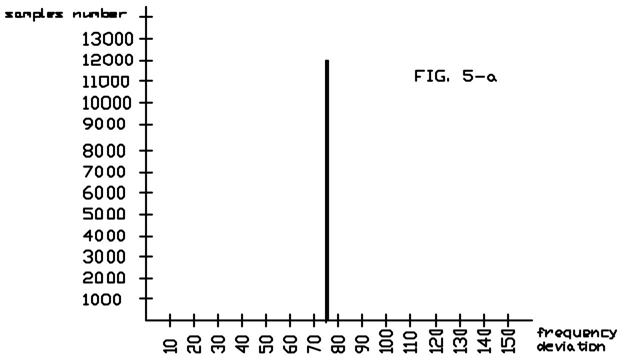
These values, obtained with even many minutes long observation periods, will be placed into a graph in the following manner:

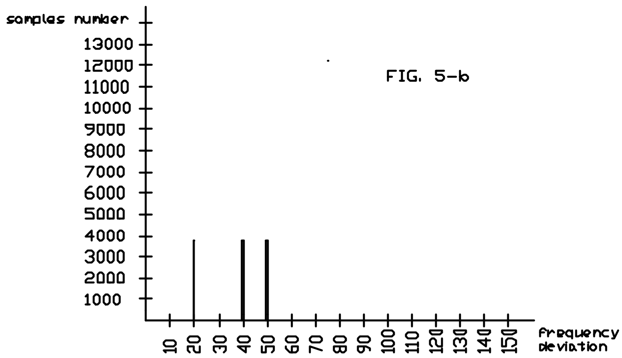
on the abscissas, the frequency deviation will be placed with a deep scale of 150KHz

on the ordinates the number of samples of the corresponding deviation value will be placed

It maybe by extreme examples it's possible to explain the concept better. Suppose to modulate the transmitter with a fix tone having a deviation of ±75KHz and to perform the peak measurement in object for a period of 10 minutes. Thus 12000 samples all with the value 75 will be obtained: the graph will be of a single vertical line 12000 high and placed on the abscissa 75 (fig. 5.a).

On the opposite if we modulate the transmitter for 3 minutes with ±20KHz deviation, then for further 3 minutes with ±40KHz and at last for further 3 minutes with ±50KHz and the observation period fixed at 9 minutes we will obtain 10800 samples 3600 of which will have abscissa 30, other 3600 samples abscissa 40 and the last ones abscissa 50 (fig. 5.b).





Now, instead of these simple examples, take our transmitter modulated with the sample noise previously mentioned, and we detect in accordance with the CEPT 54-01 the modulation peak samples in a 30 minutes observation period, so obtaining the graph. **5.c-a** whereas, if we increase the modulation, always with the same input signal, of 1dB, we'll obtain the graph **5.d-a** with a 30 minutes observation period:

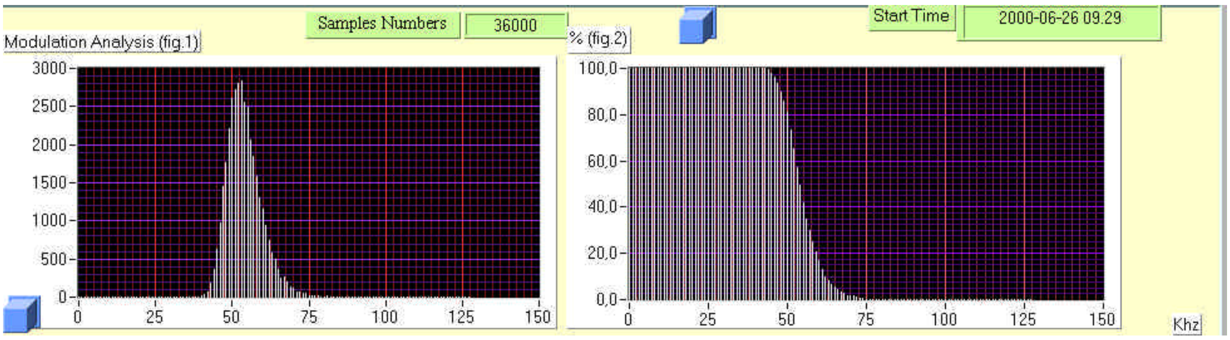


fig. 5.c-a **fig. 5.c-b**

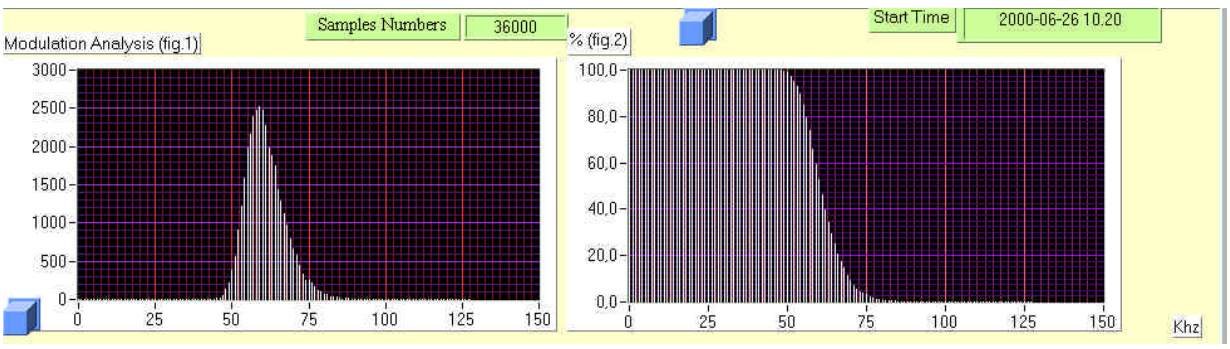


fig. 5.d-a **fig. 5.d-b**

On the first graph it can be observed that during the 30 minutes about 2600 peak samples have been measured which have deviated the carrier of ±54KHz, 1500 ±60KHz, 10 ±75KHz, while about ten samples resulted higher than ±75KHz. What has been measured is a signal which respects all the spectrum occupation and over modulation rules; it can be soon noticed that this signal has been higher with its modulation peaks than the threshold of 75KHz for about 0.2% of the samples so it's wrong to sustain that this value is never exceeded at all. Relying for the modulation adjustment on the bar-graph of which almost all the transmitters are equipped, one risks to have to under modulate if the trimmer is set to remain within 75KHz.

In the figures 5.c-b and 5.d-b, as suggested by CEPT 54-01, the "Accumulated distribution plot of deviation" have been reported on the graph, relating to the graphs of the left figures -a and -b ; in this case all the samples from left to right have been added and the samples total value has been normalized.

In other words, starting from left fig. 5.d-a (0KHz) and going towards right (150KHz) it's noticed that all the samples are towards right (100 %) till about 35KHz, to 50KHz over than the 80% of samples is on the right, at 70kHhz just the 5% of samples is on the right, as it has been evidenced on the graphs –b ordinates.

The CEPT 54-01 rule and the equivalent REC. ITU-R SM.1268 and REC. ITU-R BS.412-7, at this point stop and they do not give exact and rigorous information about the interpretation of the graphs mentioned above.

On the opposite by connecting the different rules it's possible to analyse the graphs of fig. 5.c-a and 5.c-b to draw some statistic parameters which, deriving from a reference system, can, as said previously, be applied to a typical music broadcast.

So some quantities will be defined peculiar to the two graphs which will define just one over modulation factor, whose value will be used as limit parameter.

Definitions:

M : average of all the measured samples as peak maximum every 50msec

OM : average of the samples which have exceeded the 75KHz threshold only

OM% : samples percentage which has exceeded 75KHz as to the total

K : over modulation factor, defined as follows:

K = (OM - 75)*OM% /100

The formula can be explained easily and intuitively, since the over modulation factor is directly proportional to the peak number percentage detected over 75KHz (OM%), while the ones lower than this threshold must not give any contribution to K, and it's also directly proportional to the peaks KHz value which have exceed 75KHz (OM–75).

If no maximum peaks measured through the 50msec samples has exceeded 75KHz, we are in a favourable condition, OM = 0 and OM% = 0 and so K = 0

If all the peaks exceed 75KHz and their average is 78 then K = (78 –75) * 100 / 100 = 3

Now getting the example again of the transmitter modulated with coloured noise as to the CCIR-559 and IEC-244 rules previously seen, which has originated the graphs of fig. 5c-a , 5c-b, 5d-a and 5d-b and we apply the above mentioned parameters and calculate them each minute. Thus it will be obtained other graphs which can be added to the two previous couples, so originating a screen shot full of all the parameters relating to the peak modulation measurement:

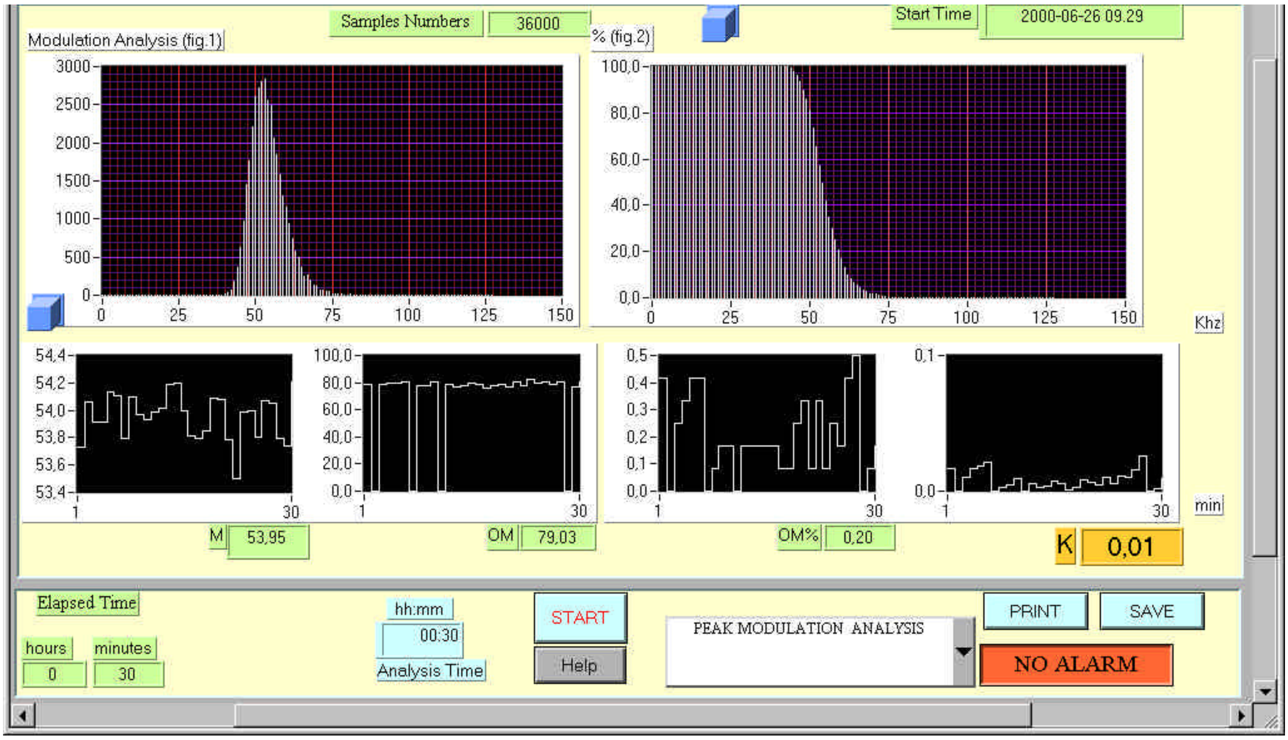


fig. 5.e

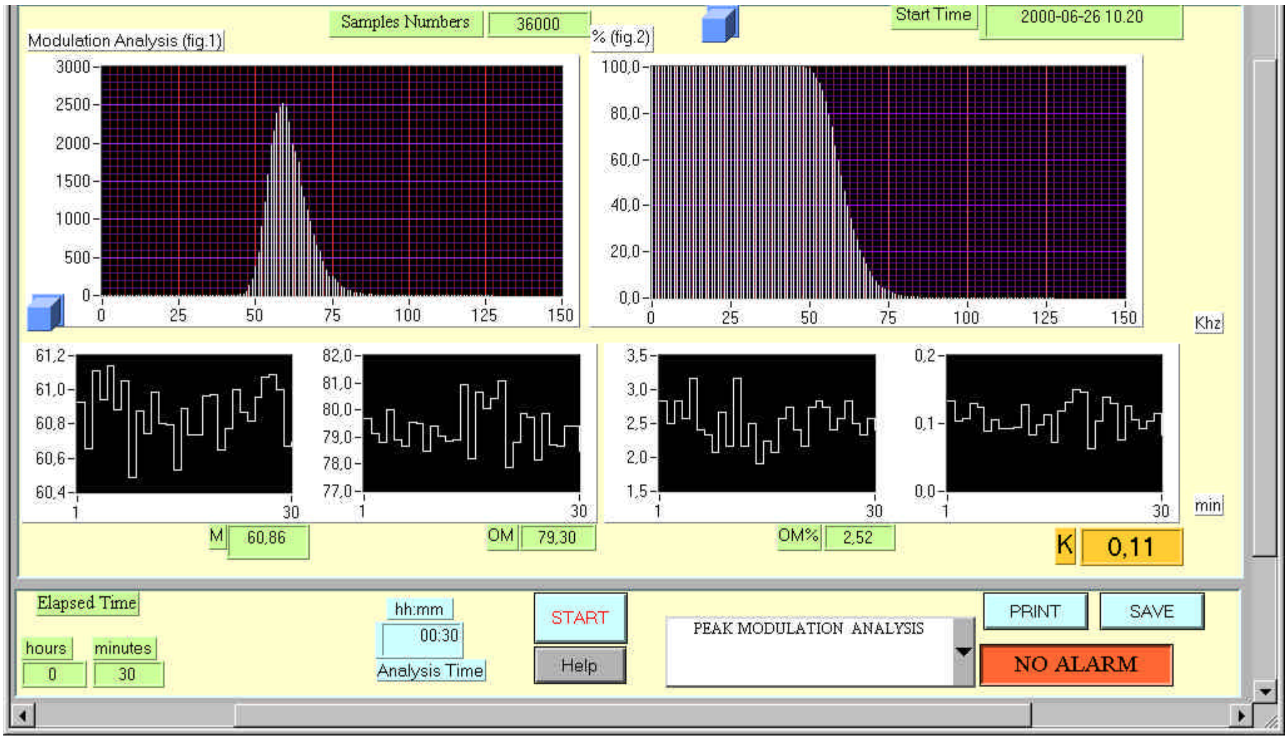


fig. 5.f

Examine the graphs of. 5.e, which could correspond to the modulation peak analysis of a regular transmitter which doesn't over modulate: in these each minute M, OM, OM% values have been calculated and consequently the K factor. It can be noticed that K value constantly keeps each minute below the **value 0.01**.

So assume this value as limit for the over modulation factor.

Increasing the modulation of 1dB the graphs in fig. 5.f are given, corresponding to a transmitter which deviates little more than ±8KHz; in this case K value is 0.11. Thus it can be noticed that for small modulation values higher than ±75KHz, K increases considerably.

The rules rightly have tried to fix some limits for the instruments accuracy which need to perform this kind of measurements, but the system weakness is surely constituted by the receiver, with all its problems concerning the answer to quick transitory and also the peaks, which is almost ever distorted by the medium and low frequency filters group delaying with over elongations or miscompensated attenuation.

So it would be ideal to draw the modulating signal, which is usually available on all the transmitters, performing all the measurements on it, after having made sure of the exact relation between the audio level and the frequency deviation. In the TX50S this is automatic and we think if a modulation peak analysis measurement made far from the transmitter, has produced doubtful and questionable results, it must be repeated by the instrument inside the transmitter like in the TX50S.

The measurement must be started for a whole day observation period so to pick up the programs having most over modulation problems and consequently to act on the dynamic limiter–compressor every study must have. With this measurement method help it's possible to set best the limiter-compressor no longer by ear but by real data and no more subjective elements.

7.3 Modulation power measurement

Another important parameter determining the interference intensity on the adjacent channel is the modulation power value. The term is not of common use and the idea that the modulation power can influence the interferences is not easy to understand.

Reading the CEPT 54-01 rule it's noticed that the transmitter modulation power in object must not exceed the samples reference signal one, represented by a sinusoidal signal which deviates 19KHz of peak. **The 19KHz value has no relation with the stereophonic subcarrier value but it's the frequency deviation which the sample signal** creates on the transmitter. On the tuned receiver this signal will be carried to the loudspeaker with a certain voltage directly proportional to the deviation value; then there will be a certain electric power on the loudspeaker equal to the effectual voltage square about divided into the loudspeaker impedance; it, at less of the diffuser efficiency, coincides to the acoustic power. So it's possible to believe the modulation power as the equivalent of the acoustic power spread by the loudspeaker, and perceived by our ears.

Thus as for the electric power, the equivalent mathematical rules are valid for the modulation power also. In the first case the value depends on the voltage square, in the second one on the deviation square.

In the case of a sinusoidal quantity, which may be voltage or deviation, the power is calculated for a time equal or multiple the semi period of the wave form, while in the case of a music signal the calculation is to be made by the integral which defines the power. Besides the modulation power value in absolute form would be of a difficult understanding, for this reason any sinusoidal signal is taken as reference whose power, for long observation periods, doesn't depend on the sinusoid frequency but only on its peak value square.

So the rule provides to measure the modulation power, which is as previously seen equal to modulating signal electric power, for one minute time period and to compare it to a sinusoidal modulating signal one which deviates ±19KHz. The result, expressed in dB, must be lower or equal to zero to comply the rule.

The modulation power integral calculation is made inside the transmitter by integrating, between 0 and 1 minute, the modulating signal square. The integration is made in a discreet manner by calculating the function area in the integration time; the signal sampling is made at a double speed respecting its bandwidth, so microprocessor is practically locked for a minute to follow instant by instant MPX signal value. After this period it performs the set values square, add them up, which is equal to the integral, then it calculates the logarithm respecting the reference sinusoidal value.
The value is displayed in a numerical form or on a graph (on the PC) which has in the abscissas the time (discreet with 1min steps) and in the ordinates the value in dB of the music signal power and the reference sinusoidal one ratio.

Even in this case it's possible to refer to a modulating signal made of the usual coloured noise in accordance to CCIR-559 particularly Rec.ITU-R BS.412-7 mentions at pag.5-note 4:

The power of a sinusoidal tone causing a peak deviation of 19KHz is equal to the coloured noise modulation signal according to Recommendation ITU-R BS.641 , i.e. a coloured noise signal causing a quasi-peak deviation of 32KHz

So, for the modulation power measurement instrument alignment, it's possible to refer either to a 500Hz sinusoidal signal (the frequency is not important) which makes the carrier to deviate of 19KHz or to the coloured noise which deviates 32KHz. Both signals give the listening the same sensation of " volume intensity ", told in non technical words and not considering physiological effects of the ear sensibility at the different frequencies.

7.4 Considerations on the real measurements performed

Performing modulation measurements with the methods described so far on broadcast networks which have been modulating for years without over modulation problems, one realizes how the limits imposed by the rules mentioned so far are particularly restrictive and maybe not in compliance with current reality.

There are some contradictions and gaps the rules self sometimes point out. We report two examples which give the idea of the real difficulty about the strict application of them:

REC. 641 , Rep.1064

5. FREQUENCY DEVIATION OF THE SIGNAL GEN.

..................The unwanted transmitter L is then modulated with a 500 Hz sinusoidal tone obtained from audio generator A. Attenuator B is then adjusted to obtain a deviation of 32 KHz. The audio frequency level as the input of the unwanted transmitter ***before the pre-emphasis*** *is now measured by means of the noise voltmeter U. The noise-weighting network is switched off. Next, a noise signal C+D replaces the sinusoidal tone, and attenuator E is adjusted to obtain the same peak-reading as before at the noise voltmeter. The quasi-peak deviation is thus equal to 32 KHz.* ***Since the pre-emphasis has not been included in the level measurement, the actual peak deviation is higher .****The described adjustment corresponds to the present-day broadcasting practice.*

Note. – ***A normal sound-broadcasting programme without compression is simulated by modulating the unwanted transmitter with the standardized coloured noise signal using a frequency deviation of 32 KHz. Therefore, the results obtained with this method and this deviation are only valid for sound broadcasting programmes without compression.***

The not considering the pre-emphasis leads to a difference of 1dB about, whereas the audio compressors installed now in every broadcast networks increase the modulation power of 2dB further on.

If a stereophonic signal is being examined the Rec.ITU-R BS.412-7 is very clear and it makes no distinction between the modulation power within monophonic and stereophonic signal:

Rec. ITU-R BS.412-7

2.3 *The radio-frequency protection ratios assume that the maximum peak deviation of 75 KHz is not exceeded. Moreover, it is assumed that the power of the complete multiplex signal including pilot-tone and additional signals , integrated over any interval of 60 s is not higher than the power of a MPX signal containing a single sinusoidal tone which causes a peak dev. of 19 KHz (see Note 4)*

....

Note 4 – The power of a sinusoidal tone causing a peak dev. Of 19 KHz is equal to the power of the coloured noise modulation signal ***according to ITU-R BS.641*** *i.e. a coloured noise signal causing* ***a quasi-peak deviation of 32 KHz*** *.*

Whereas the IEC 244-13 makes a difference between monophonic signal (reference of 32KHz) and stereophonic one (40KHz):

IEC 244-13

9.4 For monophonic operation

Check that the pre and de-emphasis filters are in circuit

Adjust the output of the LF generator at <1KHz to a level witch

corresponds to a frequency dev. 7.4 dB below maximum rated

*deviation (**32 KHz for 75 KHz dev**.)*
Measure the peak value by means of the noise meter at the out of the demodulator (without weighting network).
Switch the LF generator out of circuit and the noise generator in circuit and adjust the output of the noise generator , so that the noise meter gives the same reading. The peak-dev. is now correct.
....
....

For stereophonic operation

Check that the appropriate pre and de-emphasis are in circuit
*Adjust the output of the LF generator at <1KHz to a level corresponding **to a frequency deviation of 40 KHz including pilot tone.***
Measure the peak value in channel B after the demodulator and stereo encoder by means of the noise meter (without the weighting network).
For the remaining procedure , see the method used for monophonic operation

In case of stereophonic broadcast in accordance to the IEC 244-13 rule the reference power is moved highwards of 1.9 dB in relation to the corresponding REC. ITU-R BS.412-7.

REMOTE CONTROL

8.1 PC connections

The transmitter can be connected to a Personal Computer through a three wires serial cable.

There are three serial ports: the first (COM1), placed on the front panel works as monitor for a connection to a PC, the second (COM2), placed on the back needs for the connection to a possible power amplifier, with the third (COM3) it's possible to connect a modem linked to a telephone line or to do the connection of N+1 transmitters.

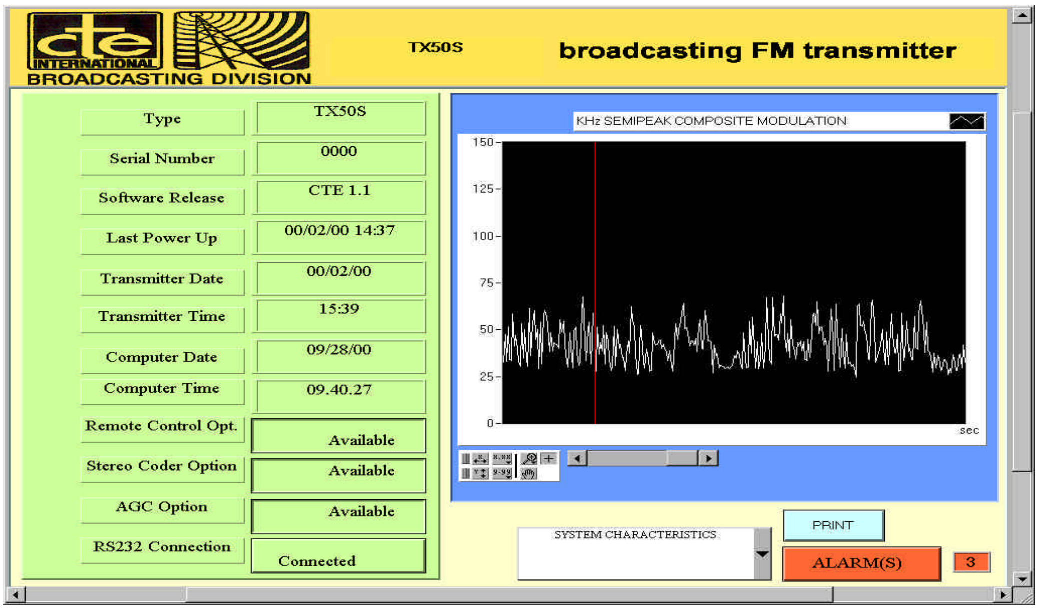
The PC must have:

processor	:	PENTIUM o sup.
Operative system	:	WIN3.1 / WIN95 / WIN98
RAM	:	32MB
Non volatile memory	:	32MB
Graphic	:	SVGA 600x800/768x1024
CD reader		

8.2 COM1

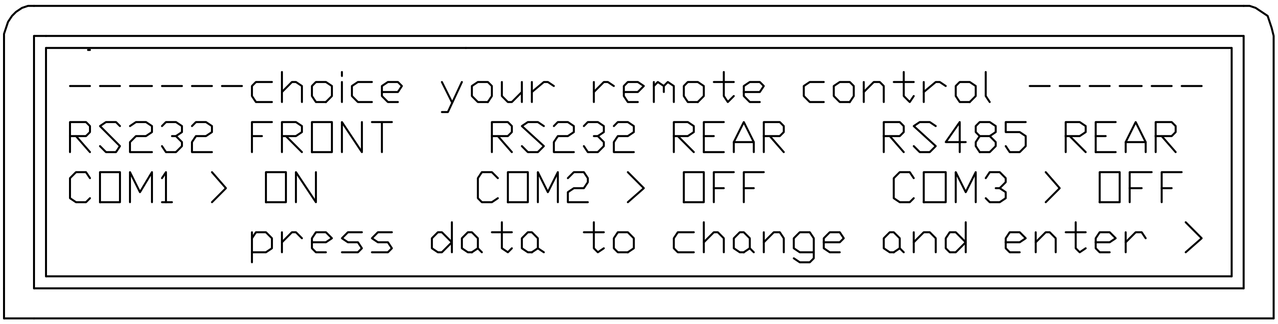
If one wishes to connect a PC to replace the transmitter keyboard and thus have a wider and easier communication to every visualisation and control function, it's possible to connect the DB9 front port (COM1) to a serial cable with at least three wires to the serial port of a personal computer where the communicating software provided on the transmitter enclosed CD has been already loaded. If unready it is sufficient to start the SETUP and automatically the software is installed as to create an icon (XPT-50), which will need for the program start.

Once started it will appear on the display:



The screen cursor which displays the modulation will be still and the low left inscription RS232 Connection will show: **not connected**. At this point it is essential, after the transmitter has been switched on, to make it communicate.

So the transmitter keyboard blue button marked as REMOTE 232 must be entered
The following page will appear on the display:



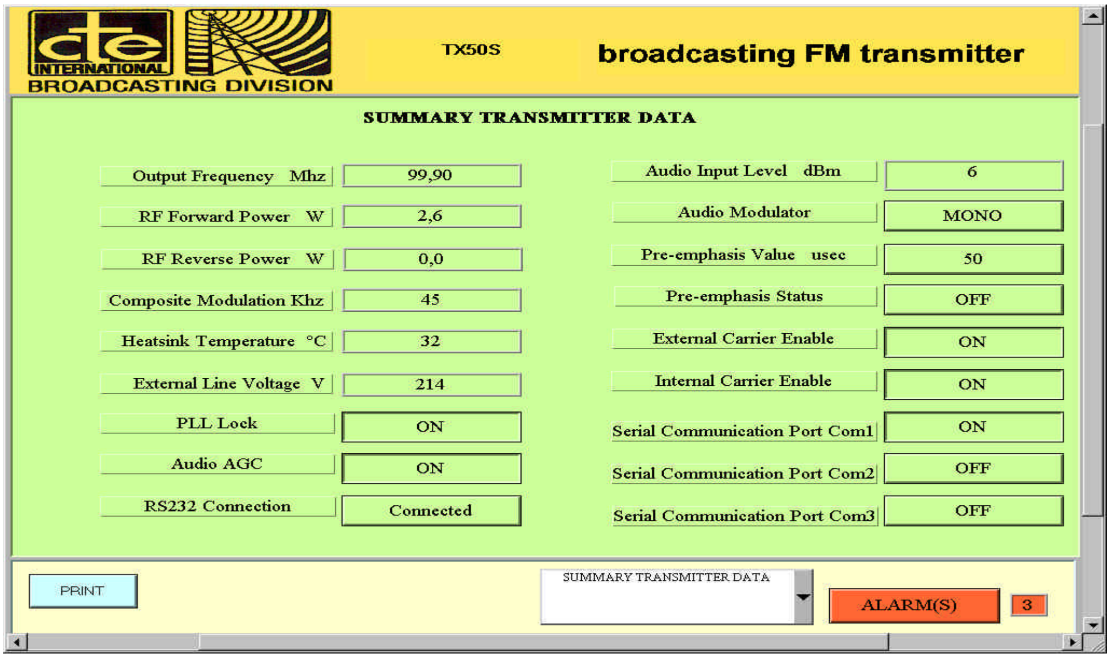
which indicates that by default the COM1 connection has been chosen instead of the COM3 and on the COM2 no power amplifier is connected.

If on the COM2 an amplifier was connected automatically it would be detected and its caption would appear beside the COM2 one.

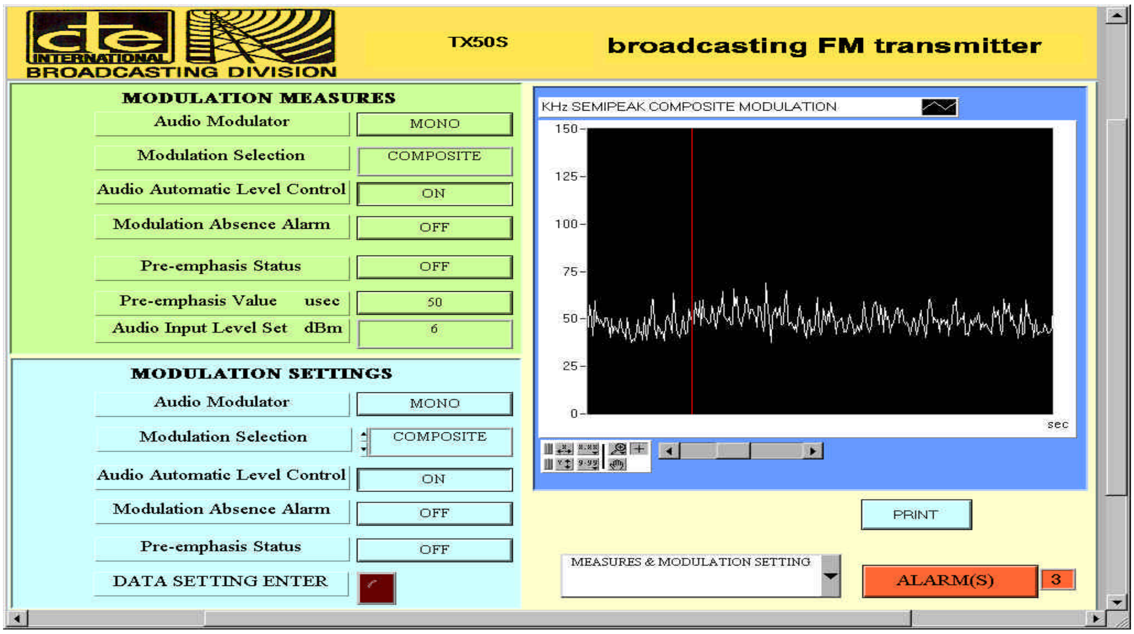
If a modem connected to the telephone line is to be connected it needs to select by the horizontal cursor and the data key the COM3.

If the selected options are right, pressing ENTER the communication to the PC connected to the COM1 is entered, the blue key led switches on, on the display the cursor moves from left towards right, displaying the modulation peaks as an oscilloscope and the caption **connected** will appear on the left bottom.

The first page is just an introduction to the system, of which it's possible to know the options installed or the hour of the last switching on. At the right bottom of the display there is a grey window with an arrow and if it is entered it's possible to enter into the following pages:

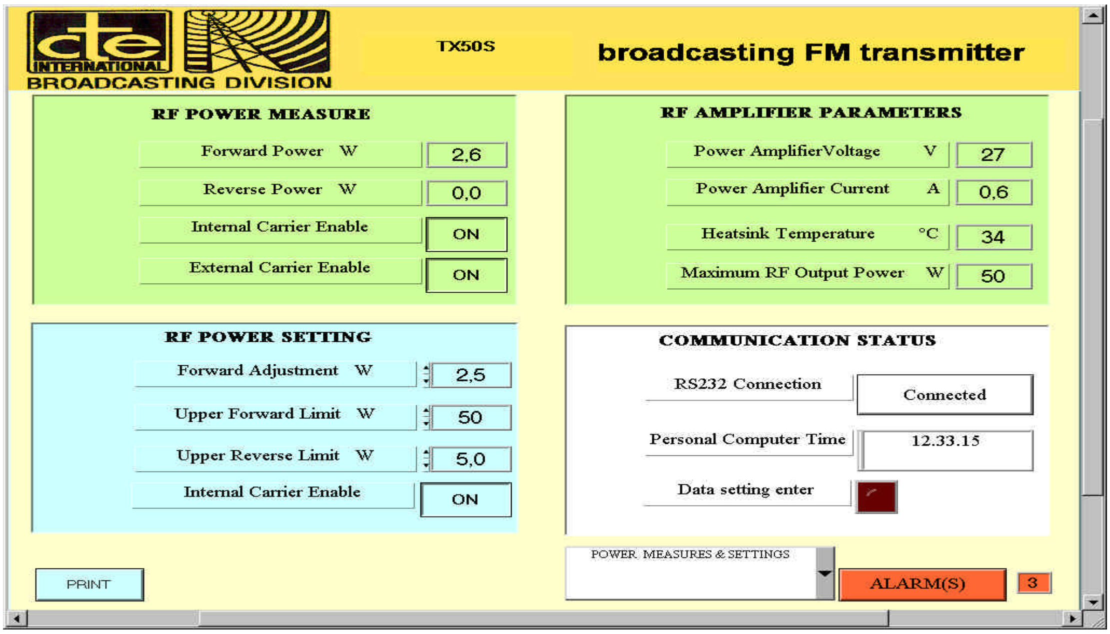


The second page allows to know all the transmitter operation data: frequency–power etc., without the possibility to modify them. Choosing by the lower arrow the third page the data displaying of the input low frequency signal and modulation can be entered:



All the pages have different coloured windows to divide the width measurements from the setting of them. On the top of this page it's possible to check which channel is displayed on the screen shot (COMPOSITE); to change this display because, for example, one wants to check the LEFT course, one must enter the lower window (MODULATION SETTINGS), and press "DATA SETTING ENTER". The red button will switch on, the modulation will disappear and changing in the window "Channel Modulation", the respective changes will be displayed on the higher window too. When the chosen data are the requested ones it's possible to switch the red button off and the normal displaying will be restored.

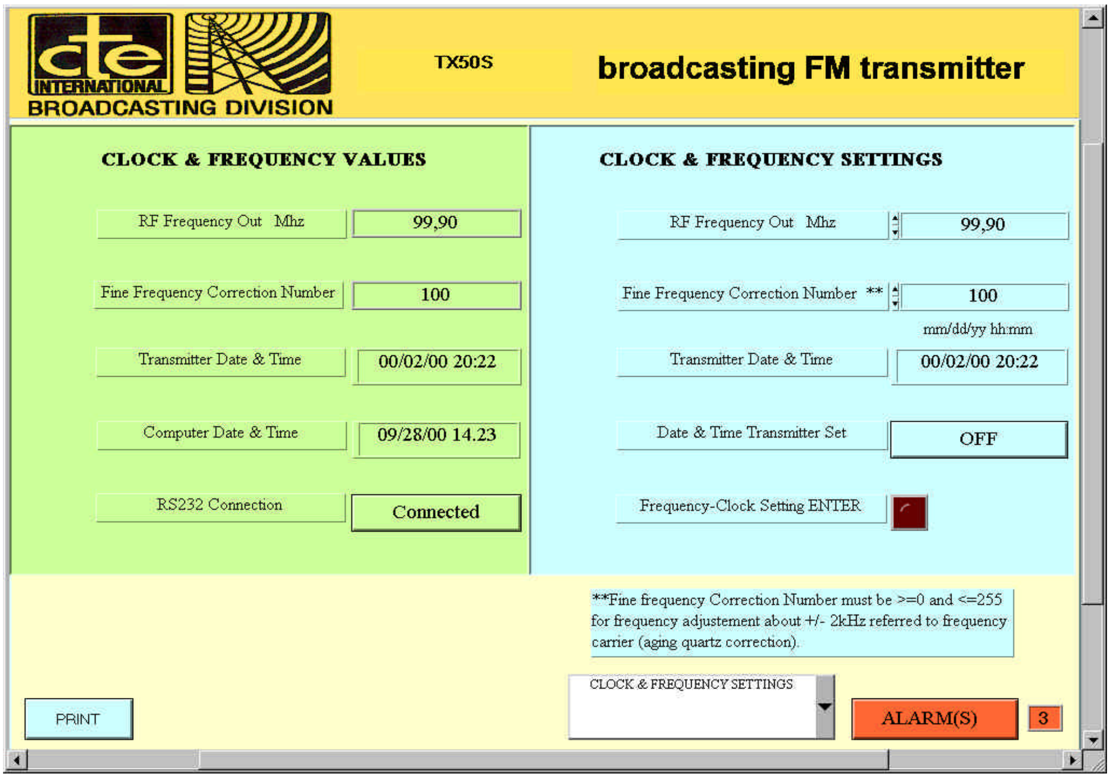
Selecting the fourth page the power settings are entered:



Here also the settings are distinguished from the measurements by a different colour.

To change data it is sufficient to press the red button, which will lighten, and will change data in the RF POWER SETTING window. At every new setting a changing of the measurement displayed above will correspond. On the top right window also the power final stage parameters are reported.

Choosing the next page there will be:

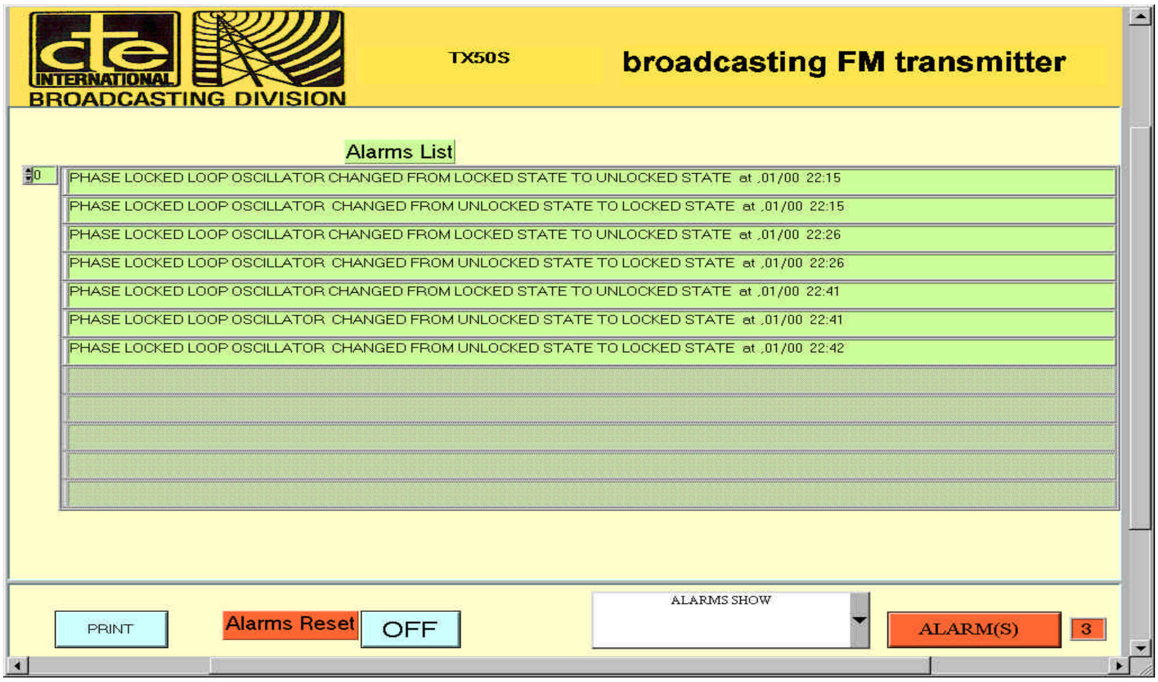


Here the transmitter clock settings and frequencies can be changed.

Differently from the previous pages, here the variations cannot be performed in real time, to avoid the transmitter goes on unwanted frequencies. So, at first data must be inserted then the red button must be pressed to enter them. During the frequency change power is disabled for few seconds and the oscillator anomalous condition is not stored as alarm. If an out-of-channelization frequency is entered, the item is ignored.

It is also possible a fine frequency correction, to correct the crystal ageing by inserting a number included between 0 and 255 and checking by a frequency-meter connected to the RF monitor.

The following page allows the alarm displaying and erasing:



The quantities controlled by this function are:

MAINS SUPPLY VOLTAGE

CURRENT ON THE RF FINAL

VOLTAGE ON THE RF FINAL

RF FINAL RADIATOR TEMPERATURE

MODULATION ABSENCE

SYNTHESIZED OSCILLATOR ANOMALOUS OPERATING

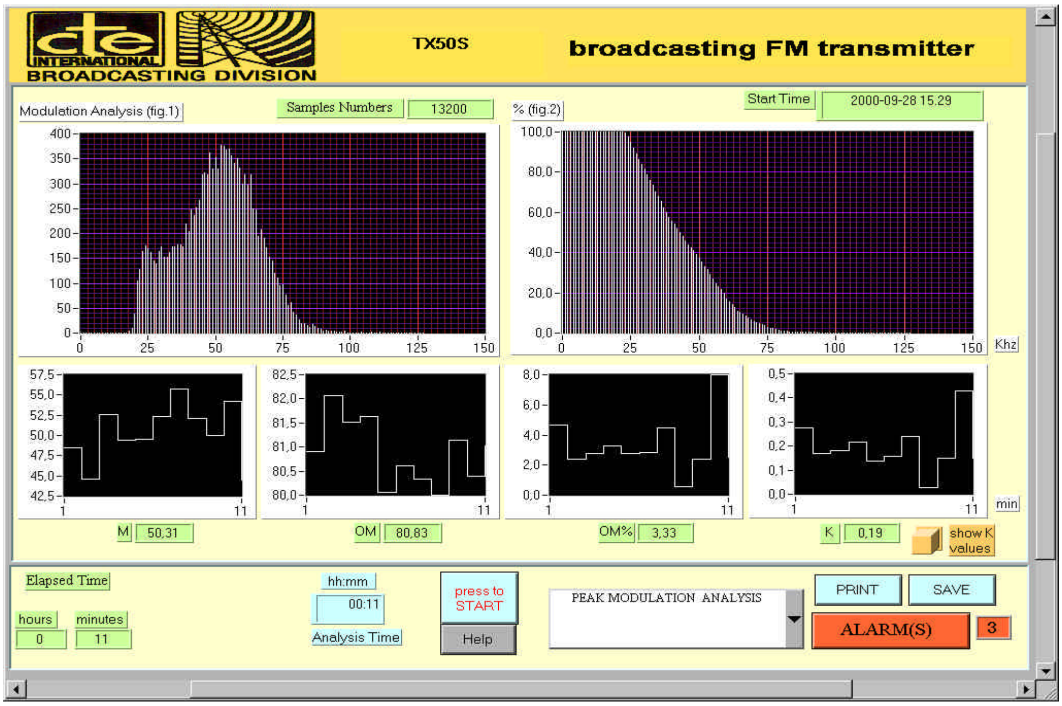
EXTERNAL CARRIER ENABLE

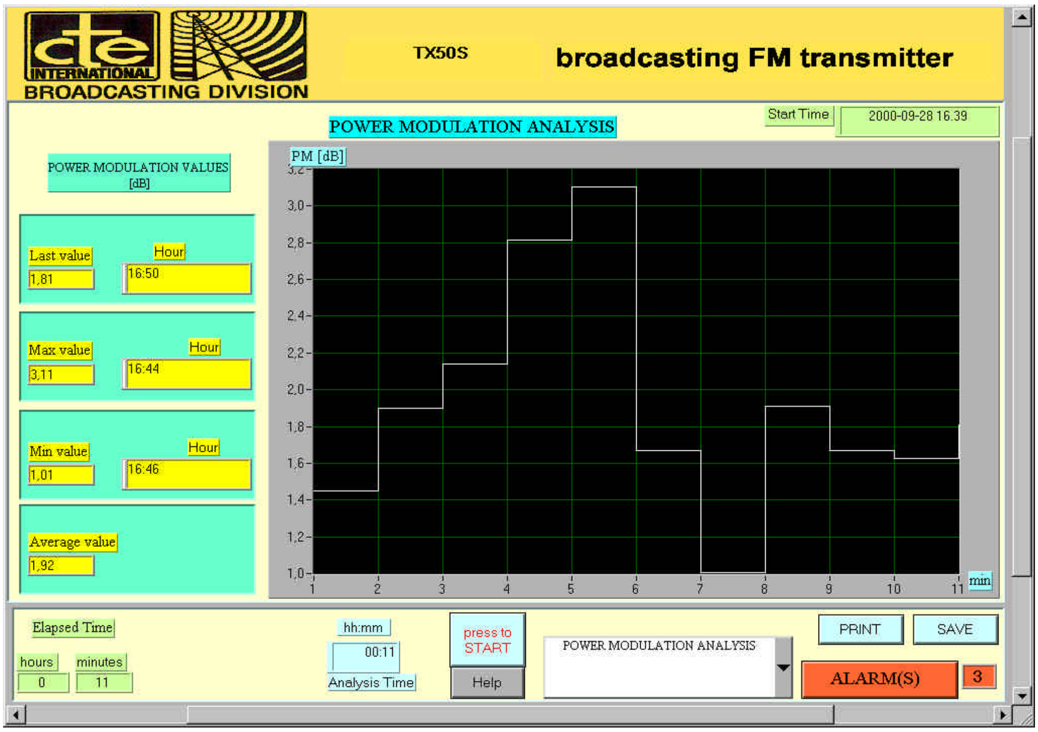
Whenever the limits joined to each quantity mentioned above are exceeded, the output power is taken off, a visual signalling and ON/OFF contacts are given and the event is stored and associated to the date when it has occurred.

Besides the ceased alarms are stored as to know the output power absence period.

As for the keyboard, the alarms can be erased.

The last pages are dedicated to the modulation analysis measurement (power and peak):





As appendix the whole theory concerning this kind of measurements is dealt in chapter **7**, dedicated to the modulation measurements.

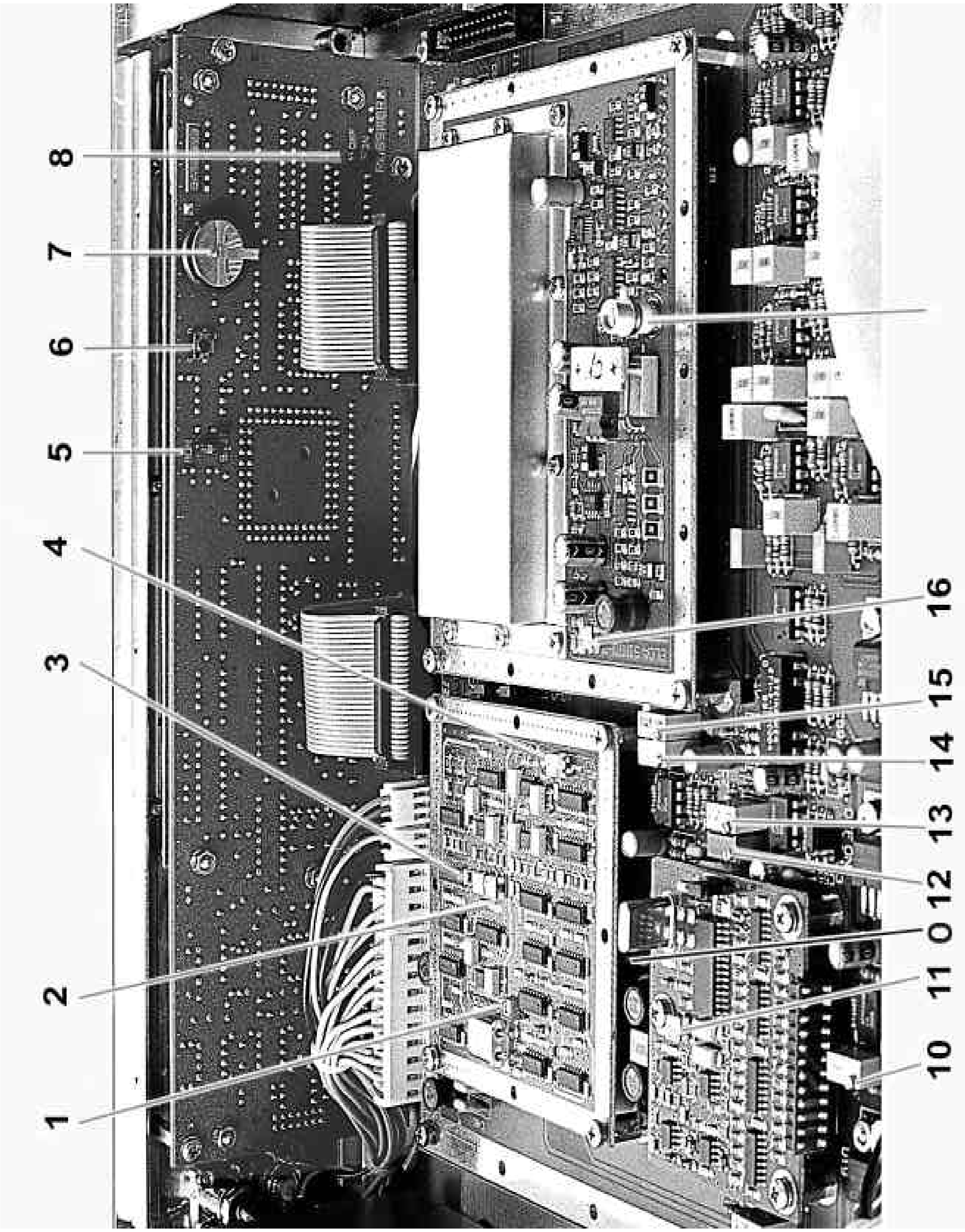
In the upper graphs the peak modulation statistic parameters of a broadcast network observed during 10 minutes period are reported. It can be observed that the 12000 peak measurement samples detected lead to consider that the network is on the limit of the allowed deviation; the last K diagram clearly shows the spoken broadcasting for the first two minutes followed by a music passage (K>4), at the end other two minutes spoken (K<3).

By entering HELP on the window the followed rule appears (CEPT 54-01). The observation time period is edited in ANALYSIS TIME followed by START.

TX50S INTERNAL ADJUSTMENTS & SETTINGS

See figg. 9.a , 9.b , 9.c for function number

N°	*Board name/ Component*	*FUNCTION*	*DESCRIPTION*
0	MBA/RT7	MPX frequency deviation	Adjust, with nominal MPX input level, for 75 Khz frequency deviation
1	DMPX/C22	Pilot frequency	Adjust stereo subcarrier to 19 Khz +/-1Hz
2	DMPX/RT1	Pilot level	Adjust to 20dB less than MPX signal
3	DMPX/RT3	Pilot phase	Adjust to the right phase by antiphase tecnique
4	DMPX/RT2	MPX spurious	Adjust for minimum spurious of MPX signal
5	DLCD/Z1	Run/Boot	Set jumper to RUN for normal operation, to BOOT for firmware loading (by COM1)
6	DLCD/P9	MCU reset	Press button to Reset 68HC11 microcontroller
7	DLCD/BT1	Clock battery	Use only 3.3 V lithium battery (**WARNING:TOXIC COMPONENT**)
8	DLCD/Z2	Password	Set jumper to PASSW. to enable password function.
9	MBA/RT5	Freq.dev.display	Adjust to display modulation = 75 Khz on Page 0
10	MBA/RT4	Pilot THD	Adjust to minimum pilot THD
11	AGC/RT1	AGC level input	Adjust, with nominal LF level input, DC voltage on DZ1 to 2.6V
12	MBA/RT1	Clipper symm.	Adjust for clipper symmetry
13	MBA/RT6	Clipper level	Adjust to the desired clipper level
14	MBA/RT2	Chan. separation	Adjust for max channel separation
15	MBA/RT3	Chan. separation	Adjust for max channel separation
16	SINTD/RT1	Mono frequency deviation	Adjust, with nominal mono audiolevel in MPX input, for 75 Khz deviation
17	SINTD/CV1	Frequency	Adjust to right output frequency with fine frequency number set to 100
18	HSW/RT6	Line voltage meas.	Adjust to display on page 0 line voltage measured between M2 connector pins on HSW board
19	HSW/RT3	PAC meas.	Adjust to 0Vdc on PAC (J1-1) without connector
20	HSW/RT2	+28Vdc	Adjust to 28 Vdc (J1-12)
21	HSW/RT5	+15Vdc	Adjust to 15 Vdc (J1-13)
22	HSW/RT1	PAC limiter	Rotate completely clockwise for Ilim>5A (max value)
23	RFDC/RT2	PWR offset	Adjust to obtain (without RFin) 0Vdc on PWR feedthrough
24	RFDC/RT1	PWR meas.	Adjust to read on display (without RF load) PWD=PWR (PWR set = 5W)
25	RFDC/RT3	PWD meas.	Adjust to obtain Pout = 50W (PWD set = 50W)
26	RFDC/RT4	PWD offset	Adjust to obtain (without RFin) 0Vdc on PWD feedthrough
27	40WN/RT2	Final RF mosfet current meas.	Adjust to read (without RF) PACurrent=1A on display page1
28	40WN/RT1	Driver current	Adjust to obtain (without RF) 35mVdc voltage drop on R11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7
6
5
4
3
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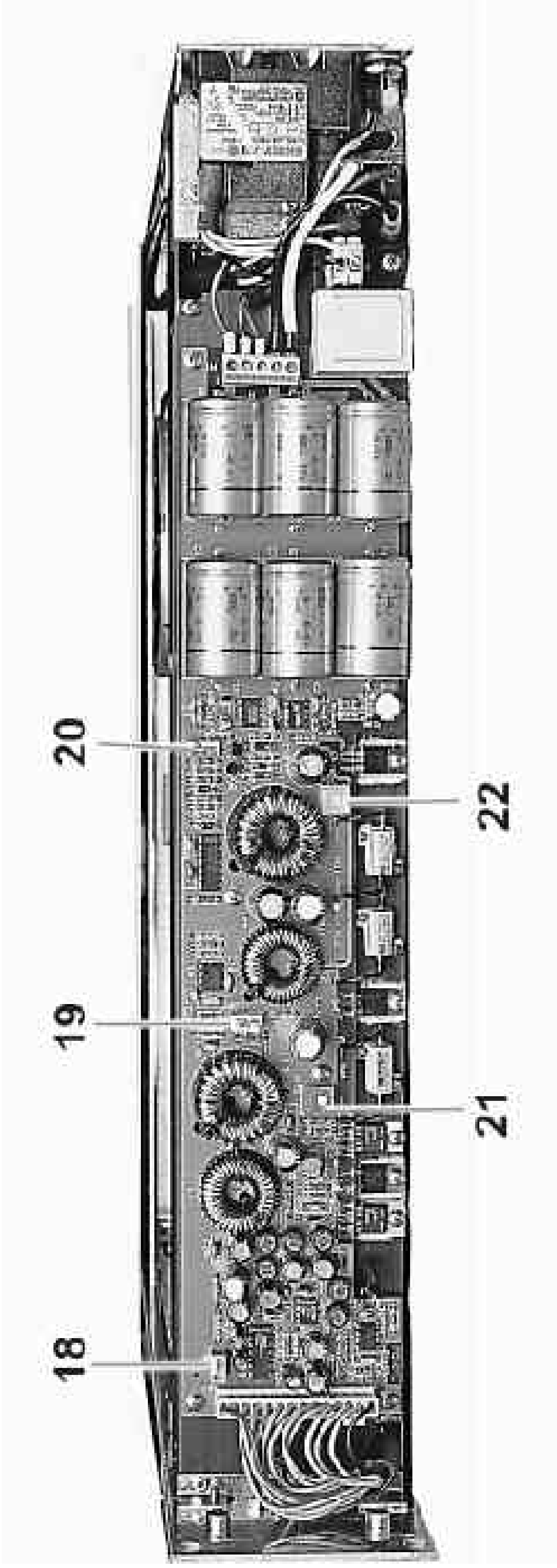
13
12
0
11
10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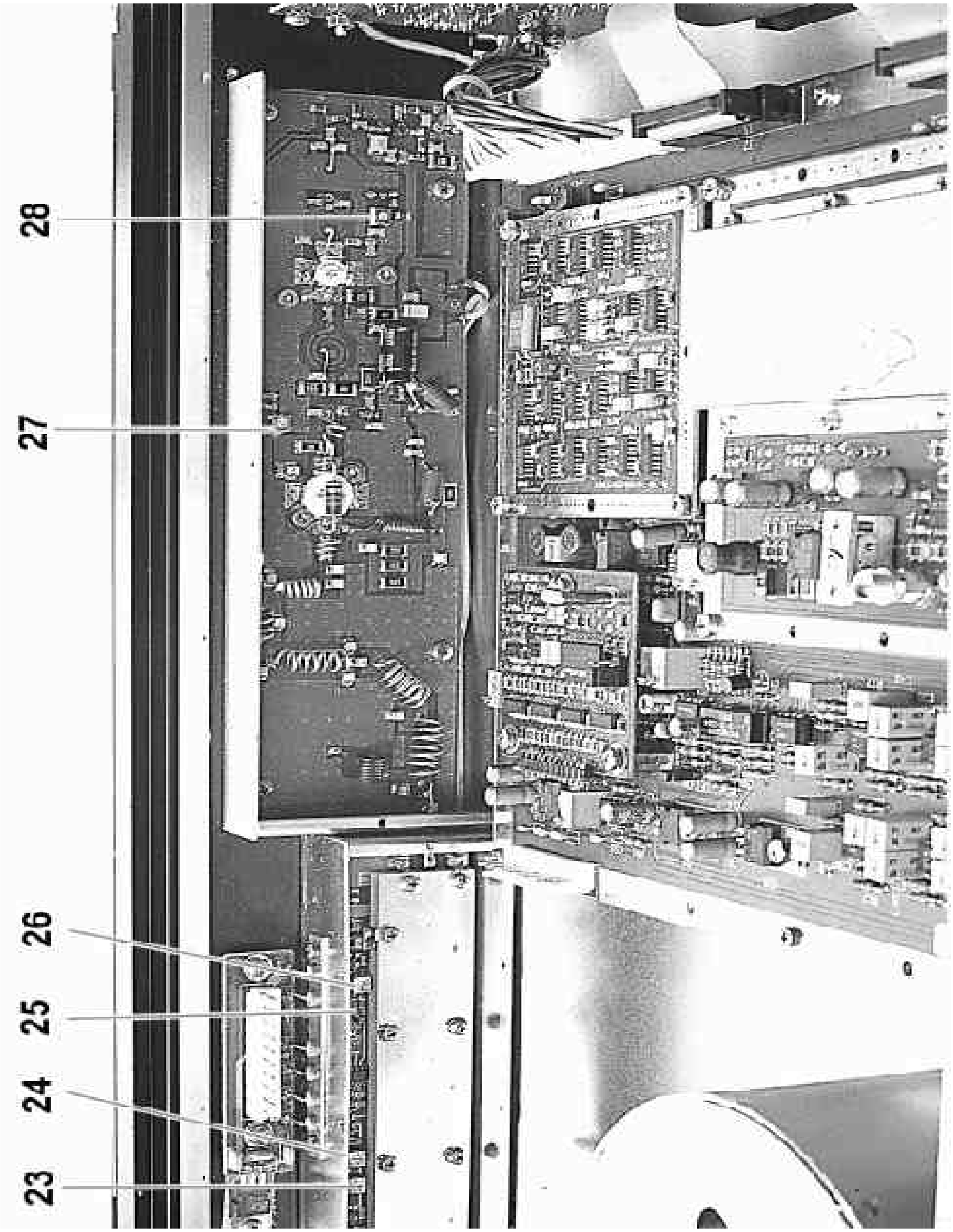
18

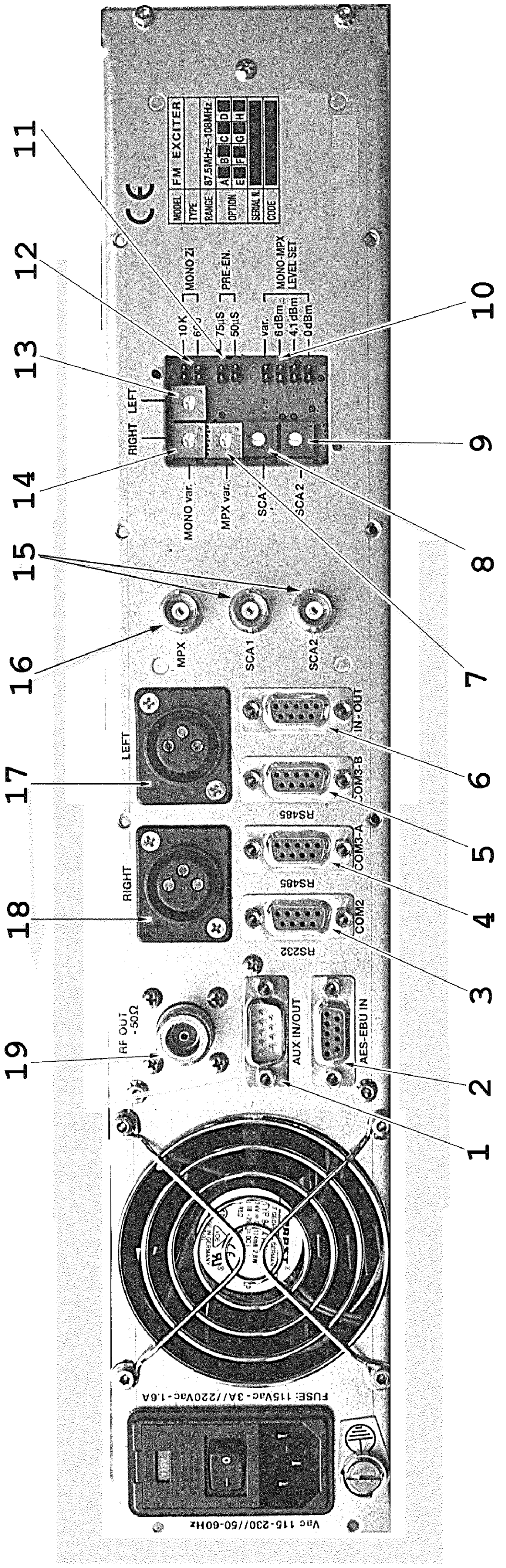

28
27
26
25
24
23

TX50S REAR CONNECTIONS & SETTINGS

See fig. 9.d for function number

N°	FUNCTION	CONNECTION		
1	AUX IN/OUT	PIN NUMBER (DB9)	1	NC
			2	NC
			3	NC
			4	NC
			5	GND
			6	EXTERNAL PWD
			7	EXTERNAL PWR
			8	NC
			9	NC
2	AES/EBU IN	PIN NUMBER (DB9)	1	NC
			2	NC
			3	NC
			4	NC
			5	GND
			6	I1
			7	I2
			8	NC
			9	NC
3	COM2 RS232 to power amplifier	PIN NUMBER (DB9)	1	NC
			2	RX (amplifier)
			3	TX (amplifier)
			4	NC
			5	GND
			6	NC
			7	NC
			8	NC
			9	NC
4	COM3A RS485 to remote control (external Modem) or N+1 system	PIN NUMBER (DB9)	1	NC
			2	INPUT RS485 +
			3	INPUT RS485 -
			4	NC
			5	GND
			6	NC
			7	NC
			8	NC
			9	NC

N°	FUNCTION	CONNECTION		
5	COM3B RS485 to N+1 system	PIN NUMBER (DB9)	1	NC
			2	INPUT RS485 +
			3	INPUT RS485 -
			4	NC
			5	GND
			6	NC
			7	NC
			8	NC
			9	NC
6	IN/OUT	PIN NUMBER (DB9)	1	19 Khz sync. out (1 Vpp out)
			2	EX Carrier enable input (input contact open = enable)
			3	ALARM1 out (closed or open output contact / Z1, Z2 - MBA board)
			4	ALARM2 out (closed or open output contact / Z1, Z2 – MBA board)
			5	GND
			6	NC
			7	NC
			8	NC
			9	NC
7	EXTERNAL MONO / MPX INPUT ADJUSTMENT	Trimmer RT5 / AUDIO IN board -6 / +12 dBm adj. for 75 Khz modulation frequency		
8	SUBCARRIER 1 INPUT ADJUSTMENT	Trimmer RT1 / AUDIO IN board -20 dBu adj.		
9	SUBCARRIER 2 INPUT ADJUSTMENT	Trimmer RT2 / AUDIO IN board -20 dBu adj.		
10	NOMINAL VALUE LF INPUT SETSETTING	Jumpers Z3,Z4,Z5,Z6 / AUDIO IN board 0 , 4.1 , 6 , variable (-6/+12) dBm setting choice		
11	PREEMPHASIS VALUE CHOICE	Jumpers Z8,Z2 / AUDIO IN board 50 / 75 microseconds choice		
12	MONO INPUT (L / R) IMPEDENCE CHOICE	Jumpers Z1,Z7 / AUDIO IN board 600 Ohm / 10 Kohm choice		
13	LEFT INPUT ADJUSTMENT	Trimmer RT4 / AUDIO IN board -6 / +12 dBm adj. for 75 Khz modulation frequency		
14	RIGHT INPUT ADJUSTMENT	Trimmer RT3 / AUDIO IN board -6 / 12 dBm adj. for 75 Khz modulation frequency		
15	SCA1 & SCA2 INPUTS	BNC connector		
16	EXTERNAL MPX INPUT	BNC connector		
17	LEFT INPUT	PIN NUMBER (Cannon)	1	GND
			2	LEFT + (unbalanced with GND)
			3	LEFT – (balanced with LEFT+)
18	RIGHT INPUT	PIN NUMBER (Cannon)	1	GND
			2	RIGHT + (unbalanced with GND)
			3	RIGHT – (balanced with RIGHT+)
19	RF OUT	N connector		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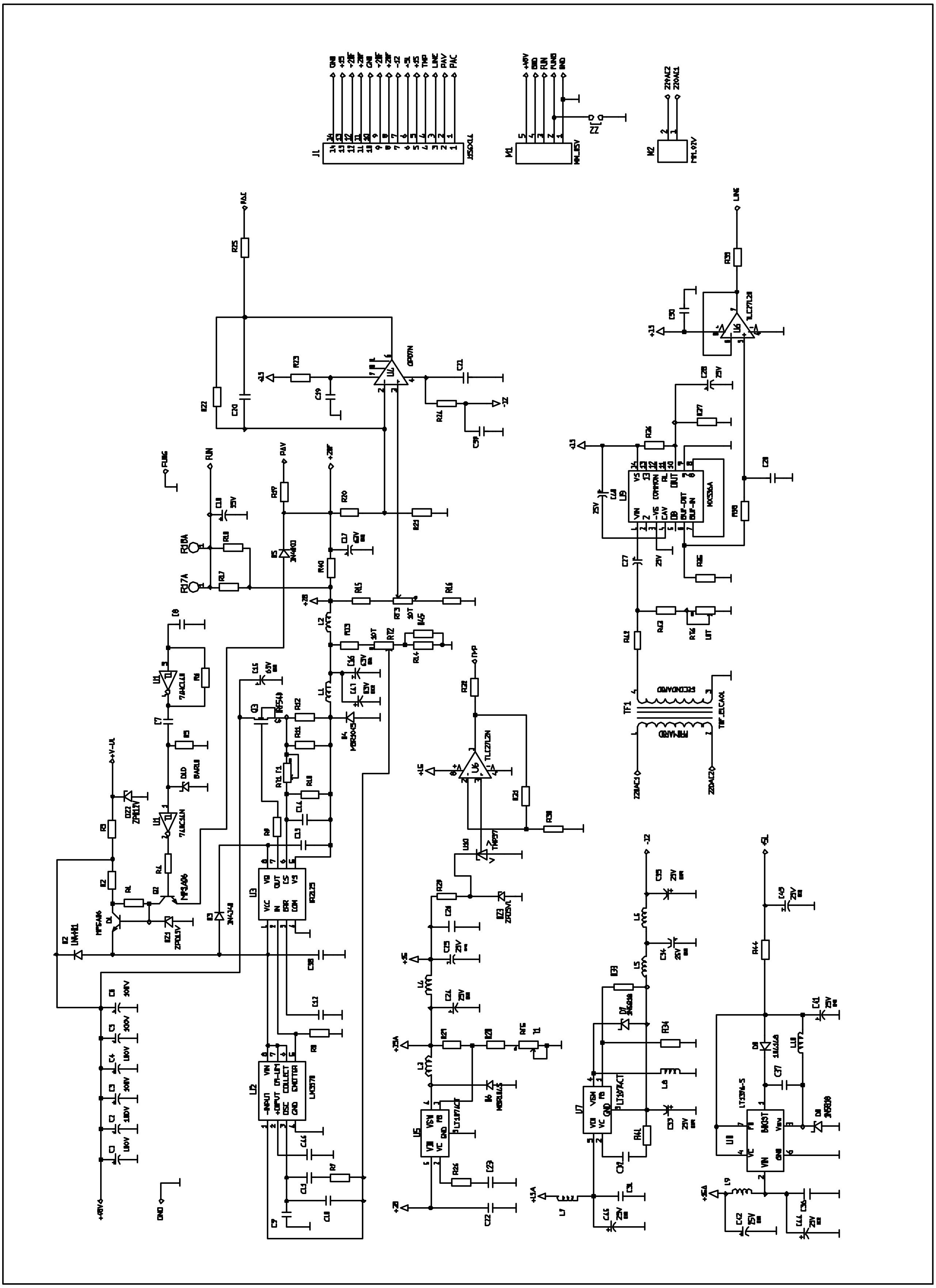
FM EXCITER
MONO Zi
PRE-EN.
MONO-MPX LEVEL SET
10K
600
75µS
50µS
var.
6 dBm
4.1dBm
0 dBm
LEFT
RIGHT
MONO var.
MPX var.
SCA1
SCA2
MPX
IN-OUT
COM3-B
RS485
COM3-A
COM2
RS232
AUX IN/OUT
AES-EBU IN
RF OUT -50Ω
FUSE: 115Vac - 3A / 220Vac - 1.6A
Vac 115-230//50-60Hz

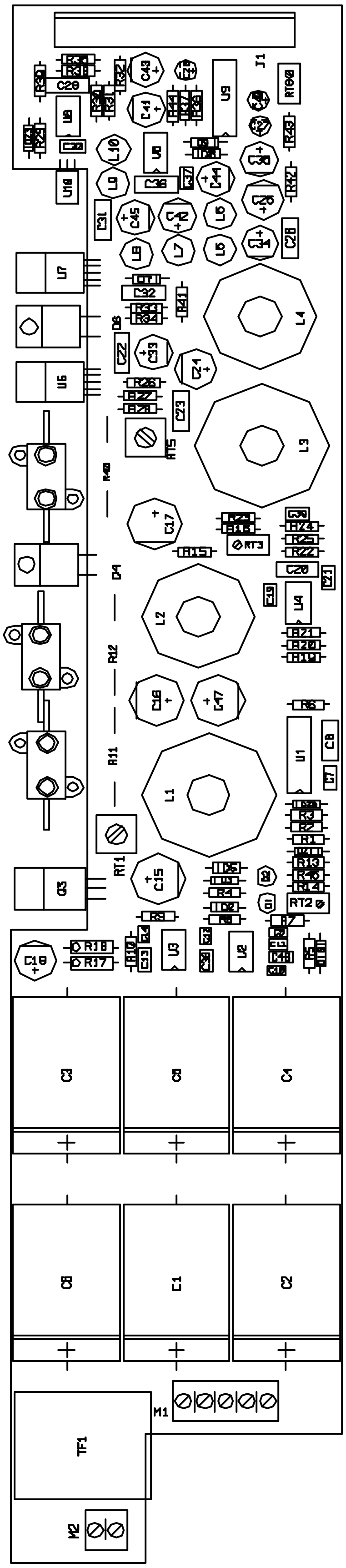
Fig. 9.d

DIAGRAMS AND LAYOUTS

HSW BOARD - POWER SUPPLY



HSW BOARD - POWER SUPPLY

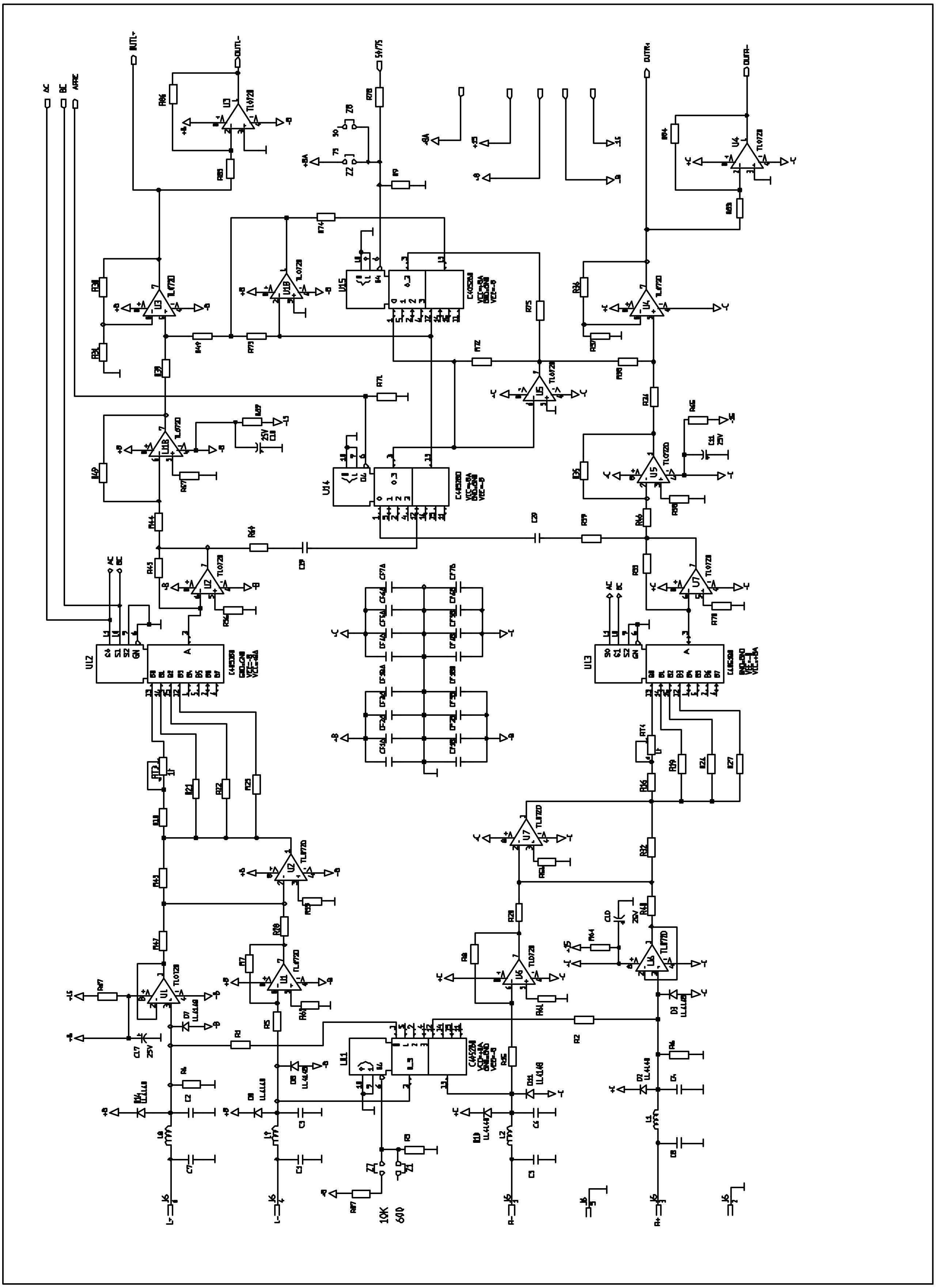


HSW BOARD - POWER SUPPLY

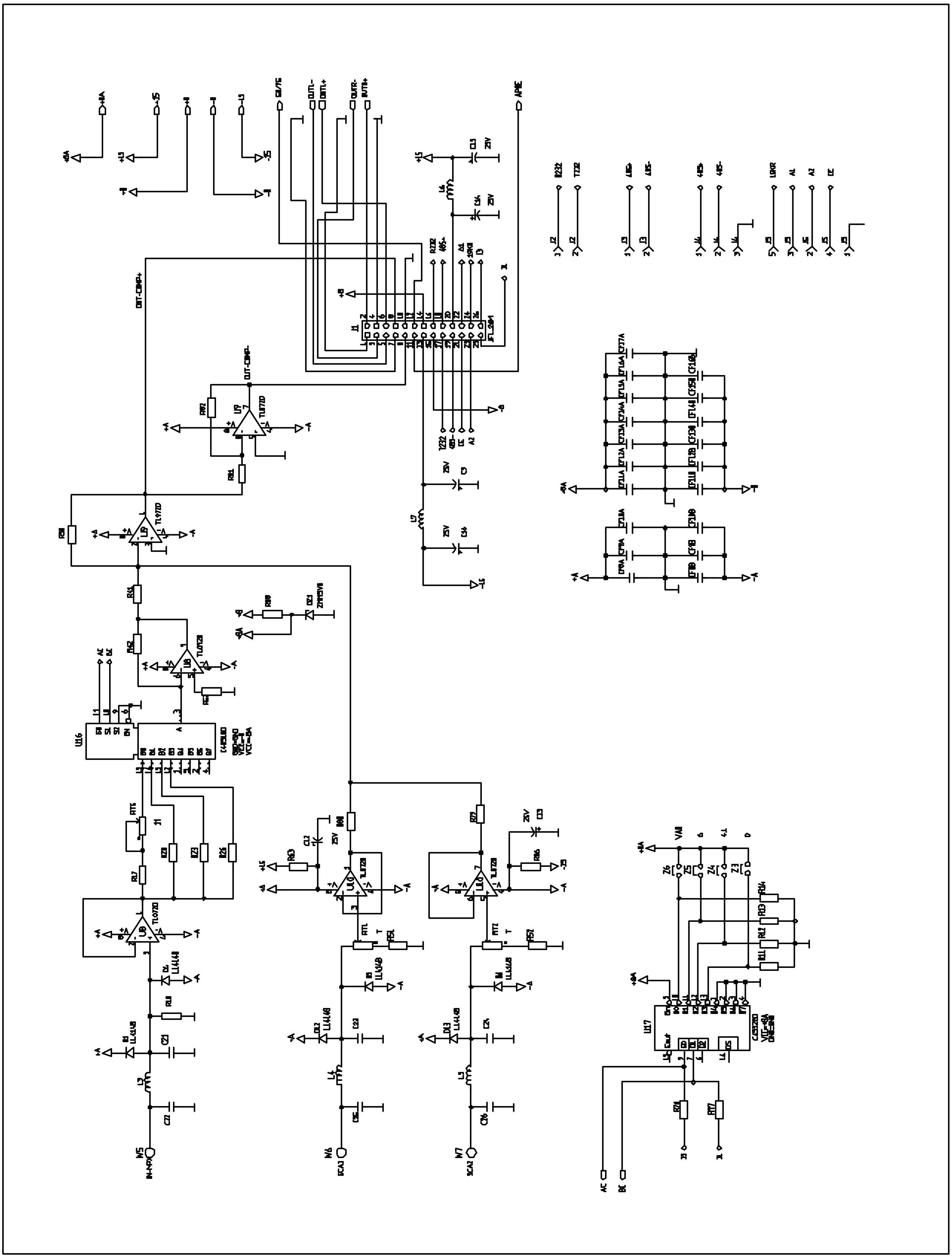
	qty	part number	Val	Tol	Work.Volt.	description	
1	1	BAR10				diode	D10
2	1	CCM_1u	1u	20%		Multilayer Ceramic Capacito	C8
3	1	CCM_1u	1u	20%		Multilayer Ceramic Capacito	C22
4	1	CCM_1u	1u	20%		Multilayer Ceramic Capacito	C23
5	1	CCM_1u	1u	20%		Multilayer Ceramic Capacito	C26
6	1	CCM_1u	1u	20%		Multilayer Ceramic Capacito	C31
7	1	CCM_1u	1u	20%		Multilayer Ceramic Capacito	C36
8	1	CCM_2n2	2n2	10%		Multilayer Ceramic Capacitor	C14
9	1	CCM_2u2	2u2	20%		Multilayer Ceramic Capacitor	C20
10	1	CCM_2u2	2u2	20%		Multilayer Ceramic Capacitor	C29
11	1	CCM_3n3	3n3	10%		Multilayer Ceramic Capacitor	C9
12	1	CCM_10n	10n	10%		Multilayer Ceramic Capacitor	C11
13	1	CCM_56p	56p	5%		Multilayer Ceramic Capacitor	C10
14	1	CCM_100n	100n	10%		Multilayer Ceramic Capacitor	C7
15	1	CCM_100n	100n	10%		Multilayer Ceramic Capacitor	C13
16	1	CCM_100n	100n	10%		Multilayer Ceramic Capacitor	C21
17	1	CCM_100n	100n	10%		Multilayer Ceramic Capacitor	C19
18	1	CCM_100n	100n	10%		Multilayer Ceramic Capacitor	C39
19	1	CCM_100n	100n	10%		Multilayer Ceramic Capacitor	C30
20	1	CCM_100n	100n	10%		Multilayer Ceramic Capacito	C37
21	1	CCM_100n	100n	10%		Multilayer Ceramic Capacitor	C38
22	1	CCM_100n	100n	10%		Multilayer Ceramic Capacitor	C46
23	1	CCM_100p	100p	10%		Multilayer Ceramic Capacitor	C12
24	1	CCM_220n	220n	20%		Multilayer Ceramic Capacitor	C32
25	1	CEV_10u-25V	10u	20%	25V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C40
26	1	CEV_10u-25V	10u	20%	25V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C28
27	1	CEV_10u-25V	10u	20%	25V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C27
28	1	CEV_47u-25V_EKR	47u	20%	25V		C45
29	1	CEV_47u-25V_EKR	47u	20%	25V		C33
30	1	CEV_47u-25V_EKR	47u	20%	25V		C34
31	1	CEV_47u-25V_EKR	47u	20%	25V		C35
32	1	CEV_47u-25V_EKR	47u	20%	25V		C43
33	1	CEV_47u-25V_EKR	47u	20%	25V		C41
34	1	CEV_47u-25V_EKR	47u	20%	25V		C44
35	1	CEV_47u-25V_EKR	47u	20%	25V		C42
36	1	CEV_220u-25V_EKR	220u	20%	25V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C24
37	1	CEV_220u-25V_EKR	220u	20%	25V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C25
38	1	CEV_220u-63V_EKR	220u	20%	63V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C16
39	1	CEV_220u-63V_EKR	220u	20%	63V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C17
40	1	CEV_220u-63V_EKR	220u	20%	63V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C15
41	1	CEV_220u-63V_EKR	220u	20%	63V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C47
42	1	CEV_470u-35V	470u	20%	35V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C18
43	1	CEV_1000u-100V	1000u	20%	100V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C1
44	1	CEV_1000u-100V	1000u	20%	100V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C2
45	1	CEV_1000u-100V	1000u	20%	100V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C3
46	1	CEV_1000u-100V	1000u	20%	100V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C4
47	1	CEV_1000u-100V	1000u	20%	100V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C5
48	1	CEV_1000u-100V	1000u	20%	100V	ALUM. RADIAL ELCTROLYTIC CAPACITOR	C6
49	1	DROP_NC					Z2
50	1	IRF540				N-Channel Power MOSFET TO220	Q3
51	1	IR2125				CURRENT LIMITING CHANNEL DRIVER	U3
52	1	J156X14				Connettore Passo 3.96mm (156th) 14 Poli	J1
53	1	LM3578				SWITCHING REGULATOR	U2
54	1	LTUBE-D8P5	1mH			Inductor Tube Diametro 8.5mm Passo 5mm PTH	L5
55	1	LTUBE-D8P5	1mH			Inductor Tube Diametro 8.5mm Passo 5mm PTH	L7
56	1	LTUBE-D8P5	1mH			Inductor Tube Diametro 8.5mm Passo 5mm PTH	L6
57	1	LTUBE-D8P5	22uH			Inductor Tube Diametro 8.5mm Passo 5mm PTH	L8
58	1	LTUBE-D8P5	22uH			Inductor Tube Diametro 8.5mm Passo 5mm PTH	L9
59	1	LTUBE-D8P5	1mH			Inductor Tube Diametro 8.5mm Passo 5mm PTH	L10
60	1	LT1074CT					U7
61	1	LT1074CT					U5
62	1	LT1376-5				1.5A, 500KHz STEP-DOWN SWITCHING REGULATOR	U8
63	1	L_TORO_100uH	100uH			TOROIDE AVVOLTO 100uH 5 AMPERE	L2
64	1	L_TORO_100uH	100uH			TOROIDE AVVOLTO 100uH 5 AMPERE	L4
65	1	L_TORO_250uH	250uH			TOROIDE AVVOLTO 250uH 5 AMPERE	L1
66	1	L_TORO_250uH	250uH			TOROIDE AVVOLTO 250uH 5 AMPERE	L3
67	1	MBR1045				Diode MBR1045 Case DO220AB	D4
68	1	MBR1045				Diode MBR1045 Case DO220AB	D6
69	1	MM_02V					M2
70	1	MM_05V					M1
71	1	MPSA06				Transistor, NPN BJT	Q2
72	1	MPSA06				Transistor, NPN BJT	Q1
73	1	MX536A					U9
74	1	OP07N				ULTRA-LOW-OFFSET-VOLTAGE OPERATIONAL AMPLIFIER	
75	1	RFILM5W	0.22	%		Film Resistor Mounted with dissipator	R11
76	1	RFILM5W	0.22	%		Film Resistor Mounted with dissipator	R12
77	1	RFILM5W	0.1	%		Film Resistor Mounted with dissipator	R40
78	1	RT_72P	10k	10%		Trimmer Cermet Monogiro serie 72P Beckman	RT1
79	1	RT_72P	1k	10%		Trimmer Cermet Monogiro serie 72P Beckman	RT5
80	1	RT_3296W	500	10%		Trimmer Cermet Multigiro serie 3296W Bourns	RT3
81	1	RT_3296W	200	10%		Trimmer Cermet Multigiro serie 3296W Bourns	RT6

82	1	RT_3296W	500	10%			Trimmer Cermet Multigiro serie 3296W Bourns	RT2	
83	1	R05-J-68R	68R	5%			RESISTOR - Metal Film	R18	COD
84	1	R05-J-68R	68R	5%			RESISTOR - Metal Film	R17	COD
85	1	R025-J-1K0	1K0	5%			RESISTOR - Metal Film 0.25 W	R26	
86	1	R025-J-1K0	1K0	5%			RESISTOR - Metal Film 0.25 W	R29	
87	1	R025-J-1K0	1K0	5%			RESISTOR - Metal Film 0.25 W	R33	
88	1	R025-J-1K2	1K2	5%			RESISTOR - Metal Film	R16	
89	1	R025-J-1K5	1K5	5%			RESISTOR - Metal Film	R21	
90	1	R025-J-2K2	2K2	5%			RESISTOR SMD 0805	R8	
91	1	R025-J-2K2	2K2	5%			RESISTOR - Metal Film	R10	
92	1	R025-J-2K2	2K2	5%			RESISTOR - Metal Film	R41	
93	1	R025-J-2K7	2K7	5%			RESISTOR - Metal Film	R15	
94	1	R025-J-2K7	2K7	5%			RESISTOR - Metal Film	R20	
95	1	R025-J-3K3	4K7	5%			RESISTOR - Metal		
103	1	R025-J-10K	10K	5%			RESISTOR - Metal Film	R30	
104	1	R025-J-10K	10K	5%			RESISTOR - Metal Film	R35	
105	1	R025-J-10K	10K	5%			RESISTOR - Metal Film	R37	
106	1	R025-J-15K	15K	5%			RESISTOR - Metal Film	R31	
107	1	R025-J-22K	22K	5%			RESISTOR - Metal Film	R22	
108	1	R025-J-22K	22K	5%			RESISTOR - Metal Film	R36	
109	1	R025-J-47R	47R	5%			RESISTOR - Metal Film	R9	
110	1	R025-J-56K	56K	5%			RESISTOR - Metal Film	R7	
111	1	R025-J-000	0R82	5%			RESISTOR - Metal Film	R44	
112	1	R025-J-100K	100K	5%			RESISTOR - Metal Film	R13	
113	1	R025-J-100K	115K	5%			RESISTOR - Metal Film	R19	
114	1	R025-J-100K	100K	5%			RESISTOR - Metal Film	R38	
115	1	R025-J-100K	100K	5%			RESISTOR - Metal Film	R45	
116	1	R025-J-100R	100	5%			RESISTOR - Metal Film	R24	
117	1	R025-J-100R	100	5%			RESISTOR - Metal Film	R23	
118	1	R025-J-270R	270R	5%			RESISTOR - Metal Film	R25	
119	1	R025-J-270R	270R	5%			RESISTOR - Metal Film	R32	
120	1	R025-J-270R	270R	5%			RESISTOR - Metal Film	R39	
121	1	R025-J-390R	390R	5%			RESISTOR - Metal Film	R43	
122	1	R025-J-560R	820R	5%			RESISTOR - Metal Film	R42	
123	1	R025-J-680R	680R	5%			RESISTOR - Metal Film	R2	
124	1	R025-J-680R	680R	5%			RESISTOR - Metal Film	R28	
125	1	TLC27L2N					Precision Dual Operational Amplifiers DIP8	U6	
126	1	TMP37				V		U10	
127	1	TP1_1						R18A	
128	1	TP1_1						R17A	
129	1	TRF_ELCA01						TF1	
130	1	ZPD5V1					Zener Diode 0,5 W - 5.1 V	DZ3	
131	1	ZPD12V					Zener Diode 0,5 W - 12V	DZ2	
132	1	ZPD15V					Zener Diode 0,5 W - 12V	DZ1	
133	1	1N4001					General Purpose Rectifier	D2	
134	1	1N4001					General Purpose Rectifier	D5	
135	1	1N4148					General Purpose Rectifier 0,1 A	D3	
136	1	1N4148					General Purpose Rectifier 0,1 A	D9	
137	1	1N5818					Diode Schottky 3A	D7	
138	1	1N5818					Diode Schottky 3A	D8	
139	1	74HC14N					IC, Hex Inverter Schmitt-Trigger	U1	

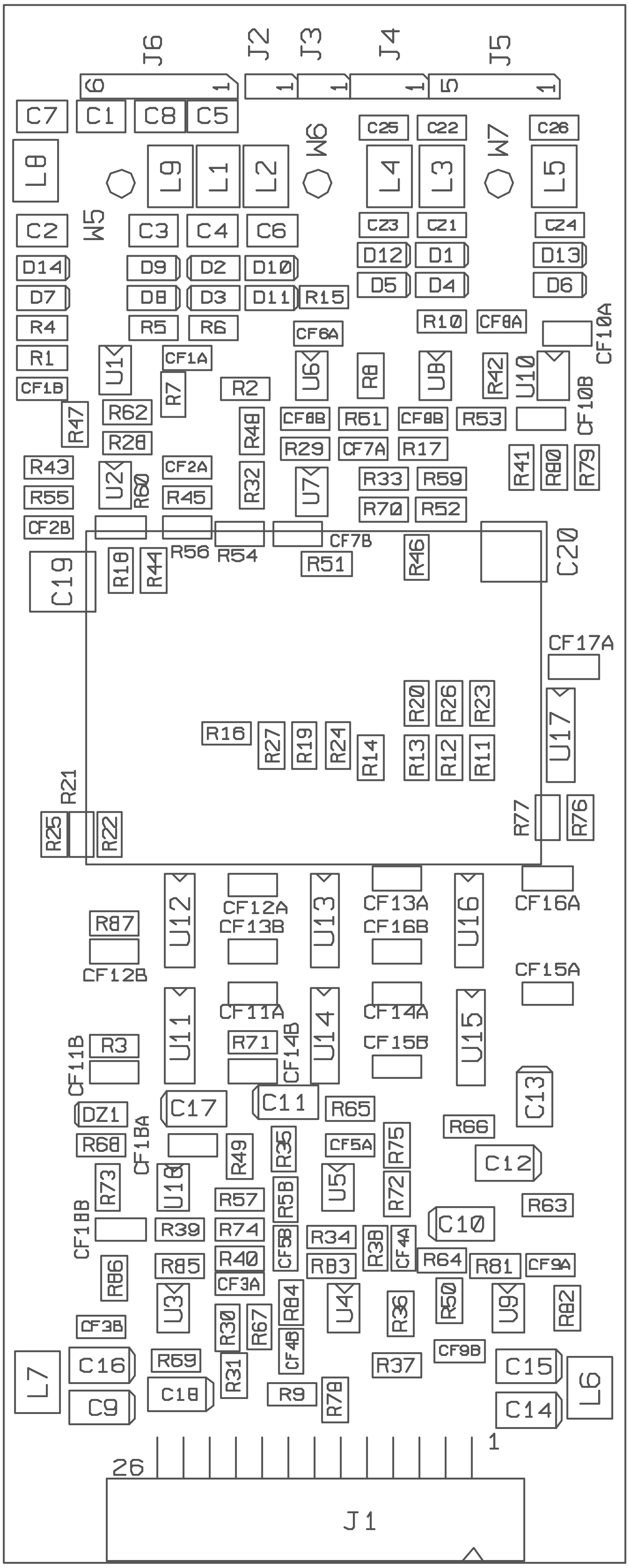
AUDIOIN BOARD - AUDIO INPUTS



AUDIOIN BOARD - AUDIO INPUTS



AUDIOIN BOARD- AUDIO INPUTS



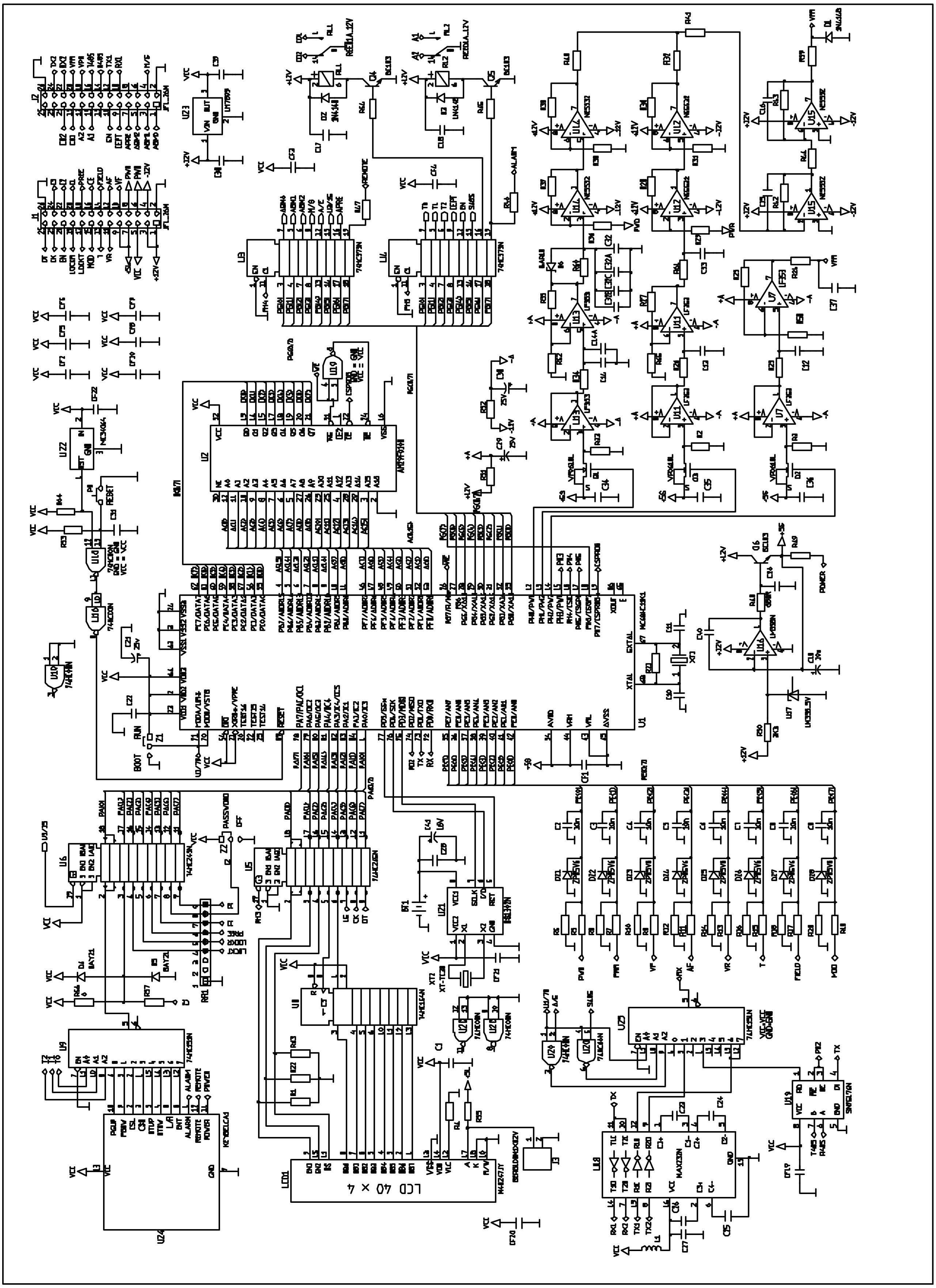
AUDIOIN BOARD- AUDIO INPUTS

item	qty	part number	Val	Tol	Work.Volt.	description		
1	1	BERG100F1X06V				Physical Connector	J6	
2	1	BERG100M1X02V				Physical Connector	J2	
3	1	BERG100M1X02V				Physical Connector	J3	
4	1	BERG100M1X03V				Physical Connector	J4	
5	1	BERG100M1X05V				Physical Connector	J5	
6	1	CPVP_6n8_63V	6n8	10%	63V	capacitor	C19	
7	1	CPVP_6n8_63V	6n8	10%	63V	capacitor	C20	
8	1	C1210_1n	1n	20		capacitor	C7	
9	1	C1210_1n	1n	20		capacitor	C2	
10	1	C1210_1n	1n	20		capacitor	C1	
11	1	C1210_1n	1n	20		capacitor	C3	
12	1	C1210_1n	1n	20		capacitor	C8	
13	1	C1210_1n	1n	20		capacitor	C4	
14	1	C1210_1n	1n	20		capacitor	C5	
15	1	C1210_1n	1n	20		capacitor	C6	
16	1	C4051BD				Multiplexer, Analog 8-Bit	U12	
17	1	C4051BD				Multiplexer, Analog 8-Bit	U13	
18	1	C4051BD				Multiplexer, Analog 8-Bit	U16	
19	1	C4052BD				Multiplexer, Analog Dual 4-Bit	U11	
20	1	C4052BD				Multiplexer, Analog Dual 4-Bit	U14	
21	1	C4052BD				Multiplexer, Analog Dual 4-Bit	U15	
22	1	C4532BD				Decoder, 3-to-8 Line	U17	
23	1	JFL_26M				Connector Flat 26 pins	J1	
24	1	LL4148				diode	D14	
25	1	LL4148				diode	D7	
26	1	LL4148				diode	D9	
27	1	LL4148				diode	D8	
28	1	LL4148				diode	D2	
29	1	LL4148				diode	D3	
30	1	LL4148				diode	D10	
31	1	LL4148				diode	D11	
32	1	LL4148				diode	D1	
33	1	LL4148				diode	D4	
34	1	LL4148				diode	D12	
35	1	LL4148				diode	D5	
36	1	LL4148				diode	D13	
37	1	LL4148				diode	D6	
38	1	L1812_1mH	1mH			inductor	L7	
39	1	L1812_1mH	1mH			inductor	L6	
40	1	L1812_1mH	10uH			inductor	L9	
41	1	L1812_1mH	10uH			inductor	L2	
42	1	L1812_1mH	10uH			inductor	L1	
43	1	L1812_1mH	10uH			inductor	L3	
44	1	L1812_1mH	10uH			inductor	L4	
45	1	L1812_1mH	10uH			inductor	L5	
46	1	L1812_1mH	10uH			inductor	L8	
47	1	PIN_WIRE				Pin Wire	W5	
48	1	PIN_WIRE				Pin Wire	W6	
49	1	PIN_WIRE				Pin Wire	W7	
50	1	RT_72P	10K	10%		resistor	RT1	
51	1	RT_72P	10K	10%		resistor	RT2	
52	1	RT_72P-20K	20K	10%		resistor	RT3	COD
53	1	RT_72P-20K	20K	10%		resistor	RT4	COD
54	1	RT_72P-20K	20K	10%		resistor	RT5	COD
55	1	R1206-F-2K22	2K22	1%		resistor	R44	
56	1	R1206-F-2K22	2K22	1%		resistor	R49	
57	1	R1206-F-2K22	2K22	1%		resistor	R39	
58	1	R1206-F-2K22	2K22	1%		resistor	R31	
59	1	R1206-F-2K22	2K22	1%		resistor	R30	
60	1	R1206-F-2K22	2K22	1%		resistor	R28	
61	1	R1206-F-2K22	2K22	1%		resistor	R46	
62	1	R1206-F-2K22	2K22	1%		resistor	R35	
63	1	R1206-F-2K22	2K22	1%		resistor	R34	
64	1	R1206-F-2K22	2K22	1%		resistor	R37	
65	1	R1206-F-2K22	2K22	1%		resistor	R36	
66	1	R1206-F-2K22	2K22	1%		resistor	R29	
67	1	R1206-F-2K22	2K22	1%		resistor	R38	
68	1	R1206-F-2K22	2K22	1%		resistor	R40	
69	1	R1206-F-2K22	2K22	1%		resistor	R41	
70	1	R1206-F-2K22	2K22	1%		resistor	R50	
71	1	R1206-F-2K22	2K22	1%		resistor	R85	
72	1	R1206-F-2K22	2K22	1%		resistor	R86	
73	1	R1206-F-2K22	2K22	1%		resistor	R83	
74	1	R1206-F-2K22	2K22	1%		resistor	R84	
75	1	R1206-F-2K22	2K22	1%		resistor	R81	
76	1	R1206-F-2K22	2K22	1%		resistor	R82	
77	1	R1206-F-2K22	2K22	1%		resistor	R47	COD
78	1	R1206-F-2K22	2K22	1%		resistor	R43	COD
79	1	R1206-F-2K22	2K22	1%		resistor	R18	COD
80	1	R1206-F-2K22	2K22	1%		resistor	R48	COD
81	1	R1206-F-2K22	2K22	1%		resistor	R32	COD
82	1	R1206-F-2K22	2K22	1%		resistor	R16	COD

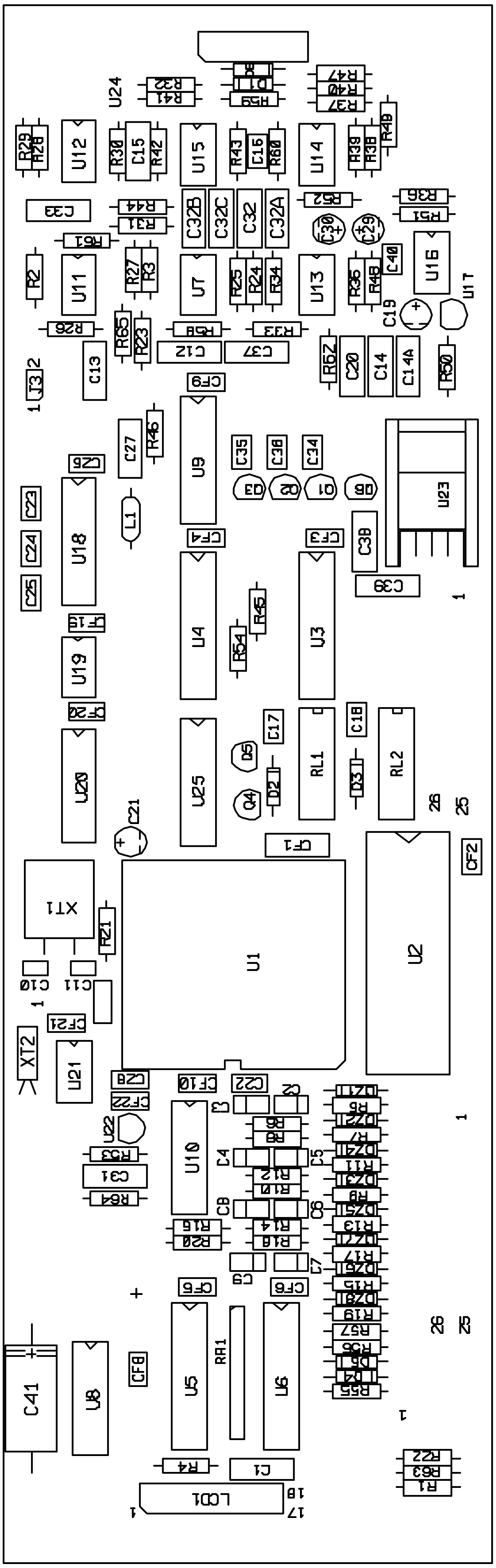
83	1	R1206-F-2K22	2K22	1%		resistor	R17	COD
84	1	R1206-F-5K23	5K23	1%		resistor	R25	COD
85	1	R1206-F-5K23	5K23	1%		resistor	R27	COD
86	1	R1206-F-5K23	5K23	1%		resistor	R26	COD
87	1	R1206-F-5K62	5K62	1%		resistor	R87	COD
88	1	R1206-F-8K45	8K45	1%		resistor	R22	COD
89	1	R1206-F-8K45	8K45	1%		resistor	R24	COD
90	1	R1206-F-8K45	8K45	1%		resistor	R23	COD
91	1	R1206-F-10K5	10K5	1%		resistor	R21	COD
92	1	R1206-F-10K5	10K5	1%		resistor	R19	COD
93	1	R1206-F-10K5	10K5	1%		resistor	R20	COD
94	1	R1206-F-10K7	10K7	1%		resistor	R45	COD
95	1	R1206-F-10K7	10K7	1%		resistor	R33	COD
96	1	R1206-F-10K7	10K7	1%		resistor	R42	COD
97	1	R1206-F-22K1	22K1	1%		resistor	R80	
98	1	R1206-F-22K1	22K1	1%		resistor	R79	
99	1	R1206-J-1K0	1K0	5%		resistor	R56	
100	1	R1206-J-1K0	1K0	5%		resistor	R57	
101	1	R1206-J-1K0	1K0	5%		resistor	R55	
102	1	R1206-J-1K0	1K0	5%		resistor	R58	
103	1	R1206-J-1K0	1K0	5%		resistor	R54	
104	1	R1206-J-1K0	1K0	5%		resistor	R53	
105	1	R1206-J-1K0	1K0	5%		resistor	R51	
106	1	R1206-J-1K0	1K0	5%		resistor	R52	
107	1	R1206-J-1K0	1K0	5%		resistor	R76	COD
108	1	R1206-J-1K0	1K0	5%		resistor	R77	COD
109	1	R1206-J-1K2	1K2	5%		resistor	R70	
110	1	R1206-J-4K7	4K7	5%		resistor	R62	
111	1	R1206-J-4K7	4K7	5%		resistor	R61	
112	1	R1206-J-5K6	120	5%		resistor	R78	
113	1	R1206-J-10K	10K	5%		resistor	R4	
114	1	R1206-J-10K	10K	5%		resistor	R5	
115	1	R1206-J-10K	10K	5%		resistor	R3	
116	1	R1206-J-10K	10K	5%		resistor	R6	
117	1	R1206-J-10K	10K	5%		resistor	R15	
118	1	R1206-J-10K	10K	5%		resistor	R7	
119	1	R1206-J-10K	10K	5%		resistor	R8	
120	1	R1206-J-10K	22K	5%		resistor	R9	
121	1	R1206-J-10K	10K	5%		resistor	R10	
122	1	R1206-J-10K	22K	5%		resistor	R11	
123	1	R1206-J-10K	22K	5%		resistor	R12	
124	1	R1206-J-10K	22K	5%		resistor	R13	
125	1	R1206-J-10K	22K	5%		resistor	R14	
126	1	R1206-J-11K	11K	5%		resistor	R72	
127	1	R1206-J-11K	11K	5%		resistor	R73	
128	1	R1206-J-22K	22K	5%		resistor	R75	
129	1	R1206-J-22K	22K	5%		resistor	R74	
130	1	R1206-J-47R	47R	5%		resistor	R60	
131	1	R1206-J-47R	47R	5%		resistor	R59	
132	1	R1206-J-100K	100K	5%		resistor	R71	
133	1	R1206-J-120R	120R	5%		resistor	R64	
134	1	R1206-J-120R	120R	5%		resistor	R67	
135	1	R1206-J-120R	120R	5%		resistor	R65	
136	1	R1206-J-120R	120R	5%		resistor	R69	
137	1	R1206-J-120R	120R	5%		resistor	R63	
138	1	R1206-J-120R	120R	5%		resistor	R66	
139	1	R1206-J-120R	120R	5%		resistor	R68	
140	1	R1206-J-680R	680R	5%		resistor	R1	
141	1	R1206-J-680R	680R	5%		resistor	R2	
142	1	TAJ_10u-25V	10u	20%	25V		C17	
143	1	TAJ_10u-25V	10u	20%	25V		C10	
144	1	TAJ_10u-25V	10u	20%	25V		C18	
145	1	TAJ_10u-25V	10u	20%	25V		C11	
146	1	TAJ_10u-25V	10u	20%	25V		C12	
147	1	TAJ_10u-25V	10u	20%	25V		C13	
148	1	TAJ_10u-25V	10u	20%	25V		C14	
149	1	TAJ_10u-25V	10u	20%	25V		C15	
150	1	TAJ_10u-25V	10u	20%	25V		C16	
151	1	TAJ_10u-25V	10u	20%	25V		C9	
152	1	TL072D				Opamp 5-pin	U1	
153	1	TL072D				Opamp 5-pin	U2	
154	1	TL072D				Opamp 5-pin	U18	
155	1	TL072D				Opamp 5-pin	U3	
156	1	TL072D				Opamp 5-pin	U6	
157	1	TL072D				Opamp 5-pin	U7	
158	1	TL072D				Opamp 5-pin	U5	
159	1	TL072D				Opamp 5-pin	U4	
160	1	TL072D				Opamp 5-pin	U8	
161	1	TL072D				Opamp 5-pin	U9	
162	1	TL072D				Opamp 5-pin	U10	
163	1	ZMM5V6				zener diode	DZ1	
164	1	Z2_P100					Z1	
165	1	Z2_P100					Z7	
166	1	Z2_P100					Z2	
167	1	Z2_P100					Z6	
168	1	Z2_P100					Z5	
169	1	Z2_P100					Z4	
170	1	Z2_P100					Z3	
171	1	Z2_P100					Z8	
172	1	c1206-100n	100n	10%	25V	capacitor	CF9A	

173	1	c1206-100n	100n	10%	25V	capacitor	CF11A
174	1	c1206-100n	100n	10%	25V	capacitor	CF13A
175	1	c1206-100n	100n	10%	25V	capacitor	CF15A
176	1	c1206-100n	100n	10%	25V	capacitor	CF8A
177	1	c1206-100n	100n	10%	25V	capacitor	CF10A
178	1	c1206-100n	100n	10%	25V	capacitor	CF12A
179	1	c1206-100n	100n	10%	25V	capacitor	CF14A
180	1	c1206-100n	100n	10%	25V	capacitor	CF16A
181	1	c1206-100n	100n	10%	25V	capacitor	CF17A
182	1	c1206-100n	100n	10%	25V	capacitor	CF8B
183	1	c1206-100n	100n	10%	25V	capacitor	CF9B
184	1	c1206-100n	100n	10%	25V	capacitor	CF10B
185	1	c1206-100n	100n	10%	25V	capacitor	CF11B
186	1	c1206-100n	100n	10%	25V	capacitor	CF12B
187	1	c1206-100n	100n	10%	25V	capacitor	CF13B
188	1	c1206-100n	100n	10%	25V	capacitor	CF14B
189	1	c1206-100n	100n	10%	25V	capacitor	CF15B
190	1	c1206-100n	100n	10%	25V	capacitor	CF16B
191	1	c1206-100n	100n	10%	25V	capacitor	CF2A
192	1	c1206-100n	100n	10%	25V	capacitor	CF18A
193	1	c1206-100n	100n	10%	25V	capacitor	CF1A
194	1	c1206-100n	100n	10%	25V	capacitor	CF3A
195	1	c1206-100n	100n	10%	25V	capacitor	CF7B
196	1	c1206-100n	100n	10%	25V	capacitor	CF6B
197	1	c1206-100n	100n	10%	25V	capacitor	CF5B
198	1	c1206-100n	100n	10%	25V	capacitor	CF4B
199	1	c1206-100n	100n	10%	25V	capacitor	CF6A
200	1	c1206-100n	100n	10%	25V	capacitor	CF4A
201	1	c1206-100n	100n	10%	25V	capacitor	CF7A
202	1	c1206-100n	100n	10%	25V	capacitor	CF5A
203	1	c1206-100n	100n	10%	25V	capacitor	CF1B
204	1	c1206-100n	100n	10%	25V	capacitor	CF2B
205	1	c1206-100n	100n	10%	25V	capacitor	CF3B
206	1	c1206-100n	100n	10%	25V	capacitor	CF18B
207	1	c1206-220p	220p	10%	100V	capacitor	C25
208	1	c1206-220p	220p	10%	100V	capacitor	C23
209	1	c1206-220p	220p	10%	100V	capacitor	C26
210	1	c1206-220p	220p	10%	100V	capacitor	C24
211	1	c1206-270p	270p	10%	100V	capacitor	C22
212	1	c1206-270p	270p	10%	100V	capacitor	C21

DLCD BOARD - DISPLAY DRIVER



DLCD BOARD- DISPLAY DRIVER



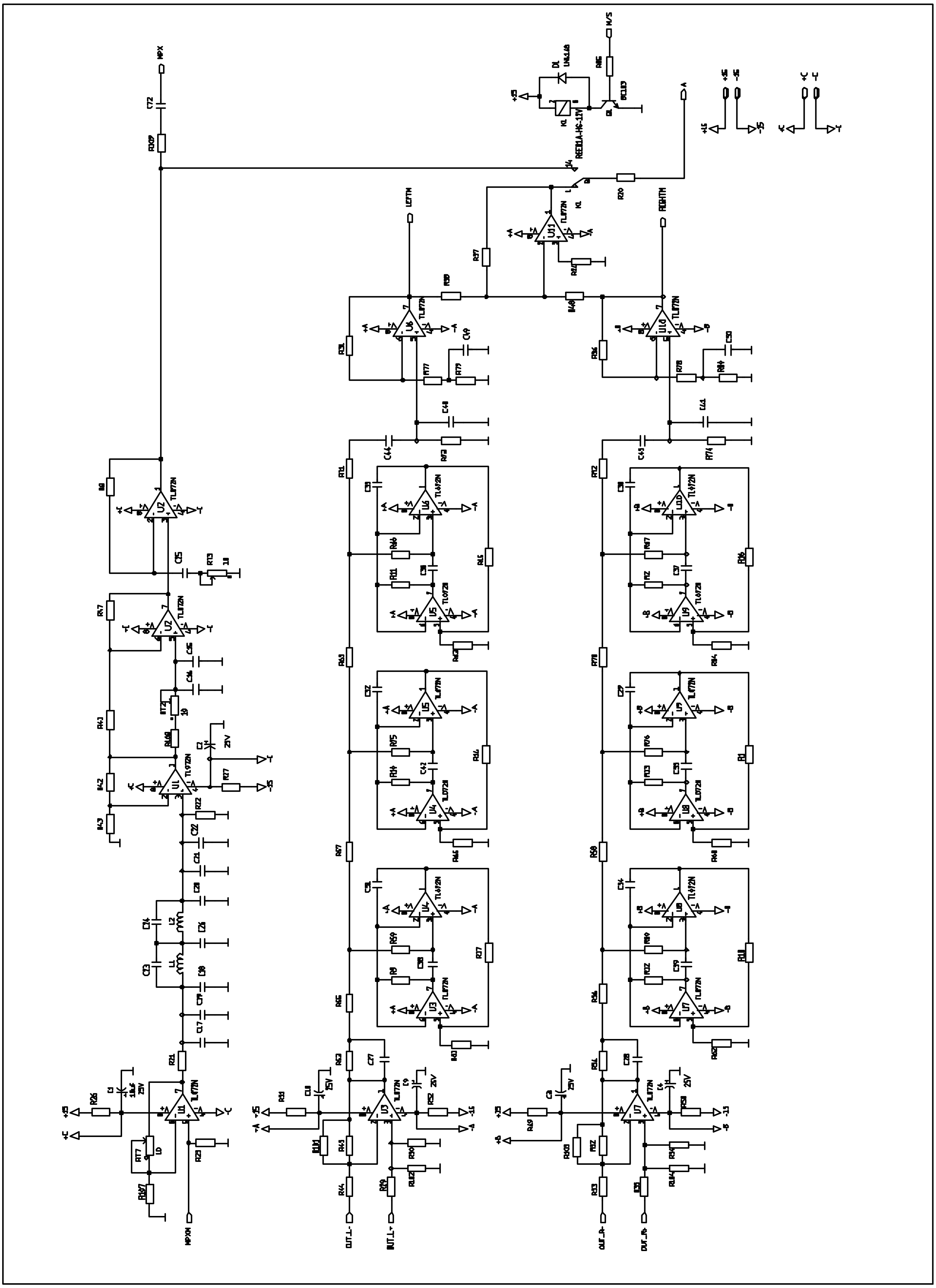
DLCD BOARD - DISPLAY DRIVER

item	qty	part number	Val	Tol	Work.Volt.	description		
1	1	AM29F010N					U2	
2	1	BAR10				diode	D6	
3	1	BAY21				diode	D4	
4	1	BAY21				diode	D5	
5	1	BC183				Transistor, NPN BJT	Q5	
6	1	BC183				Transistor, NPN BJT	Q6	
7	1	BC183				Transistor, NPN BJT	Q4	
8	1	BERG100M1X02V					J3	
9	1	CCM_1n	1n	5%	100V	capacitor	C40	COD
10	1	CCM_1u	1u	20%		capacitor	C15	COD
11	1	CCM_2u2	2u2	20%		capacitor	C1	COD
12	1	CCM_2u2	2u2	20%		capacitor	C12	COD
13	1	CCM_2u2	2u2	20%		capacitor	C13	COD
14	1	CCM_2u2	2u2	20%		capacitor	C14	COD
15	1	CCM_2u2	2u2	20%		capacitor	C20	COD
16	1	CCM_2u2	2u2	20%		capacitor	CF1	COD
17	1	CCM_2u2	2u2	20%		capacitor	C31	COD
18	1	CCM_2u2	2u2	20%		capacitor	C32	COD
19	1	CCM_2u2	2u2	20%		capacitor	C33	COD
20	1	CCM_2u2	2u2	20%		capacitor	C37	COD
21	1	CCM_2u2	2u2	20%		capacitor	C38	COD
22	1	CCM_2u2	2u2	20%		capacitor	C39	COD
23	1	CCM_2u2	2u2	20%		capacitor	C27	COD
24	1	CCM_2u2	2u2	20%		capacitor	C14A	COD
25	1	CCM_2u2	2u2	20%		capacitor	C32A	COD
26	1	CCM_2u2	2u2	20%		capacitor	C32C	COD
27	1	CCM_2u2	2u2	20%		capacitor	C32B	COD
28	1	CCM_10n	10n	10%		capacitor	C2	COD
29	1	CCM_10n	10n	10%		capacitor	C3	COD
30	1	CCM_10n	10n	10%		capacitor	C4	COD
31	1	CCM_10n	10n	10%		capacitor	C5	COD
32	1	CCM_10n	10n	10%		capacitor	C6	COD
33	1	CCM_10n	10n	10%		capacitor	C7	COD
34	1	CCM_10n	10n	10%		capacitor	C8	COD
35	1	CCM_10n	10n	10%		capacitor	C9	COD
36	1	CCM_27p	27p	5%		capacitor	C10	COD
37	1	CCM_27p	27p	5%		capacitor	C11	COD
38	1	CCM_100n	100n	10%		capacitor	C16	COD
39	1	CCM_100n	100n	10%		capacitor	C17	COD
40	1	CCM_100n	100n	10%		capacitor	C18	COD
41	1	CCM_100n	100n	10%		capacitor	CF3	COD
42	1	CCM_100n	100n	10%		capacitor	CF4	COD
43	1	CCM_100n	100n	10%		capacitor	C22	COD
44	1	CCM_100n	100n	10%		capacitor	C23	COD
45	1	CCM_100n	100n	10%		capacitor	C24	COD
46	1	CCM_100n	100n	10%		capacitor	C26	COD
47	1	CCM_100n	100n	10%		capacitor	C25	COD
48	1	CCM_100n	100n	10%		capacitor	CF19	COD
49	1	CCM_100n	100n	10%		capacitor	CF21	COD
50	1	CCM_100n	100n	10%		capacitor	C28	COD
51	1	CCM_100n	100n	10%		capacitor	CF2	COD
52	1	CCM_100n	100n	10%		capacitor	CF5	C
53	1	CCM_100n	100n	10%		capacitor	CF6	COD
54	1	CCM_100n	100n	10%		capacitor	CF8	COD
55	1	CCM_100n	100n	10%		capacitor	CF9	COD
56	1	CCM_100n	100n	10%		capacitor	CF22	COD
57	1	CCM_100n	100n	10%		capacitor	C34	COD
58	1	CCM_100n	100n	10%		capacitor	C35	COD
59	1	CCM_100n	100n	10%		capacitor	C36	COD
60	1	CCM_100n	100n	10%		capacitor	CF20	COD
61	1	CCM_100n	100n	10%		capacitor	CF10	COD
62	1	CEH_220u-16V	220uF	20%	16V		C41	COD
63	1	CEV_10u-25	uF	20%	V		C19	
64	1	CEV_10u-25	10u	20%	25v		C21	
65	1	CEV_10u-25	10u	20%	25V		C29	
66	1	CEV_10u-25	10u	20%	25V		C30	
67	1	DS1302N				Real Time Clock	U21	
68	1	JFL_26M				Connector Flat 26 pins	J1	
69	1	JFL_26M				Connector Flat 26 pins	J2	
70	1	KEYBELCA1					U24	
71	1	LF353N				Opamp 5-pin	U7	
72	1	LF353N				Opamp 5-pin	U11	
73	1	LF353N				Opamp 5-pin	U13	
74	1	LM336_5V	5V			Voltage Reference, ADJ.	U17	
75	1	LM358N				Opamp 5-pin	U16	
76	1	LM7805				Voltage Regulator, FIXED	U23	
77	1	L025_22u				inductor	L1	
78	1	MAX232N				Driver-Receiver RS232	U18	
79	1	MC68HC11K1					U1	

80	1	MC34064					U22	
81	1	M40247JY					LCD1	
82	1	NE5532N				Opamp 5-pin	U12	
83	1	NE5532N				Opamp 5-pin	U14	
84	1	NE5532N				Opamp 5-pin	U15	
85	1	PBATT_D16				Battery	BT1	
86	1	REED1A_12V				BOBINA RELE	RL2	
87	1	REED1A_12V				RELAIS SPDT	RL2	
88	1	REED1A_12V				RELAIS SPDT	RL1	
89	1	REED1A_12V				BOBINA RELE	RL1	
90	1	RSIP8C_10K	10K	5%			RR1	COD
91	1	R025-J-1K0	1K0	5%		resistor	R46	COD
92	1	R025-J-1K0	1K0	5%		resistor	R47	COD
93	1	R025-J-1K0	1K0	5%		resistor	R49	COD
94	1	R025-J-1K8	1K8	5%		resistor	R54	COD
95	1	R025-J-1K8	1K8	5%		resistor	R45	COD
96	1	R025-J-1R8	1R8	5%		resistor	R55	
97	1	R025-J-2M2	2M2	5%		resistor	R21	COD
98	1	R025-J-3K3	3K3	5%		resistor	R50	COD
99	1	R025-J-4K7	4K7	5%		resistor	R2	COD
100	1	R025-J-4K7	4K7	5%		resistor	R3	COD
101	1	R025-J-4K7	4K7	5%		resistor	R33	COD
102	1	R025-J-5K6	5K6	5%		resistor	R34	COD
103	1	R025-J-5K6	5K6	5%		resistor	R35	COD
104	1	R025-J-10K	10K	5%		resistor	R6	COD
105	1	R025-J-10K	10K	5%		resistor	R8	COD
106	1	R025-J-10K	10K	5%		resistor	R10	COD
107	1	R025-J-10K	10K	5%		resistor	R12	COD
108	1	R025-J-10K	10K	5%		resistor	R14	COD
109	1	R025-J-10K	10K	5%		resistor	R16	COD
110	1	R025-J-10K	10K	5%		resistor	R18	COD
111	1	R025-J-10K	10K	5%		resistor	R20	C
112	1	R025-J-10K	10K	5%		resistor	R29	COD
113	1	R025-J-10K	10K	5%		resistor	R56	COD
114	1	R025-J-10K	10K	5%		resistor	R64	COD
115	1	R025-J-10M	10M	5%		resistor	R65	COD
116	1	R025-J-12K	12K	5%		resistor	R31	COD
117	1	R025-J-12K	12K	5%		resistor	R38	COD
118	1	R025-J-18K	18K	5%		resistor	R1	COD
119	1	R025-J-18K	18K	5%		resistor	R22	COD
120	1	R025-J-18K	18K	5%		resistor	R63	COD
121	1	R025-J-33K	33K	5%		resistor	R32	COD
122	1	R025-J-33K	33K	5%		resistor	R40	COD
123	1	R025-J-33K	33K	5%		resistor	R41	COD
124	1	R025-J-47K	47K	5%		resistor	R42	COD
125	1	R025-J-47K	47K	5%		resistor	R44	COD
126	1	R025-J-56K	56K	5%		resistor	R43	COD
127	1	R025-J-68K	68K	5%		resistor	R28	COD
128	1	R025-J-68K	68K	5%		resistor	R30	COD
129	1	R025-J-68K	68K	5%		resistor	R37	COD
130	1	R025-J-68K	68K	5%		resistor	R39	COD
131	1	R025-J-82R	82R	5%		resistor	R4	COD
132	1	R025-J-100K	100K	5%		resistor	R53	COD
133	1	R025-J-100R	100	5%		resistor	R5	COD
134	1	R025-J-100R	100	5%		resistor	R7	COD
135	1	R025-J-100R	100	5%		resistor	R9	COD
136	1	R025-J-100R	100	5%		resistor	R11	COD
137	1	R025-J-100R	100	5%		resistor	R13	COD
138	1	R025-J-100R	100	5%		resistor	R15	COD
139	1	R025-J-100R	100	5%		resistor	R17	COD
140	1	R025-J-100R	100	5%		resistor	R19	COD
141	1	R025-J-150K	150K	5%		resistor	R23	COD
142	1	R025-J-150K	150K	5%		resistor	R25	COD
143	1	R025-J-150K	150K	5%		resistor	R26	COD
144	1	R025-J-150K	150K	5%		resistor	R27	COD
145	1	R025-J-150K	150K	5%		resistor	R58	COD
146	1	R025-J-150K	150K	5%		resistor	R60	C
147	1	R025-J-150K	150K	5%		resistor	R61	COD
148	1	R025-J-220R	220R	5%		resistor	R51	COD
149	1	R025-J-220R	220R	5%		resistor	R52	COD
150	1	R025-J-330R	330R	5%		resistor	R59	COD
151	1	R025-J-390K	390K	5%		resistor	R62	COD
152	1	R025-J-560R	560R	5%		resistor	R24	COD
153	1	R025-J-560R	560R	5%		resistor	R57	COD
154	1	R025-J-680R	680R	5%		resistor	R48	COD
155	1	R025-J-820R	820R	5%		resistor	R36	COD
156	1	SN75176N				Driver-Receiver R85	U19	
157	1	SP_TM114					P9	
158	1	VP0610L				Mosfet, N-chan Power	Q2	
159	1	VP0610L				Mosfet, N-chan Power	Q3	
160	1	VP0610L				Mosfet, N-chan Power	Q1	
161	1	XT-HC49U	MHz			Crystal	XT1	
162	1	XT-TC38				Crystal TC38	XT2	
163	1	ZPD5V6				zener diode	DZ2	
164	1	ZPD5V6				zener diode	DZ3	
165	1	ZPD5V6				zener diode	DZ4	
166	1	ZPD5V6				zener diode	DZ5	
167	1	ZPD5V6				zener diode	DZ6	
168	1	ZPD5V6				zener diode	DZ7	
169	1	ZPD5V6				zener diode	DZ8	

170	1	ZPD5V6				zener diode	DZ1
171	1	Z3_P100					Z1
172	1	Z3_P100					Z2
173	1	1N4148				diode	D1
174	1	1N4148				diode	D2
175	1	1N4148				diode	D3
176	1	74HC00N				Gate, 2-Input NAND	U10
177	1	74HC00N				Gate, 2-Input NAND	U20
178	1	74HC151N				Mux, 8-Bit	U9
179	1	74HC151N				Mux, 8-Bit	U25
180	1	74HC164N				Shift Register, 8-Bit	U8
181	1	74HC245N				Transceiver, Octal 3-State	U5
182	1	74HC245N				Transceiver, Octal 3-State	U6
183	1	74HC533N				Latch, Octal D-Type 3-S	U3
184	1	74HC533N				Latch, Octal D-Type 3-S	U4

MBA BOARD - MOTHER BOARD



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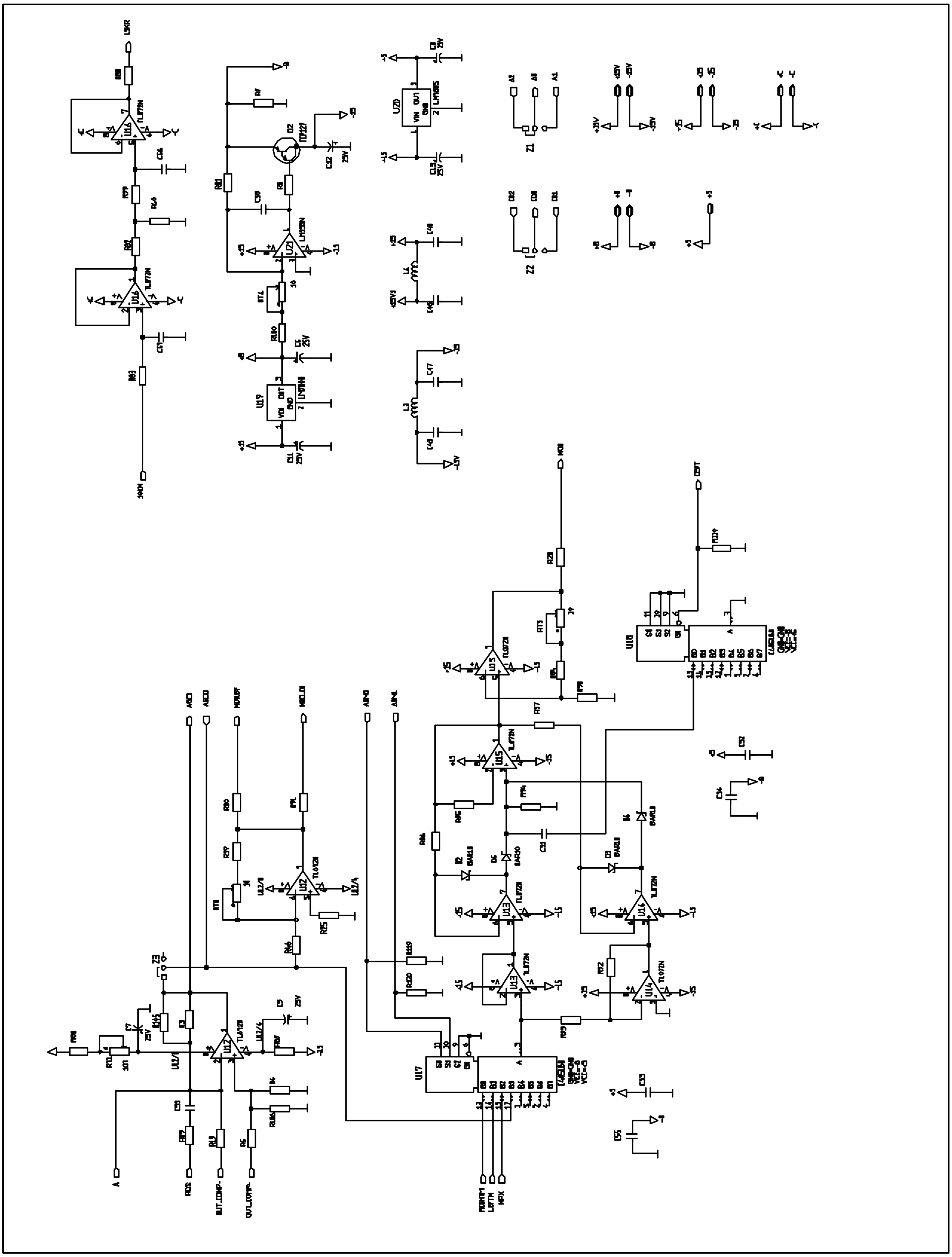

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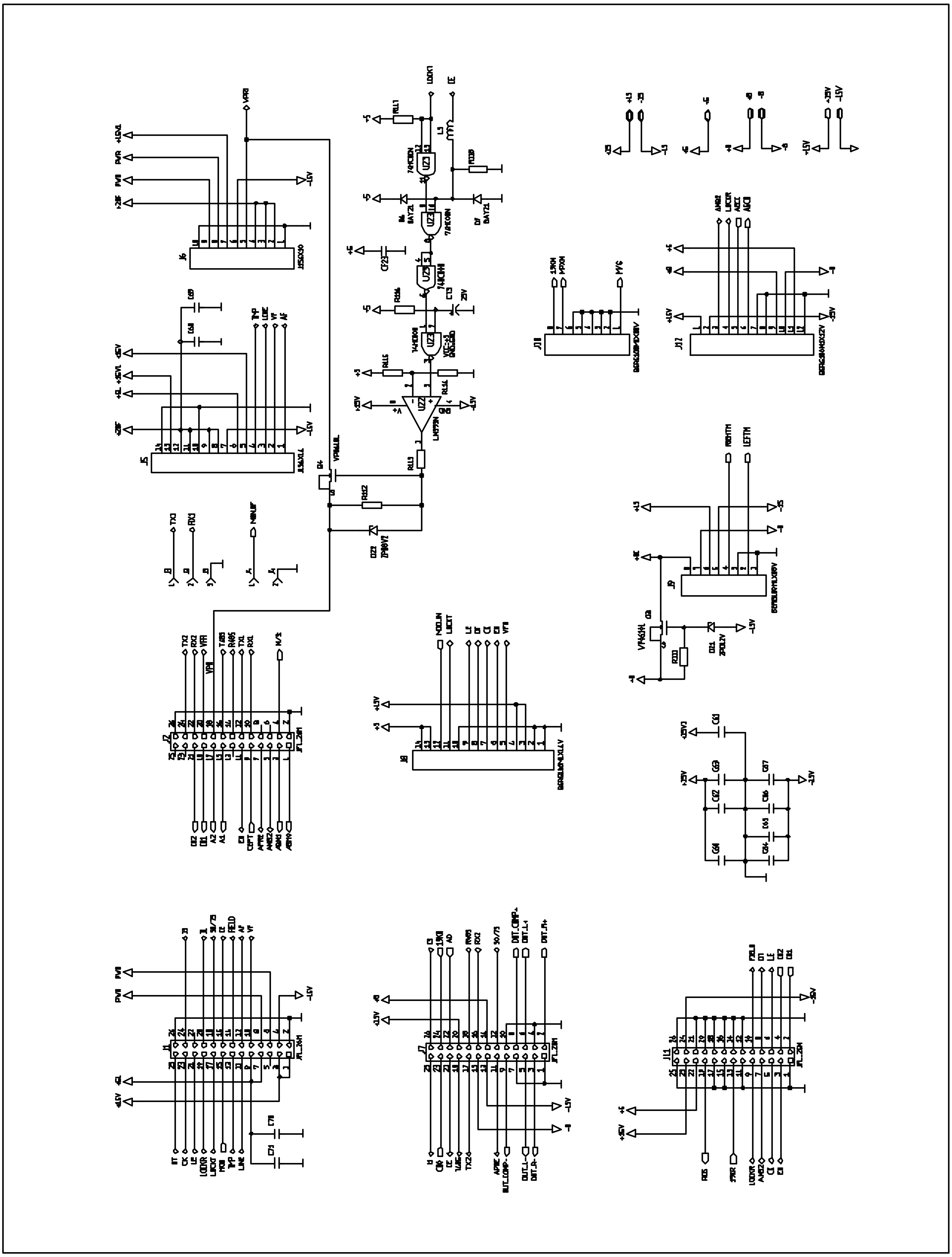

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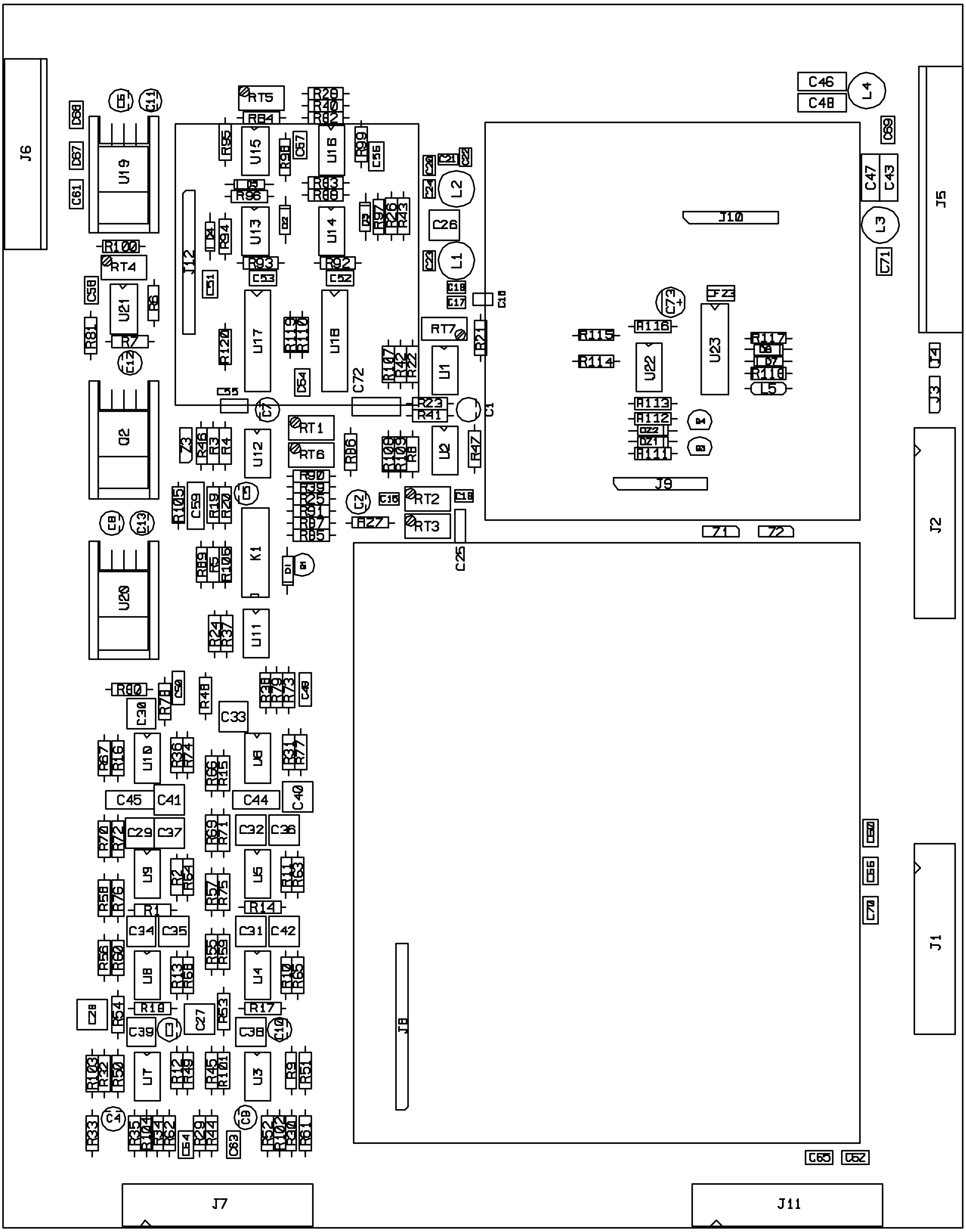


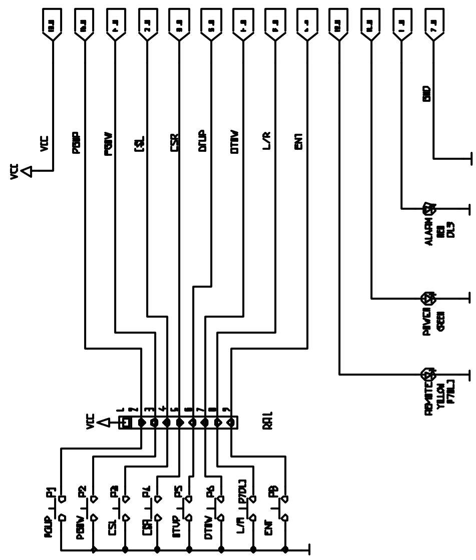
MBA BOARD - MOTHER BOARD

item	qty	part number	Val	Tol	Work.Volt.	description		
1	1	BAR10				diode	D5	
2	1	BAR10				diode	D2	
3	1	BAR10				diode	D4	
4	1	BAR10				diode	D3	
5	1	BAY21				diode	D6	
6	1	BAY21				diode	D7	
7	1	BC183				Transistor, NPN BJT	Q1	
8	1	BERG100M1X02V				Physical Connector	J4	
9	1	BERG100M1X03V				Physical Connector	J3	
10	1	BERG100M1X08V					J9	
11	1	BERG100M1X08V					J10	
12	1	BERG100M1X12V					J12	
13	1	BERG100M1X14V					J8	
14	1	CCM_1n	1n	5%	100V	capacitor	C58	
15	1	CCM_1u	1u	20%		capacitor	C59	
16	1	CCM_2u2	2u2	20%		capacitor	C44	
17	1	CCM_2u2	2u2	20%		capacitor	C45	
18	1	CCM_2u2	2u2	20%		capacitor	C46	
19	1	CCM_2u2	2u2	20%		capacitor	C48	
20	1	CCM_2u2	2u2	20%		capacitor	C43	
21	1	CCM_2u2	2u2	20%		capacitor	C47	
22	1	CCM_2u2	2u2	20%		capacitor	C72	
23	1	CCM_68p	68p	5%		capacitor	C23	
24	1	CCM_68p	68p	5%		capacitor	C24	
25	1	CCM_100n	100n	10%		capacitor	C53	
26	1	CCM_100n	100n	10%		capacitor	C55	
27	1	CCM_100n	100n	10%		capacitor	C51	
28	1	CCM_100n	100n	10%		capacitor	C52	
29	1	CCM_100n	100n	10%		capacitor	C54	
30	1	CCM_100n	100n	10%		capacitor	C68	
31	1	CCM_100n	100n	10%		capacitor	C69	
32	1	CCM_100n	100n	10%		capacitor	C70	
33	1	CCM_100n	100n	10%		capacitor	C71	
34	1	CCM_100n	100n	10%		capacitor	C63	
35	1	CCM_100n	100n	10%		capacitor	C62	
36	1	CCM_100n	100n	10%		capacitor	C60	
37	1	CCM_100n	100n	10%		capacitor	C64	
38	1	CCM_100n	100n	10%		capacitor	C65	
39	1	CCM_100n	100n	10%		capacitor	C66	
40	1	CCM_100n	100n	10%		capacitor	C67	
41	1	CCM_100n	100n	10%		capacitor	C61	
42	1	CCM_100n	100n	10%		capacitor	CF23	COD
43	1	CCM_150p	150p	5%		capacitor	C17	
44	1	CCM_150p	150p	5%		capacitor	C19	
45	1	CCM_150p	150p	5%		capacitor	C18	
46	1	CCM_150p	150p	5%		capacitor	C20	
47	1	CCM_150p	150p	5%		capacitor	C21	
48	1	CCM_150p	150p	5%		capacitor	C22	
49	1	CCM_150p	150p	5%		capacitor	C16	
50	1	CCM_150p	150p	5%		capacitor	C15	
51	1	CCM_470p	470p	5%		capacitor	C56	
52	1	CCM_470p	470p	5%		capacitor	C57	
53	1	CEV_10u-25V	10u	20%	25V		C1	
54	1	CEV_10u-25V	10u	20%	25V		C2	
55	1	CEV_10u-25V	10u	20%	25V		C10	
56	1	CEV_10u-25V	10u	20%	25V		C9	
57	1	CEV_10u-25V	10u	20%	25V		C3	
58	1	CEV_10u-25V	10u	20%	25V		C4	
59	1	CEV_10u-25V	10u	20%	25V		C5	
60	1	CEV_10u-25V	10u	20%	25V		C12	
61	1	CEV_10u-25V	10u	20%	25V		C7	
62	1	CEV_10u-25V	10u	20%	25V		C11	
63	1	CEV_10u-25V	10u	20%	25V		C6	
64	1	CEV_10u-25V	10u	20%	25V		C13	
65	1	CEV_10u-25V	10u	20%	25V		C8	
66	1	CEV_47u-25V	47u	20%	25V		C73	COD
67	1	CPVST_1n2_63V	1n2	10%	63V	capacitor	C26	
68	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C38	
69	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C31	
70	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C42	
71	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C32	
72	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C36	
73	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C33	
74	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C40	
75	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C39	
76	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C34	
77	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C29	
78	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C35	
79	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C37	
80	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C30	
81	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C41	
82	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C28	COD
83	1	CPVST_6n8_63V	6n8	10%	63V	capacitor	C27	COD
84	1	CPV_10n_100V	10n	10%	100V	capacitor	C49	

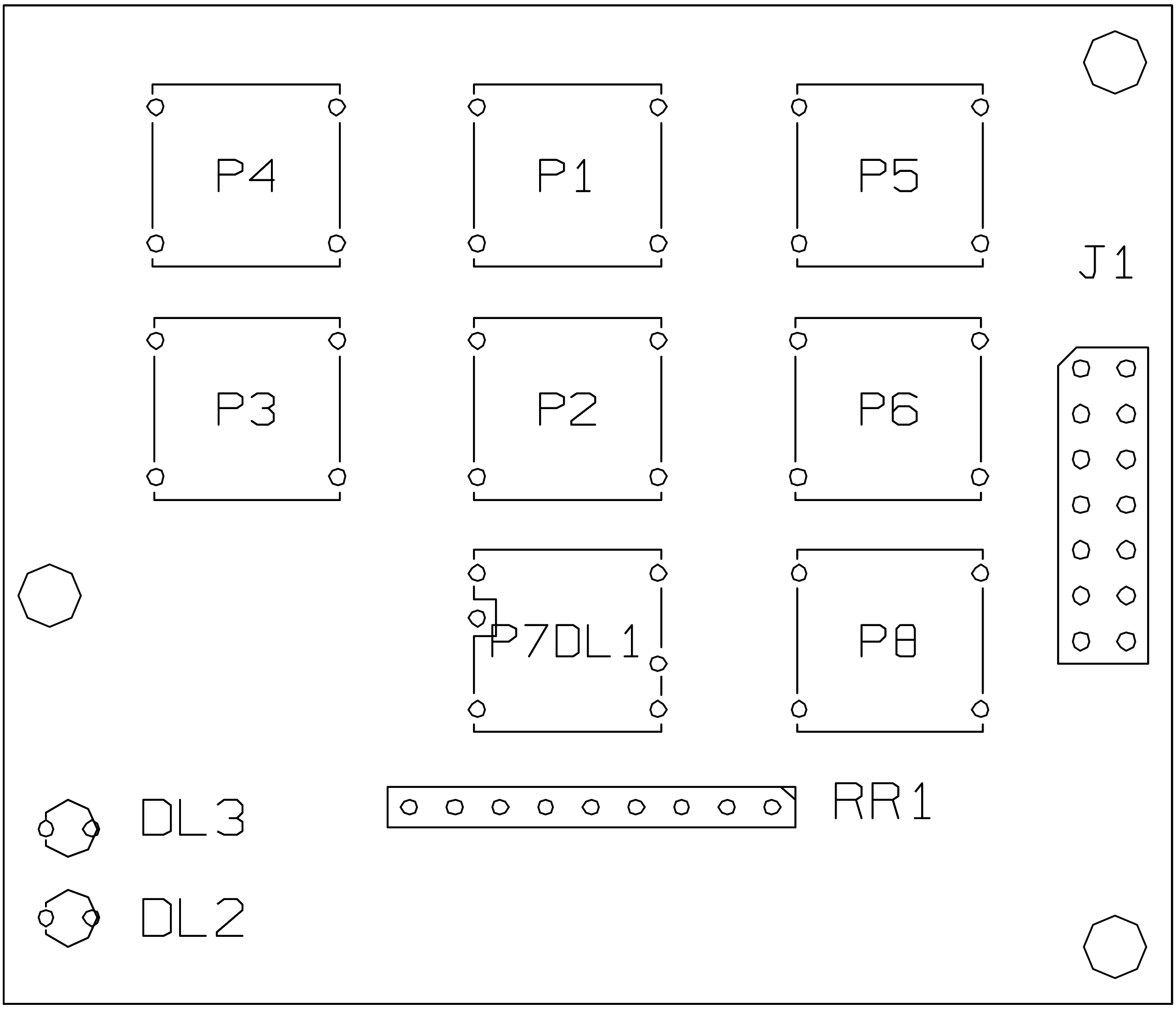
85	1	CPV_10n_100V	10n	10%	100V	capacitor	C50	
86	1	CPV_470p_100V	470p	10%	100V	capacitor	C25	COD
87	1	C4051BN				Multiplexer, Analog 8-Bit	U17	
88	1	C4051BN				Multiplexer, Analog 8-Bit	U18	
89	1	JFL_26M				Connector Flat 26 pins	J1	
90	1	JFL_26M				Connector Flat 26 pins	J2	
91	1	JFL_26M				Connector Flat 26 pins	J7	
92	1	JFL_26M				Connector Flat 26 pins	J11	
93	1	J156X10					J6	
94	1	J156X14					J5	
95	1	LM358N				Opamp 5-pin	U21	
96	1	LM393N				Voltage Comparator	U22	
97	1	LM7805				Voltage Regulator, FIXED	U20	
98	1	LM7808				Voltage Regulator, FIXED	U19	
99	1	LTUBE-D8P5	1mH			inductor	L1	
100	1	LTUBE-D8P5	1mH			inductor	L2	
101	1	LTUBE-D8P5	uH			inductor	L4	
102	1	LTUBE-D8P5	uH			inductor	L3	
103	1	L0305_10u	10uH	10%		inductor	L5	
104	1	REED1A-HS-12V				BOBINA RELE	K1	
105	1	REED1A-HS-12V				RELAIS SPDT	K1	
106	1	RT_67W	2K2	10%		resistor	RT7	
107	1	RT_67W	0K	10%		resistor	RT2	
108	1	RT_67W	500	10%		resistor	RT3	
109	1	RT_67W	2K2	10%		resistor	RT1	
110	1	RT_67W	10K	10%		resistor	RT6	
111	1	RT_67W	10K	10%		resistor	RT5	
112	1	RT_67W	5K	10%		resistor	RT4	
113	1	R025-F-1K0	1K0	1%		resistor	R21	
114	1	R025-F-1K0	1K0	1%		resistor	R23	
115	1	R025-F-1K0	1K0	1%		resistor	R22	
116	1	R025-F-1K0	1K0	1%		resistor	R8	
117	1	R025-F-1K0	1K0	1%		resistor	R9	
118	1	R025-F-1K0	1K0	1%		resistor	R17	
119	1	R025-F-1K0	1K0	1%		resistor	R10	
120	1	R025-F-1K0	1K0	1%		resistor	R14	
121	1	R025-F-1K0	1K0	1%		resistor	R11	
122	1	R025-F-1K0	1K0	1%		resistor	R15	
123	1	R025-F-1K0	1K0	1%		resistor	R12	
124	1	R025-F-1K0	1K0	1%		resistor	R18	
125	1	R025-F-1K0	1K0	1%		resistor	R13	
126	1	R025-F-1K0	1K0	1%		resistor	R1	
127	1	R025-F-1K0	1K0	1%		resistor	R2	
128	1	R025-F-1K0	1K0	1%		resistor	R16	
129	1	R025-F-1K0	1K0	1%		resistor	R24	
130	1	R025-F-1K0	1K0	1%		resistor	R25	
131	1	R025-F-1K0	1K0	1%		resistor	R6	
132	1	R025-F-1K0	1K0	1%		resistor	R7	
133	1	R025-F-1K8	1K8	1%		resistor	R77	
134	1	R025-F-1K8	1K8	1%		resistor	R78	
135	1	R025-F-1K07	1K07	1%		resistor	R71	
136	1	R025-F-1K07	1K07	1%		resistor	R72	
137	1	R025-F-1K24	1K24	1%		resistor	R75	
138	1	R025-F-1K24	1K24	1%		resistor	R76	
139	1	R025-F-1K50	1K50	1%		resistor	R107	COD
140	1	R025-F-1K54	1K54	1%		resistor	R55	
141	1	R025-F-1K54	1K54	1%		resistor	R56	
142	1	R025-F-1K87	1K87	1%		resistor	R69	
143	1	R025-F-1K87	1K87	1%		resistor	R70	
144	1	R025-F-2K1	2K1	1%		resistor	R57	
145	1	R025-F-2K1	2K1	1%		resistor	R58	
146	1	R025-F-2K2	2K2	1%		resistor	R43	
147	1	R025-F-2K2	2K2	1%		resistor	R42	
148	1	R025-F-2K2	2K2	1%		resistor	R41	
149	1	R025-F-2K2	2K2	1%		resistor	R47	
150	1	R025-F-2K2	2K2	1%		resistor	R45	
151	1	R025-F-2K2	2K2	1%		resistor	R44	
152	1	R025-F-2K2	2K2	1%		resistor	R29	
153	1	R025-F-2K2	2K2	1%		resistor	R30	
154	1	R025-F-2K2	2K2	1%		resistor	R31	
155	1	R025-F-2K2	2K2	1%		resistor	R32	
156	1	R025-F-2K2	2K2	1%		resistor	R33	
157	1	R025-F-2K2	2K2	1%		resistor	R35	
158	1	R025-F-2K2	2K2	1%		resistor	R34	
159	1	R025-F-2K2	2K2	1%		resistor	R36	
160	1	R025-F-2K2	2K2	1%		resistor	R38	
161	1	R025-F-2K2	2K2	1%		resistor	R48	
162	1	R025-F-2K2	2K2	1%		resistor	R37	
163	1	R025-F-2K2	2K2	1%		resistor	R46	
164	1	R025-F-2K2	2K2	1%		resistor	R39	
165	1	R025-F-2K2	2K2	1%		resistor	R40	
166	1	R025-F-2K2	2K2	1%		resistor	R102	
167	1	R025-F-2K2	2K2	1%		resistor	R101	
168	1	R025-F-2K2	2K2	1%		resistor	R103	
169	1	R025-F-2K2	2K2	1%		resistor	R104	
170	1	R025-F-2K2	2K2	1%		resistor	R3	
171	1	R025-F-2K2	2K2	1%		resistor	R105	
172	1	R025-F-2K2	2K2	1%		resistor	R5	
173	1	R025-F-2K2	2K2	1%		resistor	R19	
174	1	R025-F-2K2	2K2	1%		resistor	R20	

175	1	R025-F-2M2	2M2	1%		resistor	R94	
176	1	R025-F-3K9	3K9	1%		resistor	R95	
177	1	R025-F-3K30	3K30	1%		resistor	R111	COD
178	1	R025-F-5K6	5K6	1%		resistor	R96	
179	1	R025-F-5K6	5K6	1%		resistor	R97	
180	1	R025-F-6K81	6K81	1%		resistor	R4	COD
181	1	R025-F-8K2	8K2	1%		resistor	R100	
182	1	R025-F-8K25	8K25	1%		resistor	R82	COD
183	1	R025-F-10K	10K	1%		resistor	R85	
184	1	R025-F-10K	10K	1%		resistor	R84	
185	1	R025-F-10K	10K	1%		resistor	R83	
186	1	R025-F-10K	10K	1%		resistor	R81	
187	1	R025-F-10K0	10K0	1%		resistor	R113	COD
188	1	R025-F-10K0	10K0	1%		resistor	R114	COD
189	1	R025-F-10K0	10K0	1%		resistor	R115	COD
190	1	R025-F-15K	15K	1%		resistor	R89	
191	1	R025-F-18K	18K	1%		resistor	R99	
192	1	R025-F-18K0	18K0	1%		resistor	R120	COD
193	1	R025-F-18K0	18K0	1%		resistor	R119	COD
194	1	R025-F-18K0	18K0	1%		resistor	R110	COD
195	1	R025-F-27K0	27K4	1%		resistor	R98	COD
196	1	R025-F-33K	33K	1%		resistor	R93	
197	1	R025-F-33K	33K	1%		resistor	R92	
198	1	R025-F-33K0	33K0	1%		resistor	R109	COD
199	1	R025-F-33K0	33K0	1%		resistor	R112	COD
200	1	R025-F-47R	47R	1%		resistor	R91	
201	1	R025-F-95K3	95K3	1%		resistor	R53	
202	1	R025-F-95K3	95K3	1%		resistor	R54	
203	1	R025-F-100K	100K	1%		resistor	R73	
204	1	R025-F-100K	100K	1%		resistor	R74	
205	1	R025-F-100K	100K	1%		resistor	R117	COD
206	1	R025-F-100K	100K	1%		resistor	R116	COD
207	1	R025-F-100K	100K	1%		resistor	R118	COD
208	1	R025-F-100R	100R	1%		resistor	R51	
209	1	R025-F-100R	100R	1%		resistor	R52	
210	1	R025-F-100R	100R	1%		resistor	R49	
211	1	R025-F-100R	100R	1%		resistor	R50	
212	1	R025-F-120R	120R	1%		resistor	R26	
213	1	R025-F-120R	120R	1%		resistor	R27	
214	1	R025-F-120R	120R	1%		resistor	R28	
215	1	R025-F-150R	150R	1%		resistor	R108	COD
216	1	R025-F-243R	243R	1%		resistor	R59	
217	1	R025-F-243R	243R	1%		resistor	R60	
218	1	R025-F-330R	330R	1%		resistor	R87	
219	1	R025-F-330R	330R	1%		resistor	R88	
220	1	R025-F-390R	390R	1%		resistor	R79	
221	1	R025-F-390R	390R	1%		resistor	R80	
222	1	R025-F-500R	500R	1%		resistor	R86	
223	1	R025-F-562R	562R	1%		resistor	R61	
224	1	R025-F-562R	562R	1%		resistor	R62	
225	1	R025-F-680R	680R	1%		resistor	R90	
226	1	R025-F-768R	768R	1%		resistor	R63	
227	1	R025-F-768R	768R	1%		resistor	R64	
228	1	R025-F-822R	822R	1%		resistor	R106	COD
229	1	R025-F-825R	825R	1%		resistor	R65	
230	1	R025-F-825R	825R	1%		resistor	R66	
231	1	R025-F-825R	825R	1%		resistor	R68	
232	1	R025-F-825R	825R	1%		resistor	R67	
233	1	TIP127				Transistor, PNP Darlington	Q2	
234	1	TL072N				Opamp 5-pin	U1	
235	1	TL072N				Opamp 5-pin	U2	
236	1	TL072N				Opamp 5-pin	U3	
237	1	TL072N				Opamp 5-pin	U4	
238	1	TL072N				Opamp 5-pin	U5	
239	1	TL072N				Opamp 5-pin	U6	
240	1	TL072N				Opamp 5-pin	U7	
241	1	TL072N				Opamp 5-pin	U8	
242	1	TL072N				Opamp 5-pin	U9	
243	1	TL072N				Opamp 5-pin	U10	
244	1	TL072N				Opamp 5-pin	U11	
245	1	TL072N				Opamp 5-pin	U12	
246	1	TL072N				Opamp 5-pin	U13	
247	1	TL072N				Opamp 5-pin	U15	
248	1	TL072N				Opamp 5-pin	U14	
249	1	TL072N				Opamp 5-pin	U16	
250	1	VP0610L				Mosfet, N-chan Power	Q4	
251	1	VP0610L				Mosfet, N-chan Power	Q3	
252	1	ZPD8V2				zener diode	DZ2	COD
253	1	ZPD12V				zener diode	DZ1	COD
254	1	Z3-100					Z1	
255	1	Z3-100					Z2	
256	1	Z3_P100					Z3	
257	1	1N4148				diode	D1	
258	1	74HC00N				Gate, 2-Input NAND	U23	

KEY BOARD - KEY



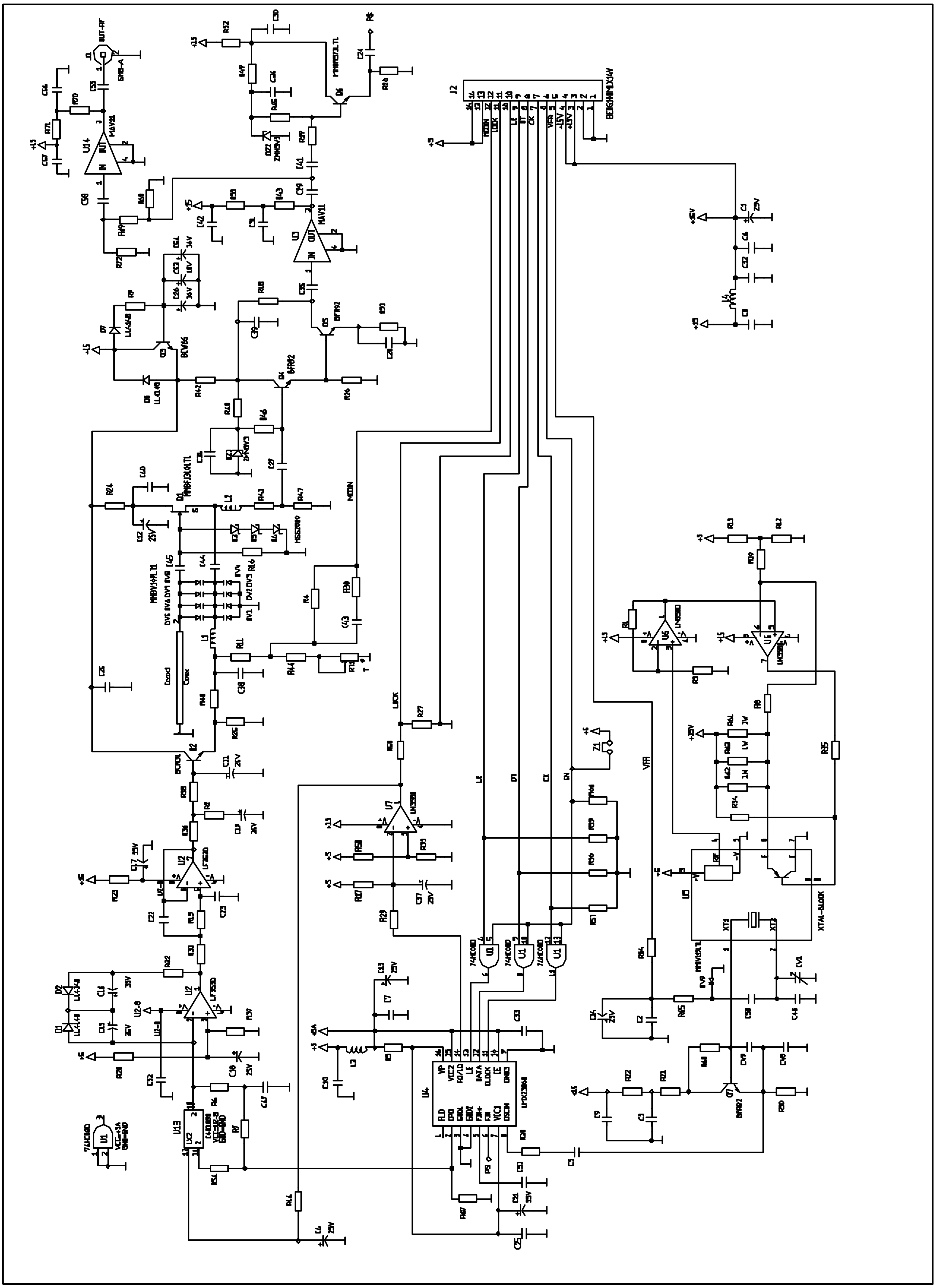
KEY BOARD - KEY



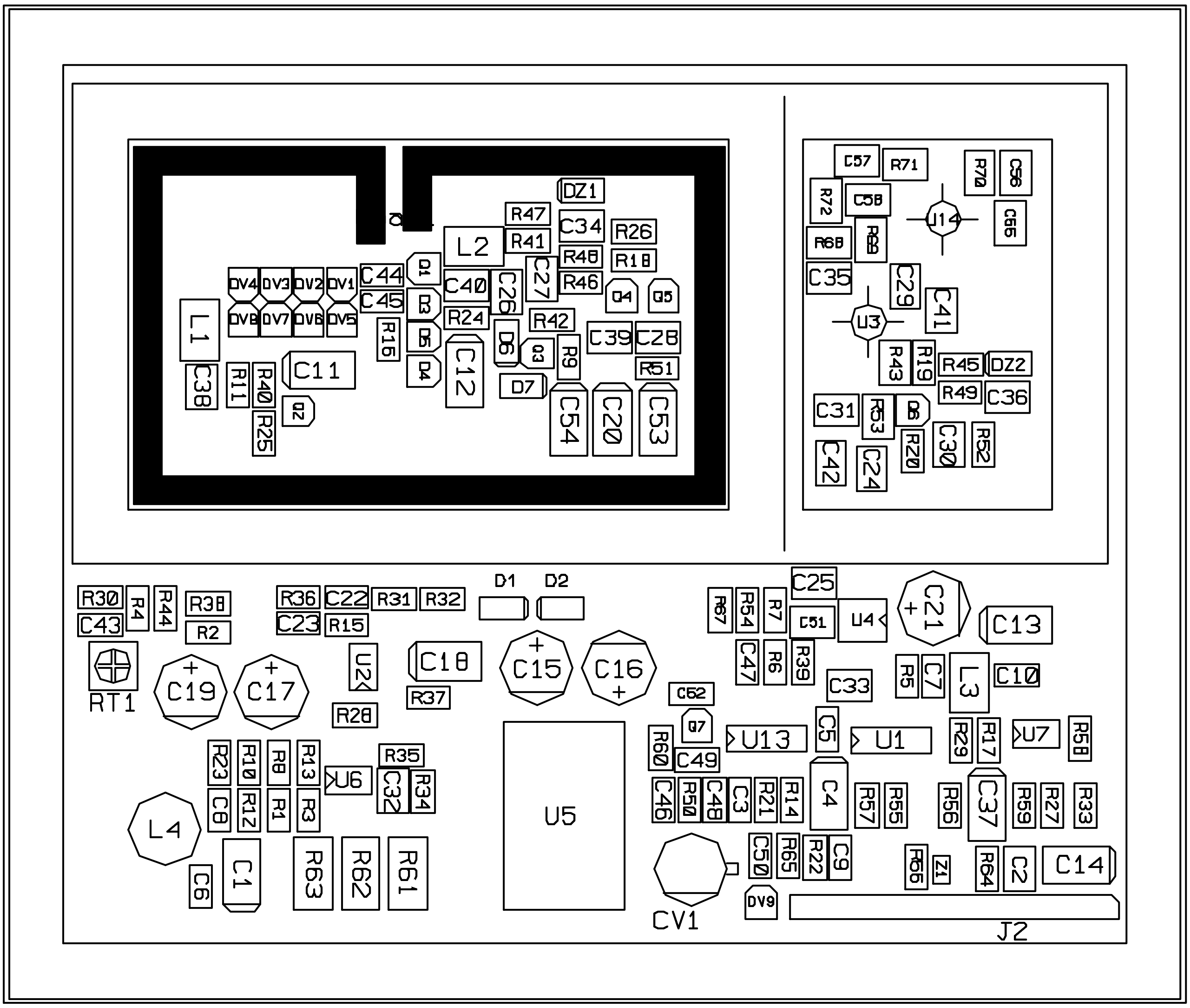
KEY BOARD - KEY

item	qty	part number	Val	Tol	Work.Volt.	description	
1	1	BERG100M2X07V				Physical Connector	J1
2	1	LED_D3V				photoemissive diode	DL3
3	1	LED_D3V				photoemissive diode	DL2
4	1	RSIP8C_10K	10K	5%			RR1
5	1	SP_3FT					P1
6	1	SP_3FT					P2
7	1	SP_3FT					P3
8	1	SP_3FT					P4
9	1	SP_3FT					P5
10	1	SP_3FT					P6
11	1	SP_3FT					P8
12	1	SP_3FTL					P7DL1
13	1	SP_3FTL				photoemissive diode	P7DL1

SINTD BOARD- VCO OSCILLATOR



SINTD BOARD - VCO OSCILLATOR



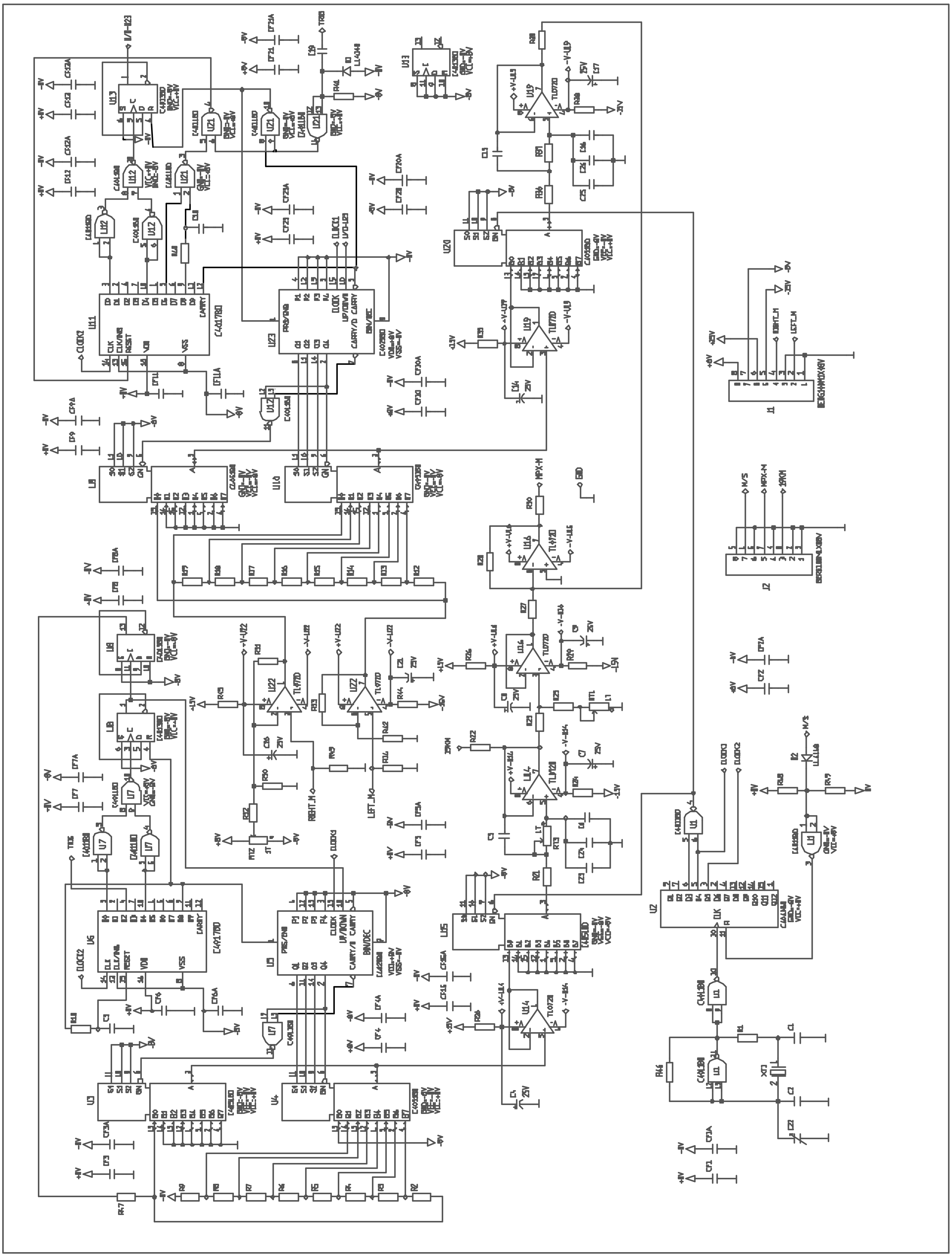
SINTD BOARD - VCO OSCILLATOR

item	qty	part number	Val	Tol	Work.Volt.	description	
1	1	BCW31				Transistor, NPN BJT	Q2
2	1	BCW72				Transistor, NPN BJT	Q3
3	1	BERG100M1X14V					J2
4	1	BFR92				Transistor, NPN BJT	Q7
5	1	BFR92				Transistor, NPN BJT	Q5
6	1	BFR92				Transistor, NPN BJT	Q4
7	1	CEV_100u-35V	100u	20%	35V		C19
8	1	CEV_100u-35V	100u	20%	35V		C16
9	1	CEV_100u-35V	100u	20%	35V		C15
10	1	CEV_100u-35V	100u	20%	35V		C17
11	1	CEV_100u-35V	100u	20%	35V		C21
12	1	Coax				Coaxial Line	Coax1
13	1	C1210	1n	20		capacitor	C38
14	1	C1210	1n	20		capacitor	C26
15	1	C1210	1n	20		capacitor	C27
16	1	C1210	1n	20		capacitor	C34
17	1	C1210	1n	20		capacitor	C28
18	1	C1210	1n	20		capacitor	C35
19	1	C1210	1n	20		capacitor	C39
20	1	C1210	1n	20		capacitor	C40
21	1	C1210	1n	20		capacitor	C29
22	1	C1210	1n	20		capacitor	C41
23	1	C1210	1n	20		capacitor	C24
24	1	C1210	1n	20		capacitor	C36
25	1	C1210	1n	20		capacitor	C31
26	1	C1210	1n	20		capacitor	C42
27	1	C1210	1n	20		capacitor	C25
28	1	C1210	1n	20		capacitor	C32
29	1	C1210	1n	20		capacitor	C30
30	1	C1210	1n	20		capacitor	C55
31	1	C1210	1n	20		capacitor	C56
32	1	C1210	1n	20		capacitor	C57
33	1	C1210	1n	20		capacitor	C2
34	1	C1210	1n	20		capacitor	C51
35	1	C1210	1n	20		capacitor	C33
36	1	C1210	1n	20		capacitor	C58
37	1	C4016BD				Analog Switch, Bilateral	U13
38	1	DROP					Z1
39	1	HSS2800				diode	D3
40	1	HSS2800				diode	D5
41	1	HSS2800				diode	D4
42	1	LF353D				Opamp 5-pin	U2
43	1	LL4148				diode	D7
44	1	LL4148				diode	D6
45	1	LL4148				diode	D1
46	1	LL4148				diode	D2
47	1	LMX2306D					U4
48	1	LM358D				Opamp 5-pin	U6
49	1	LM358D				Opamp 5-pin	U7
50	1	L1812_1mH	1mH			inductor	L3
51	1	L1812_2u2H	2u2H			inductor	L2
52	1	L1812_6u8H	6u8H			inductor	L1
53	1	MAV1_2-16_DIA300	1.6-16 pF	%		capacitor	CV1
54	1	MAV11					U3
55	1	MAV11					U14
56	1	MMBFJ310LT1				JFET, N-chan	Q1
57	1	MMBR571LT1				Transistor, NPN BJT	Q6
58	1	MMBV109LT1	26-32 pF			Varactor	DV1
59	1	MMBV109LT1	26-32 pF			Varactor	DV2
60	1	MMBV109LT1	26-32 pF			Varactor	DV3
61	1	MMBV109LT1	26-32 pF			Varactor	DV4
62	1	MMBV109LT1	26-32 pF			Varactor	DV5
63	1	MMBV109LT1	26-32 pF			Varactor	DV6
64	1	MMBV109LT1	26-32 pF			Varactor	DV7
65	1	MMBV109LT1	26-32 pF			Varactor	DV8
66	1	MMBV109LT1	26-32 pF			Varactor	DV9
67	1	RCH_895	uH			inductor	L4
68	1	RT_3314J	500	10%		resistor	RT1
69	1	R1206-F-42K0	42K0	1%		resistor	R30|COD
70	1	R1206-J-1K0	1K0	5%		resistor	R3
71	1	R1206-J-1K0	1K0	5%		resistor	R5

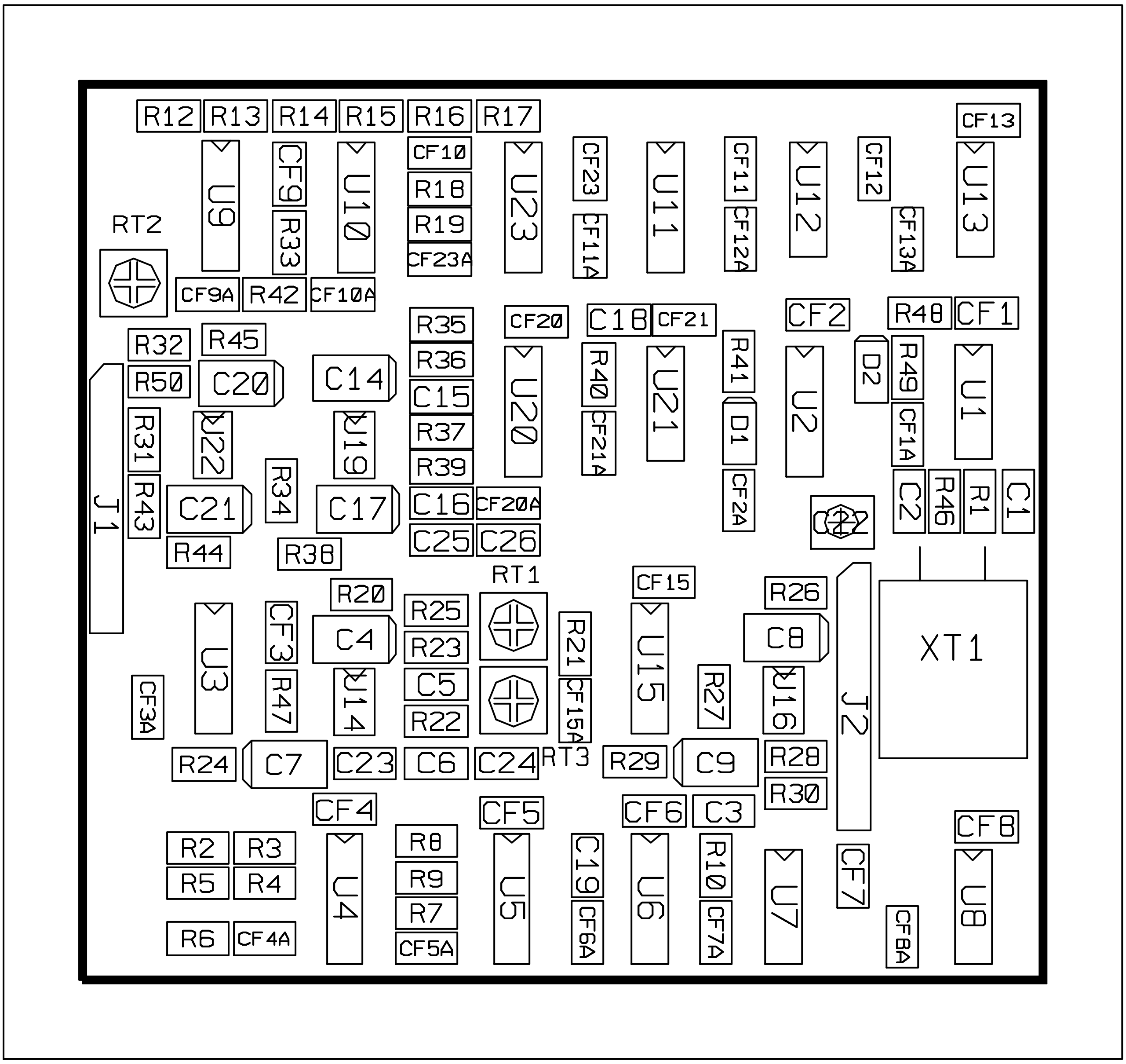
72	1	R1206-J-1K2	1K2	5%		resistor	R13	
73	1	R1206-J-1M0	1M	5%		resistor	R67	COD
74	1	R1206-J-2K2	2K2	5%		resistor	R48	
75	1	R1206-J-2K2	2K2	5%		resistor	R49	
76	1	R1206-J-2K4	2K4	5%		resistor	R58	COD
77	1	R1206-J-3K3	3K3	5%		resistor	R4	COD
78	1	R1206-J-3K9	3K9	5%		resistor	R1	
79	1	R1206-J-4K7	4K7	5%		resistor	R10	
80	1	R1206-J-4K7	4K7	5%		resistor	R11	
81	1	R1206-J-4K7	4K7	5%		resistor	R9	
82	1	R1206-J-8K2	8K2	5%		resistor	R36	COD
83	1	R1206-J-8K2	8K2	5%		resistor	R17	COD
84	1	R1206-J-10K	10K	5%		resistor	R31	
85	1	R1206-J-10K	10K	5%		resistor	R37	
86	1	R1206-J-10K	10K	5%		resistor	R28	
87	1	R1206-J-10K	10K	5%		resistor	R29	
88	1	R1206-J-10K	10K	5%		resistor	R33	
89	1	R1206-J-10K	10K	5%		resistor	R27	
90	1	R1206-J-10K	10K	5%		resistor	R35	
91	1	R1206-J-10K	10K	5%		resistor	R34	
92	1	R1206-J-10K	10K	5%		resistor	R64	
93	1	R1206-J-12K	12K	5%		resistor	R54	COD
94	1	R1206-J-15K	15K	5%		resistor	R59	
95	1	R1206-J-18K	18K	5%		resistor	R14	COD
96	1	R1206-J-18K	18K	5%		resistor	R32	COD
97	1	R1206-J-22K	22K	5%		resistor	R57	
98	1	R1206-J-22K	22K	5%		resistor	R56	
99	1	R1206-J-22K	22K	5%		resistor	R55	
100	1	R1206-J-22K	22K	5%		resistor	R66	
101	1	R1206-J-33K	33K	5%		resistor	R12	
102	1	R1206-J-33K	33K	5%		resistor	R65	
103	1	R1206-J-56K	56K	5%		resistor	R60	
104	1	R1206-J-56R	56R	5%		resistor	R46	
105	1	R1206-J-56R	56R	5%		resistor	R45	
106	1	R1206-J-75R	75R	5%		resistor	R41	COD
107	1	R1206-J-82K	82K	5%		resistor	R8	
108	1	R1206-J-82K	82K	5%		resistor	R6	
109	1	R1206-J-82K	82K	5%		resistor	R7	
110	1	R1206-J-82R	82R	5%		resistor	R47	COD
111	1	R1206-J-100K	100K	5%		resistor	R15	
112	1	R1206-J-100K	100K	5%		resistor	R16	
113	1	R1206-J-100R	100R	5%		resistor	R40	
114	1	R1206-J-100R	100R	5%		resistor	R42	
115	1	R1206-J-150R	150R	5%		resistor	R51	
116	1	R1206-J-150R	150R	5%		resistor	R50	
117	1	R1206-J-200R	200R	5%		resistor	R38	
118	1	R1206-J-200R	200R	5%		resistor	R39	
119	1	R1206-J-200R	200R	5%		resistor	R44	COD
120	1	R1206-J-330R	330R	5%		resistor	R23	
121	1	R1206-J-330R	330R	5%		resistor	R25	
122	1	R1206-J-330R	330R	5%		resistor	R24	
123	1	R1206-J-330R	330R	5%		resistor	R26	
124	1	R1206-J-330R	330R	5%		resistor	R18	
125	1	R1206-J-330R	330R	5%		resistor	R19	
126	1	R1206-J-330R	330R	5%		resistor	R20	
127	1	R1206-J-330R	330R	5%		resistor	R21	
128	1	R1206-J-330R	330R	5%		resistor	R22	
129	1	R1206-J-360R	360R	5%		resistor	R2	COD
130	1	R1206-J-680R	680R	5%		resistor	R52	
131	1	R1210-J-68R	68R	5%		resistor	R69	COD
132	1	R1210-J-82R	82R	5%		resistor	R53	COD
133	1	R1210-J-82R	82R	5%		resistor	R71	COD
134	1	R1210-J-100R	100R	5%		resistor	R43	COD
135	1	R1210-J-100R	100R	5%		resistor	R70	COD
136	1	R1210-J-100R	100R	5%		resistor	R72	COD
137	1	R1210-J-100R	100R	5%		resistor	R68	COD
138	1	R2512	33	5%		resistor	R62	
139	1	R2512	33	5%		resistor	R63	
140	1	R2512	33	5%		resistor	R61	
141	1	SMB-A				BNC	J1	
142	1	TAJ_10u-25V	10u	20%	25V		C18	COD
143	1	TAJ_10u-25V	10u	20%	25V		C4	COD
144	1	TAJ_10u-25V	10u	20%	25V		C11	COD
145	1	TAJ_10u-25V	10u	20%	25V		C12	COD
146	1	TAJ_10u-25V	10u	20%	25V		C13	COD
147	1	TAJ_10u-25V	10u	20%	25V		C1	COD
148	1	TAJ_10u-25V	10u	20%	25V		C14	COD
149	1	TAJ_10u-25V	10u	20%	25V		C37	COD
150	1	TAJ_22u-16V	22u	20%	16V		C20	COD
151	1	TAJ_22u-16V	22u	20%	16V		C53	COD
152	1	TAJ_22u-16V	22u	20%	16V		C54	COD
153	1	XTAL-BLOCK					U5	
154	1	ZMM3V3				zener diode	DZ1	
155	1	ZMM3V3				zener diode	DZ2	
156	1	c1206-22p	22p	10%	100V	capacitor	C46	COD
157	1	c1206-33p	33p	10%	100V	capacitor	C45	
158	1	c1206-33p	33p	10%	100V	capacitor	C50	COD
159	1	c1206-47n	47n	10%	25V	capacitor	C47	
160	1	c1206-68p	68p	10%	100V	capacitor	C44	
161	1	c1206-100n	100n	10%	25V	capacitor	C8	

162	1	c1206-100n	100n	10%	25V	capacitor	C6	
163	1	c1206-100n	100n	10%	25V	capacitor	C10	
164	1	c1206-100n	100n	10%	25V	capacitor	C7	
165	1	c1206-100n	100n	10%	25V	capacitor	C5	
166	1	c1206-100n	100n	10%	25V	capacitor	C9	
167	1	c1206-100n	100n	10%	25V	capacitor	C3	
168	1	c1206-100n	100n	10%	25V	capacitor	C52	COD
169	1	c1206-150p	150p	10%	100V	capacitor	C49	
170	1	c1206-150p	150p	10%	100V	capacitor	C48	
171	1	c1206-220n	220n	10%	15V	capacitor	C23	
172	1	c1206-470n	470n	10%	15V	capacitor	C22	
173	1	c1206-470n	470n	10%	15V	capacitor	C43	COD
174	1	74HC08D				Gate, 2-Input AND	U1	

DMPX BOARD - STEREOCODER



DMPX BOARD - STEREOCODER

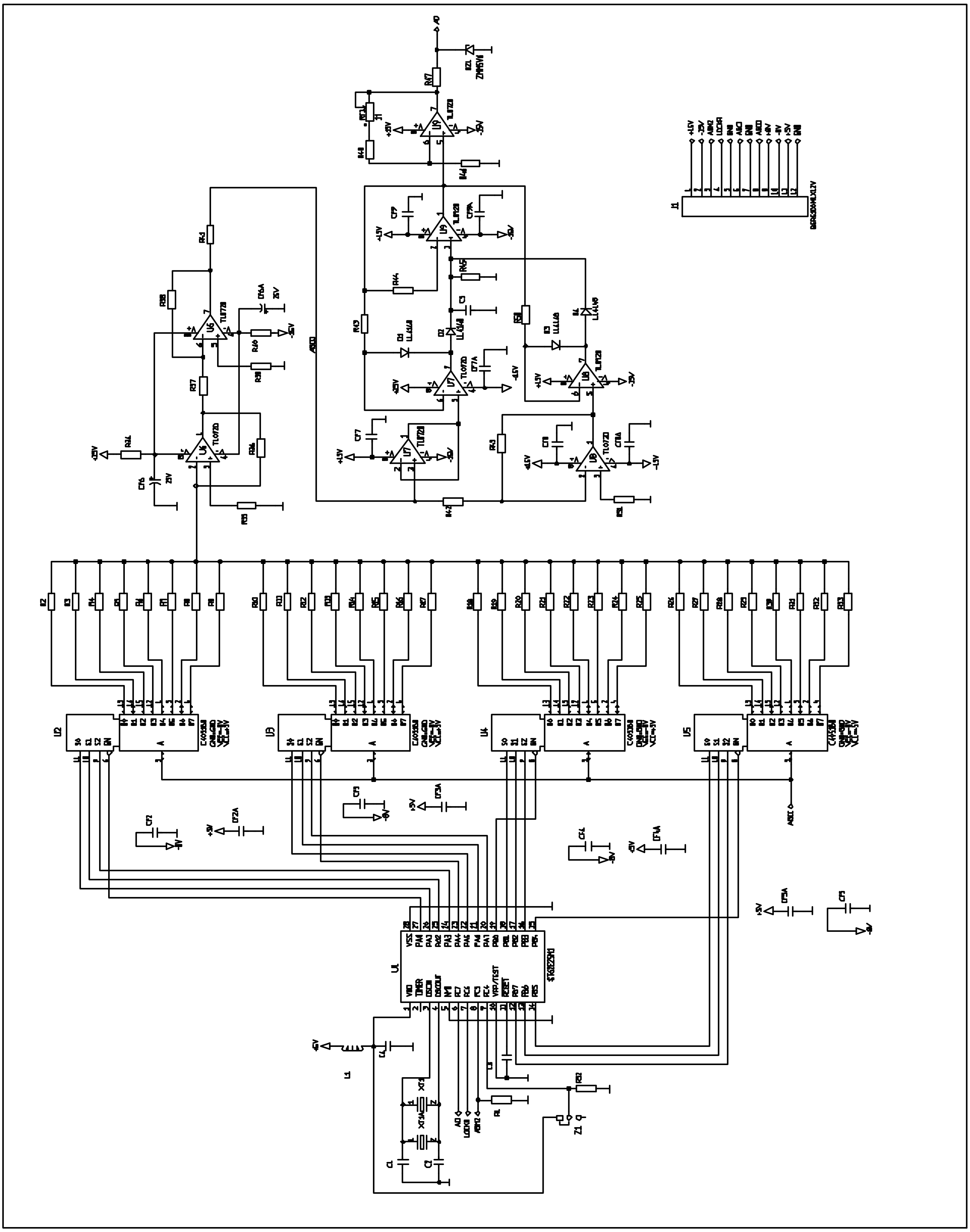


DMPX BOARD - STEREOCODER

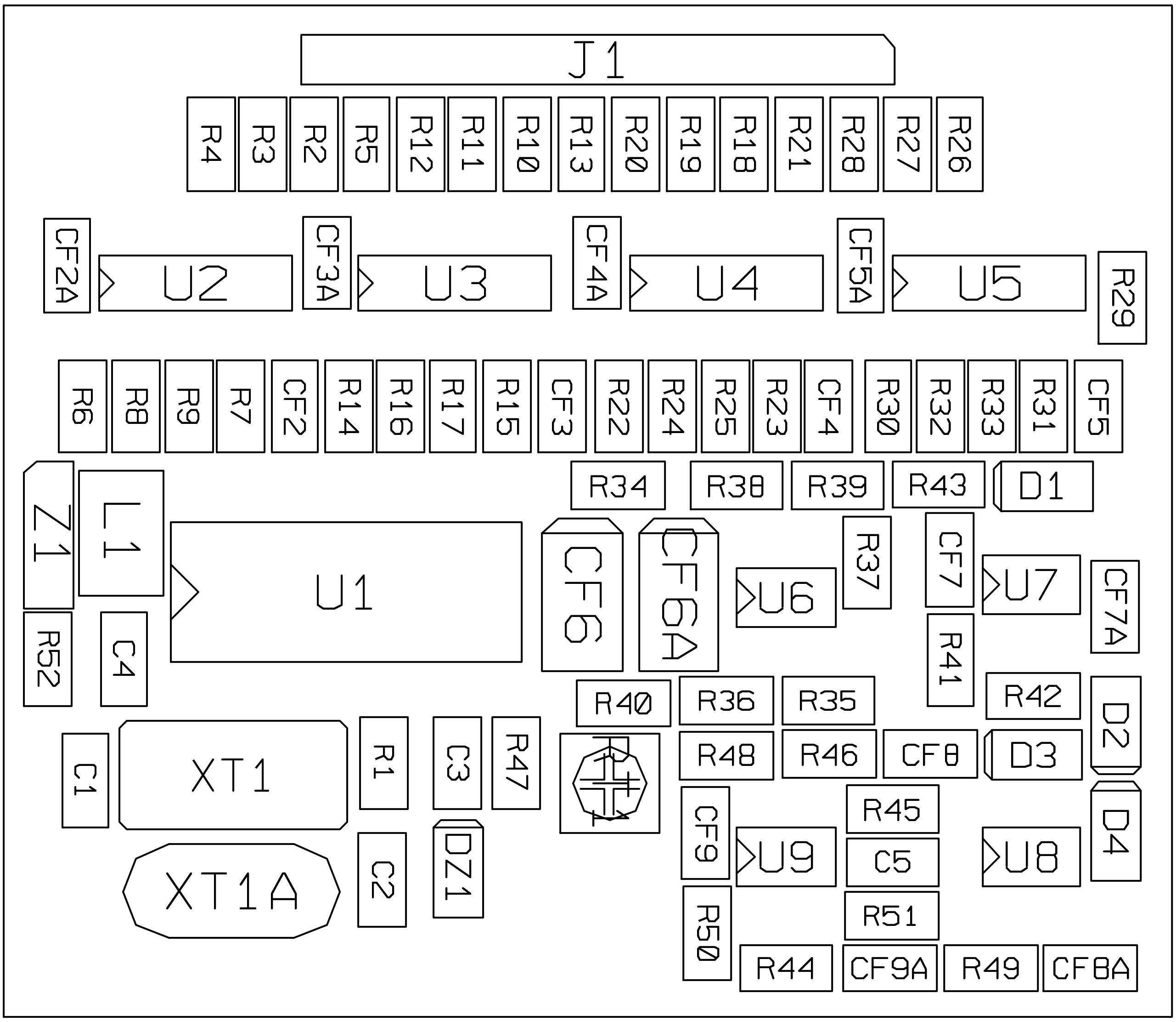
item	qty	part number	Val	Tol	Work.Volt.	description	
1	1	BERG100M1X08V					J1
2	1	BERG100M1X08V					J2
3	1	C4011BD				Gate, 2-Input NAND	U1
4	1	C4011BD				Gate, 2-Input NAND	U21
5	1	C4011BD				Gate, 2-Input NAND	U7
6	1	C4011BD				Gate, 2-Input NAND	U12
7	1	C4013BD				Flip-Flop, D-Type	U8
8	1	C4013BD				Flip-Flop, D-Type	U13
9	1	C4017BD				Counter/Divider, Decade	U6
10	1	C4017BD				Counter/Divider, Decade	U11
11	1	C4029BD					U23
12	1	C4029BD					U5
13	1	C4040BD				Counter, 12-Stage	U2
14	1	C4051BD				Multiplexer, Analog 8-Bit	U3
15	1	C4051BD				Multiplexer, Analog 8-Bit	U4
16	1	C4051BD				Multiplexer, Analog 8-Bit	U9
17	1	C4051BD				Multiplexer, Analog 8-Bit	U10
18	1	C4051BD				Multiplexer, Analog 8-Bit	U15
19	1	C4051BD				Multiplexer, Analog 8-Bit	U20
20	1	LL4148				diode	D1
21	1	LL4148				diode	D2
22	1	RT_3314J	1K	10%		resistor	RT1
23	1	RT_3314J	100	10%		resistor	RT3
24	1	RT_3314J	10K	10%		resistor	RT2
25	1	R1206-F-1K0	1K0	1%		resistor	R43
26	1	R1206-F-1K3	1K3	1%		resistor	R47
27	1	R1206-F-1K8	1K8	1%		resistor	R34
28	1	R1206-F-2K2	2K2	1%		resistor	R27
29	1	R1206-F-2K2	2K2	1%		resistor	R28
30	1	R1206-F-2K2	2K2	1%		resistor	R39
31	1	R1206-F-2K2	2K2	1%		resistor	R33
32	1	R1206-F-2K2	2K2	1%		resistor	R31
33	1	R1206-F-2K7	2K7	1%		resistor	R40
34	1	R1206-F-2K7	2K7	1%		resistor	R10
35	1	R1206-F-2M2	2M2	1%		resistor	R46
36	1	R1206-F-8K2	8K2	1%		resistor	R23
37	1	R1206-F-8K2	8K2	1%		resistor	R49
38	1	R1206-F-10K	10K	1%		resistor	R41
39	1	R1206-F-10K	10K	1%		resistor	R50
40	1	R1206-F-10K	10K	1%		resistor	R22
41	1	R1206-F-10K	10K	1%		resistor	R48
42	1	R1206-F-10K	10K	1%		resistor	R42
43	1	R1206-F-51R	51R	1%		resistor	R30
44	1	R1206-F-68R	68R	1%		resistor	R36
45	1	R1206-F-68R	68R	1%		resistor	R37
46	1	R1206-F-68R	68R	1%		resistor	R21
47	1	R1206-F-68R1	68R1	1%		resistor	R2
48	1	R1206-F-100K	100K	1%		resistor	R32
49	1	R1206-F-100R	100R	1%		resistor	R20
50	1	R1206-F-100R	100R	1%		resistor	R45
51	1	R1206-F-100R	100R	1%		resistor	R44
52	1	R1206-F-100R	100R	1%		resistor	R26
53	1	R1206-F-100R	100R	1%		resistor	R29
54	1	R1206-F-100R	100R	1%		resistor	R24
55	1	R1206-F-100R	100R	1%		resistor	R35
56	1	R1206-F-100R	100R	1%		resistor	R38
57	1	R1206-F-162R	162R	1%		resistor	R19
58	1	R1206-F-162R	162R	1%		resistor	R12
59	1	R1206-F-180R	180R	1%		resistor	R1
60	1	R1206-F-200R	200R	1%		resistor	R3
61	1	R1206-F-324R	324R	1%		resistor	R4
62	1	R1206-F-432R	432R	1%		resistor	R5
63	1	R1206-F-453R	453R	1%		resistor	R18
64	1	R1206-F-453R	453R	1%		resistor	R13
65	1	R1206-F-500R	500R	1%		resistor	R25
66	1	R1206-F-536R	536R	1%		resistor	R6
67	1	R1206-F-604R	620K	1%		resistor	R7
68	1	R1206-F-649R	649R	1%		resistor	R8
69	1	R1206-F-681R	681R	1%		resistor	R9
70	1	R1206-F-681R	681R	1%		resistor	R17
71	1	R1206-F-681R	681R	1%		resistor	R14
72	1	R1206-F-806R	806R	1%		resistor	R16

73	1	R1206-F-806R	806R	1%		resistor	R15
74	1	TAJ_10u-25V	10u	20%	25V		C4
75	1	TAJ_10u-25V	10u	20%	25V		C8
76	1	TAJ_10u-25V	10u	20%	25V		C14
77	1	TAJ_10u-25V	10u	20%	25V		C17
78	1	TAJ_10u-25V	10u	20%	25V		C20
79	1	TAJ_10u-25V	10u	20%	25V		C21
80	1	TAJ_10u-25V	10u	20%	25V		C9
81	1	TAJ_10u-25V	10u	20%	25V		C7
82	1	TL072D				Opamp 5-pin	U14
83	1	TL072D				Opamp 5-pin	U16
84	1	TL072D				Opamp 5-pin	U19
85	1	TL072D				Opamp 5-pin	U22
86	1	TZBX4	22p	5%		capacitor	C22
87	1	XT-HC49U	MHz			Crystal	XT1
88	1	c1206-10p	10p	10%	100V	capacitor	C3
89	1	c1206-10p	10p	10%	100V	capacitor	C18
90	1	c1206-22p	22p	10%	100V	capacitor	C2
91	1	c1206-100n	100n	10%	25V	capacitor	CF2
92	1	c1206-100n	100n	10%	25V	capacitor	CF2A
93	1	c1206-100n	100n	10%	25V	capacitor	CF1A
94	1	c1206-100n	100n	10%	25V	capacitor	CF1
95	1	c1206-100n	100n	10%	25V	capacitor	CF6
96	1	c1206-100n	100n	10%	25V	capacitor	CF6A
97	1	c1206-100n	100n	10%	25V	capacitor	CF11
98	1	c1206-100n	100n	10%	25V	capacitor	CF11A
99	1	c1206-100n	100n	10%	25V	capacitor	CF23
100	1	c1206-100n	100n	10%	25V	capacitor	CF23A
101	1	c1206-100n	100n	10%	25V	capacitor	CF10
102	1	c1206-100n	100n	10%	25V	capacitor	CF10A
103	1	c1206-100n	100n	10%	25V	capacitor	CF9
104	1	c1206-100n	100n	10%	25V	capacitor	CF9A
105	1	c1206-100n	100n	10%	25V	capacitor	CF8
106	1	c1206-100n	100n	10%	25V	capacitor	CF8A
107	1	c1206-100n	100n	10%	25V	capacitor	CF5
108	1	c1206-100n	100n	10%	25V	capacitor	CF5A
109	1	c1206-100n	100n	10%	25V	capacitor	CF4
110	1	c1206-100n	100n	10%	25V	capacitor	CF4A
111	1	c1206-100n	100n	10%	25V	capacitor	CF3
112	1	c1206-100n	100n	10%	25V	capacitor	CF3A
113	1	c1206-100n	100n	10%	25V	capacitor	CF7
114	1	c1206-100n	100n	10%	25V	capacitor	CF7A
115	1	c1206-100n	100n	10%	25V	capacitor	CF20
116	1	c1206-100n	100n	10%	25V	capacitor	CF20A
117	1	c1206-100n	100n	10%	25V	capacitor	CF21
118	1	c1206-100n	100n	10%	25V	capacitor	CF21A
119	1	c1206-100n	100n	10%	25V	capacitor	CF13
120	1	c1206-100n	100n	10%	25V	capacitor	CF13A
121	1	c1206-100n	100n	10%	25V	capacitor	CF12
122	1	c1206-100n	100n	10%	25V	capacitor	CF12A
123	1	c1206-100n	100n	10%	25V	capacitor	CF15A
124	1	c1206-100n	100n	10%	25V	capacitor	CF15
125	1	c1206-100p	100p	10%	100V	capacitor	C1
126	1	c1206-100p	100p	10%	100V	capacitor	C15
127	1	c1206-100p	100p	10%	100V	capacitor	C5
128	1	c1206-100p	100p	10%	100V	capacitor	C19
129	1	c1206-150p	150p	10%	100V	capacitor	C16
130	1	c1206-150p	150p	10%	100V	capacitor	C26
131	1	c1206-150p	150p	10%	100V	capacitor	C25
132	1	c1206-150p	150p	10%	100V	capacitor	C6
133	1	c1206-150p	150p	10%	100V	capacitor	C24
134	1	c1206-150p	150p	10%	100V	capacitor	C23

AGC BOARD- AUDIO AUTOMATIC GAIN CONTROL



AGC BOARD - AUDIO AUTOMATIC GAIN CONTROL

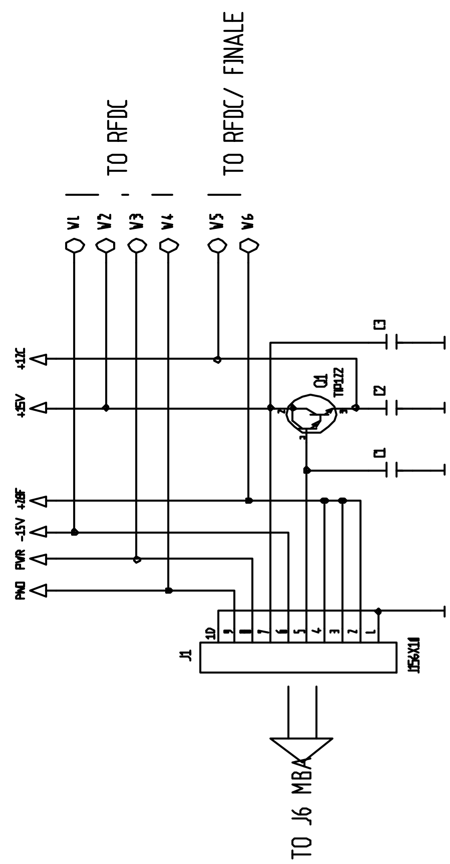


AGC BOARD - AUDIO AUTOMATIC GAIN CONTROL

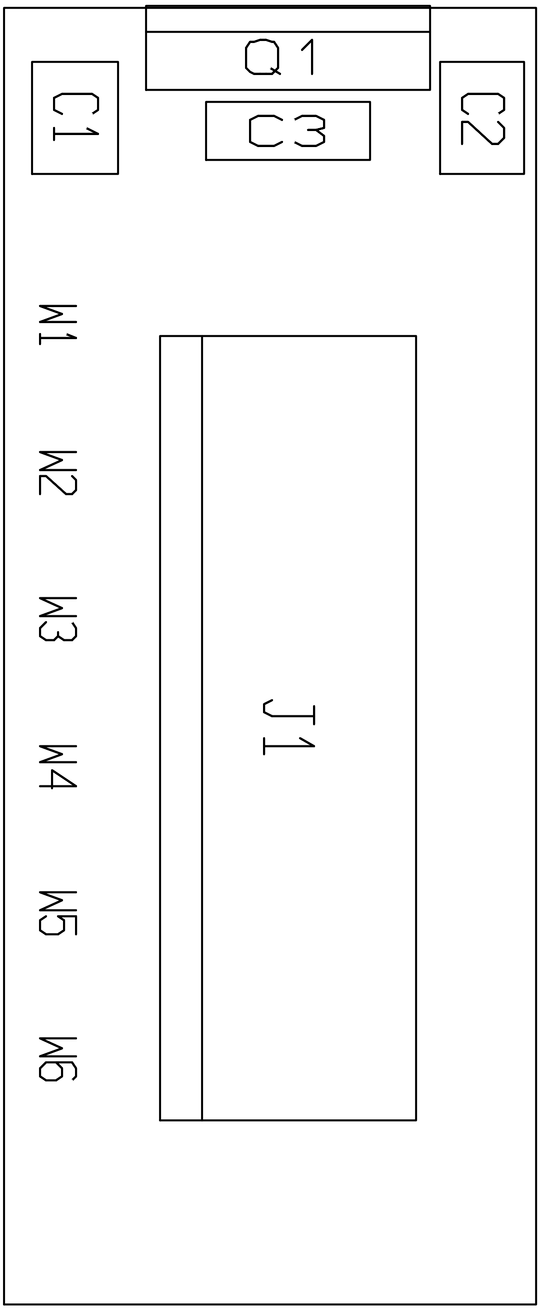
item	qty	part number	Val	Tol	Work.Volt.	description	references	Magazzino
1	1	BERG100M1X12V					J1	
2	1	C4051BD				Multiplexer, Analog 8-Bit	U2	
3	1	C4051BD				Multiplexer, Analog 8-Bit	U3	
4	1	C4051BD				Multiplexer, Analog 8-Bit	U4	
5	1	C4051BD				Multiplexer, Analog 8-Bit	U5	
6	1	LL4148				diode	D2	
7	1	LL4148				diode	D1	
8	1	LL4148				diode	D4	
9	1	LL4148				diode	D3	
10	1	L1812_6u8H	6,8uH	10		inductor	L1	
11	1	RT_3314J-10K	10K	10%		resistor	RT1	COD
12	1	R1206-F-5K11	5K11	1%		resistor	R33	COD
13	1	R1206-F-5K23	5K23	1%		resistor	R32	COD
14	1	R1206-F-5K49	5K49	1%		resistor	R31	COD
15	1	R1206-F-5K76	5K76	1%		resistor	R30	COD
16	1	R1206-F-5K90	5K90	1%		resistor	R29	COD
17	1	R1206-F-6K19	6K19	1%		resistor	R28	COD
18	1	R1206-F-6K49	6K49	1%		resistor	R27	COD
19	1	R1206-F-6K81	6K81	1%		resistor	R26	COD
20	1	R1206-F-7K15	7K15	1%		resistor	R25	COD
21	1	R1206-F-7K50	7K50	1%		resistor	R24	COD
22	1	R1206-F-7K87	7K87	1%		resistor	R23	COD
23	1	R1206-F-8K06	8K06	1%		resistor	R22	COD
24	1	R1206-F-8K45	8K45	1%		resistor	R21	COD
25	1	R1206-F-8K87	8K87	1%		resistor	R20	COD
26	1	R1206-F-9K31	9K31	1%		resistor	R19	COD
27	1	R1206-F-9K76	9K76	1%		resistor	R18	COD
28	1	R1206-F-10K0	10K0	1%		resistor	R52	COD
29	1	R1206-F-10K2	10K2	1%		resistor	R17	COD
30	1	R1206-F-10K5	10K5	1%		resistor	R16	COD
31	1	R1206-F-11K0	11K0	1%		resistor	R15	COD
32	1	R1206-F-11K5	11K5	1%		resistor	R14	COD
33	1	R1206-F-12K1	12K1	1%		resistor	R13	COD
34	1	R1206-F-12K7	12K7	1%		resistor	R12	COD
35	1	R1206-F-13K3	13K3	1%		resistor	R11	COD
36	1	R1206-F-14K0	14K	1%		resistor	R10	COD
37	1	R1206-F-14K7	14K7	1%		resistor	R9	COD
38	1	R1206-F-15K8	15K8	1%		resistor	R7	COD
39	1	R1206-F-16K4	16K4	1%		resistor	R8	COD
40	1	R1206-F-16K5	16K5	1%		resistor	R6	COD
41	1	R1206-F-17K4	17K4	1%		resistor	R5	COD
42	1	R1206-F-18K2	18K2	1%		resistor	R4	COD
43	1	R1206-F-19K1	19K1	1%		resistor	R3	COD
44	1	R1206-F-20K0	20K0	1%		resistor	R2	COD
45	1	R1206-J-1K0	1K0	5%		resistor	R39	COD
46	1	R1206-J-1M0	1M	5%		resistor	R45	COD
47	1	R1206-J-2K2	2K2	5%		resistor	R35	COD
48	1	R1206-J-2K2	2K2	5%		resistor	R37	COD
49	1	R1206-J-2K2	2K2	5%		resistor	R38	COD
50	1	R1206-J-3K9	3K9	5%		resistor	R44	COD
51	1	R1206-J-5K6	5K6	5%		resistor	R43	COD
52	1	R1206-J-5K6	5K6	5%		resistor	R50	COD
53	1	R1206-J-10K	10K	5%		resistor	R36	COD
54	1	R1206-J-10K	10K	5%		resistor	R48	COD
55	1	R1206-J-18K	18K	5%		resistor	R1	COD
56	1	R1206-J-22K	22K	5%		resistor	R51	COD
57	1	R1206-J-27K	27K	5%		resistor	R46	COD
58	1	R1206-J-47R	47R	5%		resistor	R41	COD
59	1	R1206-J-56K	56K	5%		resistor	R42	COD
60	1	R1206-J-56K	56K	5%		resistor	R49	COD
61	1	R1206-J-270R	270R	5%		resistor	R34	COD
62	1	R1206-J-270R	270R	5%		resistor	R40	COD
63	1	R1206-J-330R	330R	5%		resistor	R47	COD
64	1	ST62E25M1					U1	
65	1	TAJ_10u-25V	10u	20%	25V		CF6	COD
66	1	TAJ_10u-25V	10u	20%	25V		CF6A	COD
67	1	TL072D				Opamp 5-pin	U6	
68	1	TL072D				Opamp 5-pin	U7	
69	1	TL072D				Opamp 5-pin	U8	

70	1	TL072D				Opamp 5-pin	U9
71	1	XT-HC49U	MHz			Crystal	XT1A
72	1	XT-KX20	MHz			Crystal	XT1
73	1	ZMM5V6				zener diode	DZ1|COD
74	1	Z3_P100					Z1
75	1	c1206-33p	33p	10%	100V	capacitor	C2|COD
76	1	c1206-33p	33p	10%	100V	capacitor	C1|COD
77	1	c1206-100n	100n	10%	25V	capacitor	CF2|COD
78	1	c1206-100n	100n	10%	25V	capacitor	CF2A|COD
79	1	c1206-100n	100n	10%	25V	capacitor	CF4|COD
80	1	c1206-100n	100n	10%	25V	capacitor	CF5|COD
81	1	c1206-100n	100n	10%	25V	capacitor	CF5A|COD
82	1	c1206-100n	100n	10%	25V	capacitor	CF3|COD
83	1	c1206-100n	100n	10%	25V	capacitor	CF3A|COD
84	1	c1206-100n	100n	10%	25V	capacitor	C4|COD
85	1	c1206-100n	100n	10%	25V	capacitor	CF7|COD
86	1	c1206-100n	100n	10%	25V	capacitor	CF7A|COD
87	1	c1206-100n	100n	10%	25V	capacitor	CF9A|COD
88	1	c1206-100n	100n	10%	25V	capacitor	CF9|COD
89	1	c1206-100n	100n	10%	25V	capacitor	CF8A|COD
90	1	c1206-100n	100n	10%	25V	capacitor	CF8|COD
91	1	c1206-100n	100n	10%	25V	capacitor	CF4A|COD
92	1	c1206-470n	470n	10%	15V	capacitor	C3|COD
93	1	c1206-470n	470n	10%	15V	capacitor	C5|COD

CON BOARD - MBA / RFDC CONNECTION



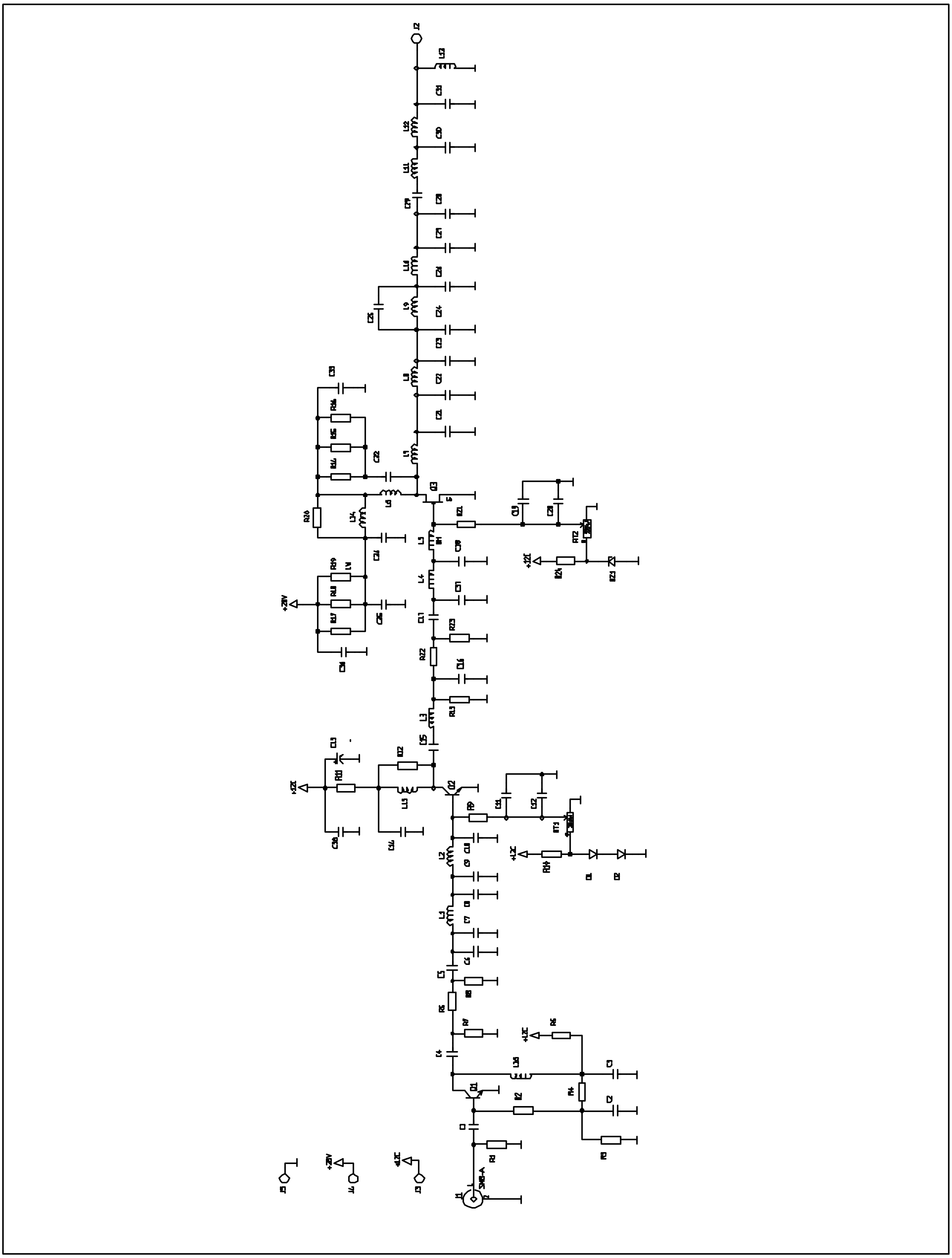
CON BOARD - MBA / RFDC CONNECTION



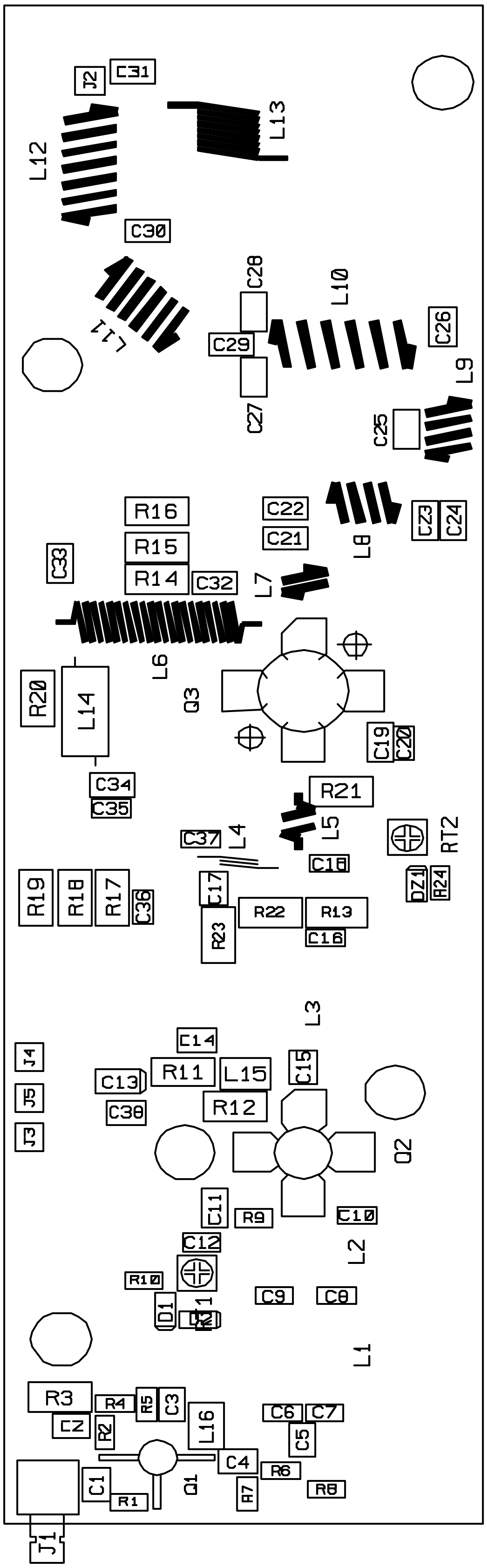
CON BOARD - MBA / RFDC CONNECTION

Item	qty	part number	Val	Tol	Work.Volt.	description	
1	1	CCM_100n	100n	10%		capacitor	C1
2	1	CCM_100n	100n	10%		capacitor	C2
3	1	CCM_100n	100n	10%		capacitor	C3
4	1	J156X10					J1
5	1	PAD_160X140				Pin Wire	W1
6	1	PAD_160X140				Pin Wire	W2
7	1	PAD_160X140				Pin Wire	W3
8	1	PAD_160X140				Pin Wire	W4
9	1	PAD_160X140				Pin Wire	W5
10	1	PAD_160X140				Pin Wire	W6
11	1	TIP122				Transistor, NPN Darlington	Q1

40WN BOARD - RF POWER MODULE



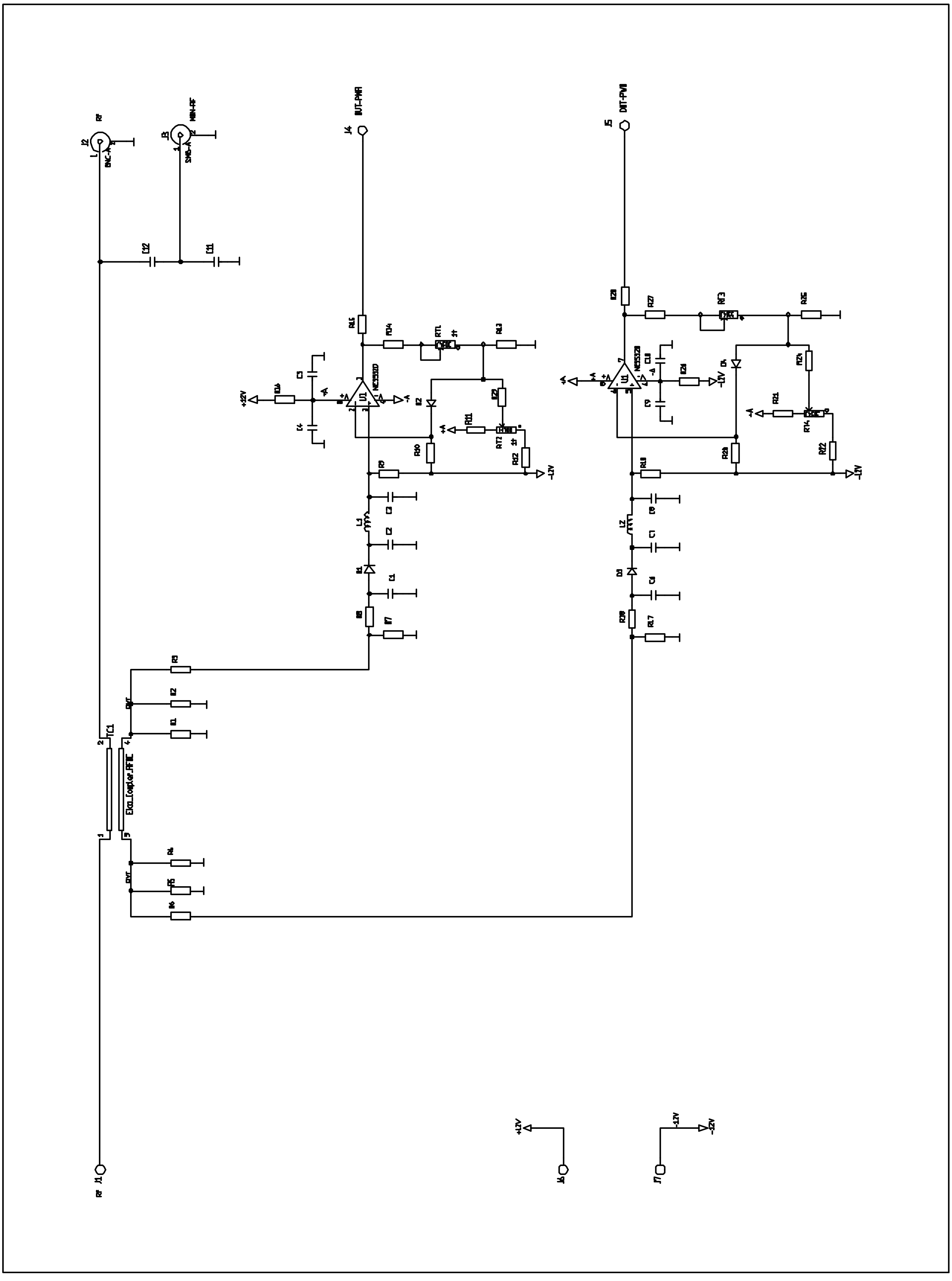
40WN BOARD- RF POWER MODULE



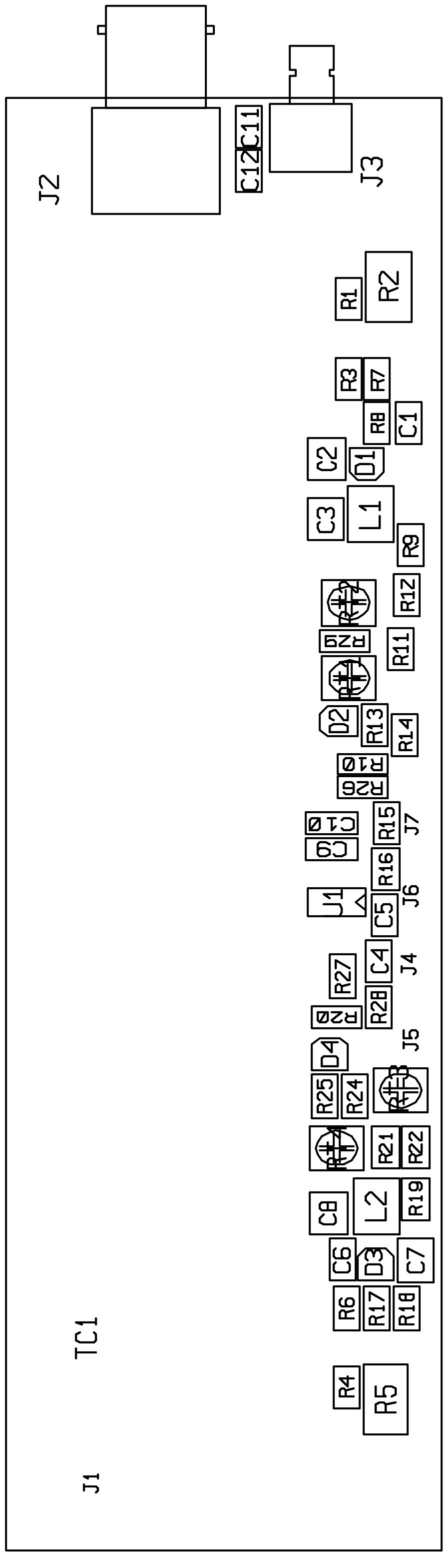
40WN BOARD - RF POWER MODULE

item	qty	part number	description	references
1	1	BFQ68	NPN 4 GHz Wideband Transistor	Q2
2	1	BFR96	NPN 4 GHz Wideband Transistor	Q1
3	16	CSMD-HQ	Chip High Frequency Monolithic Ceramic Capacitor	C11,C19,C21-C34
4	9	C1210	Capacitor SMD 1210	C1-C5,C14-C15,C17,C38
5	1	DU2860U	N-Channel RF Power MOSFET (MaCom)	Q3
6	1	LCS_ELCA1	BOBINA SU C.S. Ri=2.6mm, W=0.4mm, S=1mm, N=2.5 AVV.	L1
7	1	LCS_ELCA2	BOBINA SU C.S. Ri=2.6mm, W=0.4mm, S=1mm, N=2.5 AVV.	L2
8	1	LCS_ELCA3	BOBINA SU C.S. Ri=2.2mm, W=0.6mm, S=1mm, N=2.5 AVV.	L3
9	2	LL4148	diode	D1-D2
10	1	L_VK200_P600	Inductor PTH VK200 PASSO 600th	L14
11	1	L_2SP_5D_2L	Bobina 2 Spire, diametro 5mm, larghezza 2mm, a Saldare	L4
12	1	L_2SP_5D_6L	Bobina 2 Spire, diametro 5mm, larghezza 6mm, a Saldare	L5
13	1	L_2SP_7D_3L	Bobina 2 Spire, diametro 7mm, larghezza 3mm, a Saldare	L7
14	2	L_4SP_7D_8L	Bobina 4 Spire, diametro 7mm, larghezza 8mm, a Saldare	L8-L9
15	1	L_6SP_8D_12L	Bobina 6 Spire, diametro 8mm, larghezza 12mm, a Saldare	L11
16	1	L_6SP_8D_15L	Bobina 6 Spire, diametro 8mm, larghezza 15mm, a Saldare	L12
17	1	L_6SP_8D_18L	Bobina 6 Spire, diametro 8mm, larghezza 18mm, a Saldare	L10
18	1	L_8SP_8D_8L	Bobina 8 Spire, diametro 8mm, larghezza 8mm, a Saldare	L13
19	1	L_20SP_6D_17L	Bobina 20 Spire, diametro 6mm, larghezza 17mm, a Saldare	L6
20	2	L1812	Inductor SMD 1812	L15-L16
21	4	PAD_160X140	PAD X C.S. TIPO SMD 160X140 mills	J2-J5
22	2	RT_3314J	TRIMMER SMD 4 x 4.7 mm	RT1-RT2
23	1	R1206-J-5K6	RESISTOR SMD 1206	R4
24	1	R1206-J-10R	RESISTOR SMD 1206	R9
25	1	R1206-J-15R	RESISTOR SMD 1206	R6
26	1	R1206-J-56R	resistor	R1
27	1	R1206-J-100R	RESISTOR SMD 1206	R5
28	1	R1206-J-270R	resistor	R2
29	2	R1206-J-470R	RESISTOR SMD 1206	R7-R8
30	2	R1206-J-680R	RESISTOR SMD 1206	R10,R24
31	14	R2512	RESISTOR SMD 2512	R3,R11-R23
32	1	SMB-A	Female Right Angle SMB, PCB Mounting	J1
33	1	TAJ_10u-25V	TAJ Tantalium Capacitor SMD Size C	C13
34	1	ZMM5V6	Zener Diode 0,5 W - 5.6 V	DZ1
35	1	c1206-33p	CAPACITOR SMD 1206	C10
36	2	c1206-47p	CAPACITOR SMD 1206	C6-C7
37	1	c1206-56p	CAPACITOR SMD 1206	C8
38	1	c1206-68p	CAPACITOR SMD 1206	C37
39	4	c1206-100n	CAPACITOR SMD 1206	C12,C20,C35-C36
40	2	c1206-100p	CAPACITOR SMD 1206	C9,C16
41	1	c1206-150p	CAPACITOR SMD 1206	C18

RFDC BOARD - DIRECTIONAL COUPLER



RFDC BOARD - DIRECTIONAL COUPLER



RFDC BOARD - DIRECTIONAL COUPLER

item	qty	part number	Val	Tol	Work.Volt.	description		
1	1	BNC-A				BNC	J2	
2	1	C1210	1n	10%		capacitor	C2	
3	1	C1210	1n	10%		capacitor	C3	
4	1	C1210	1n	10%		capacitor	C7	
5	1	C1210	1n	10%		capacitor	C8	
6	1	Elca_Coupler_RFDC					TC1	
7	1	HSS2800				diode	D1	
8	1	HSS2800				diode	D2	
9	1	HSS2800				diode	D3	
10	1	HSS2800				diode	D4	
11	1	L1812				inductor	L1	
12	1	L1812				inductor	L2	
13	1	NE5532D				Opamp 5-pin	U1	
14	1	PAD_160X140				Physical Connector	J6	
15	1	PAD_160X140				Physical Connector	J7	
16	1	PAD_160X140				Physical Connector	J4	
17	1	PAD_160X140				Physical Connector	J5	
18	1	PAD_160X140				Physical Connector	J1	
19	1	RT_3314J	2K2			resistor	RT1	
20	1	RT_3314J	2K2			resistor	RT2	
21	1	RT_3314J	2K2			resistor	RT3	
22	1	RT_3314J	2K2			resistor	RT4	
23	1	R1206-J-1K0	1K	1%		resistor	R12	
24	1	R1206-J-1K0	1K	1%		resistor	R11	
25	1	R1206-J-1K0	1K	1%		resistor	R22	
26	1	R1206-J-1K0	1K	1%		resistor	R21	
27	1	R1206-J-10K	10K	1%		resistor	R29	
28	1	R1206-J-10K	10K	1%		resistor	R24	
29	1	R1206-J-15R	15R	1%		resistor	R3	
30	1	R1206-J-15R	15R	1%		resistor	R6	
31	1	R1206-J-120R	120R	1%		resistor	R8	
32	1	R1206-J-120R	120R	1%		resistor	R18	
33	1	R1206-J-200R	200R	1%		resistor	R16	
34	1	R1206-J-200R	220R	1%		resistor	R26	
35	1	R1206-J-220K	220R	1%		resistor	R20	
36	1	R1206-J-220K	220K	1%		resistor	R19	
37	1	R1206-J-220K	220K	1%		resistor	R9	
38	1	R1206-J-220K	220K	1%		resistor	R10	
39	1	R1206-J-270R	270R	1%		resistor	R15	
40	1	R1206-J-270R	270R	1%		resistor	R14	
41	1	R1206-J-270R	270R	1%		resistor	R13	
42	1	R1206-J-270R	270R	1%		resistor	R28	
43	1	R1206-J-270R	270R	1%		resistor	R27	
44	1	R1206-J-270R	270R	1%		resistor	R25	COD
45	1	R1206-J-330R	330R	1%		resistor	R7	
46	1	R1206-J-330R	330R	1%		resistor	R17	
47	1	R1206-J-470R	470R	1%		resistor	R1	
48	1	R1206-J-470R	470R	1%		resistor	R4	
49	1	R2512	82R	1%		resistor	R2	
50	1	R2512	82R	1%		resistor	R5	
51	1	SMB-A				BNC	J3	
52	1	c1206-0p3	0p3	10%	100V	capacitor	C12	
53	1	c1206-1n	1n	10%	50V	capacitor	C5	
54	1	c1206-1n	1n	10%	50V	capacitor	C9	
55	1	c1206-22p	22p	10%	100V	capacitor	C11	
56	1	c1206-33p	33p	10%	100V	capacitor	C1	
57	1	c1206-33p	33p	10%	100V	capacitor	C6	
58	1	c1206-100n	100n	10%	25V	capacitor	C4	
59	1	c1206-100n	100n	10%	25V	capacitor	C10	