



NORMARC 7050

MARKER BEACON

Transmitter



NAVIA AVIATION



TRANSMITTER DESCRIPTION

1 TX 1373A Transmitter

1.1 General Description

TX 1373A is a module designed to transmit Marker Beacon signals. An on board oscillator working at 75 MHz provides an output of app.0 dBm that is used as input to the Power Amplifier (PA). The level of this input signal is adjusted to an output of app. +20 dBm. The Power Amplifier is capable of delivering up to 4W carrier power at the cabinet output.

Unwanted frequencies are removed by a lowpass filter after the PA. Part of the signal out of the PA is tapped off to be demodulated and used for feedback and self test purposes. Demodulation is done by a mixer with a linear detector.

The audio signals are generated in the LF circuitry mainly by a Field Programmable Gate Array (FPGA). Inner, Middle or Outer Marker is selected by straps.

1.1.1 Block diagram

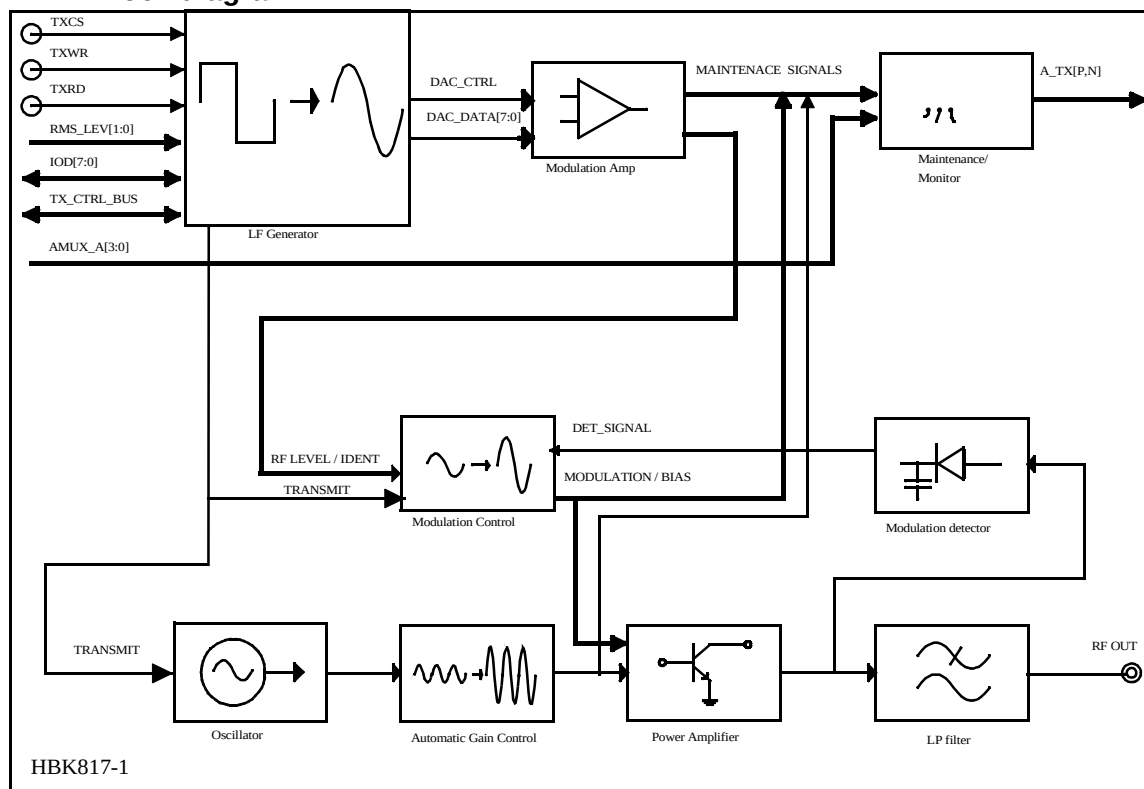


Figure 1-1 TX1373 Block diagram

1.1.2 Signals

(See block diagram Figure1-1)

In	From	Description
IOD[7:0]	MO 1374	Parellel data bus for communication between TX 1/2, CI and MO1
~TXCS	MO 1374	Transmitter card select
~TXWR	MO 1374	Write strobe for IO bus
~TXRD	MO 1374	Read strobe for IO bus
TX_ADR	CI 1376	Transmitter select
TX_ON	MO 1374	Transmitter on/off
AMUX_A[3:0]	MO 1374	Used to select measurement
~RMS_LEV[1:0]	MO 1374	Signals access level for RMS

Out	In	Description
RF_OUT	Antenna	Radio signal
~TX_FB	MO 1374	Signal tells monitor that transmitter is active
A_TX[P,N]	RMS	RMS analogue test signals
~TXCSB	MO 1374	Transmitter card select back

Bidirectional	To/From	Description
TX_CTRL_BUS	MO 1374	Changeover Control (TX_ADR), transmitter on/off (TX_ON), card select back (TXCSB), feed back (TX1/2_FB)

Power in	From	Description
V20P	PS 1375	+20 VDC to PA
V12P	PS 1375	+12 VDC
VDD	PS 1375	+5 VDC
GND	PS 1375	Analogue ground
V12N	PS 1375	-12 VDC

1.1.3 Building blocks

(See block diagram Figure1-1)

OSCILLATOR

The oscillator is controlled by the Transmit signal from the LF generator. When Transmit is low, a controllable voltage generator turns the internal oscillator 12V voltage on. +12 VDC is then applied to the collector of a bipolar transistor, which is the active device of the oscillator. A 75 MHz crystal is connected in the feedback path together with a resonance circuit.

The output signal is amplified to approximately 0 dBm through a RF gain block.

Signals in: ON/OFF to switch oscillator on.

Signals out: RF to AGC

AUTOMATIC GAIN CONTROL

The AGC circuitry is designed to adjust the signal level from the oscillator to the PA. The signal from the oscillator is fed to one of the ports of a dual gate MOSFET. The signal enters the

PA after being amplified, while part of it is fed back to the other port of the MOSFET. The transistor detects the difference between these two signals and increases or decreases the signal out to the PA, depending on the signal levels from the oscillator.

Signals in: 5 MHz RF from oscillator.
Signals out: RF to PA, app. +20 dBm
DRV_AGC: control voltage to monitor.

POWER AMPLIFIER

The Power Amplifier stage is implemented by three cascaded stages, with the two first

being bipolar MRF 553 transistors that are collector modulated. The modulation voltage is 0-12VDC both at stage one and stage two. With an input signal from oscillator / AGC of +20 dBm, the first stage will deliver +30 dBm peak power with a dynamic range of 25 dB. A 10 dB resistive π -attenuator is inserted before stage two. The input to the second stage will then be +20 dBm. After amplification and modulation, the peak power will be +30 dB, but the dynamic range is increased to 50 dB. The last stage is a MRF 171 MOSFET transistor designed to deliver high power output. It is biased by 1mA and +20VDC drain voltage. After amplification, the peak power will be +43 dBm with a dynamic range of 75-80 dB.

The TX is capable of delivering 4W carrier power.

Signals in: 75 MHz RF from oscillator / AGC.
Modulation voltages, up to +12VDC.
Power Supply, +20 VDC.
Bias, 0-5 V, to power stage.
Signals out: RF to detector / LP Filter.

LOW PASS FILTER

The output signal from the PA is filtered to remove harmonic frequencies. The filter is a seven pole passive lowpass filter.

Signals in: 75 MHz RF PA.
Signals out: RF to CI 1376.

MODULATION DETECTOR

Part of the output signal is demodulated for feedback and self test purposes. The signal is tapped out via a hybrid coupler to avoid destructive coupling from the detector to the output signal and make sure the detected signal is good. The detection is achieved by a mixer and linear detector. The output is used both as feedback to the modulation control circuitry, and sent to the monitoring circuit where RF level and keying envelope are detected.

Signals in: RF_In from PA.
Signals out: DET_SIGN to modulation control circuitry.
LO_LEVEL to monitor.

LF-GENERATOR

A Field Programmable Gate Array (FPGA) clocked by a 4.9152 MHz oscillator, EEPROM and other digital circuits generate the LF signals. The generated LF frequency is a square wave that is converted to a sinusoidal signal by filtering off the higher order harmonics. The main

inputs to the FPGA are the strapped signals used to select outer, middle, inner or FAN marker frequency, as well as status signals regarding oscillator, RF- and LF-level output. Communication with the FPGA is done by the IOD[7:0], ~TXRD and ~TXWR signals. Multiplying DAC's are used to adjust RF level and modulation depth. The keyed LF signal and the RF level is applied to the Modulation Control Circuits. The modulation voltages to the PA is generated by the use of these signals as well as the ON/OFF signal from the AGC and the detected signal from the PA.

MAINTENANCE / MONITOR CIRCUITRY

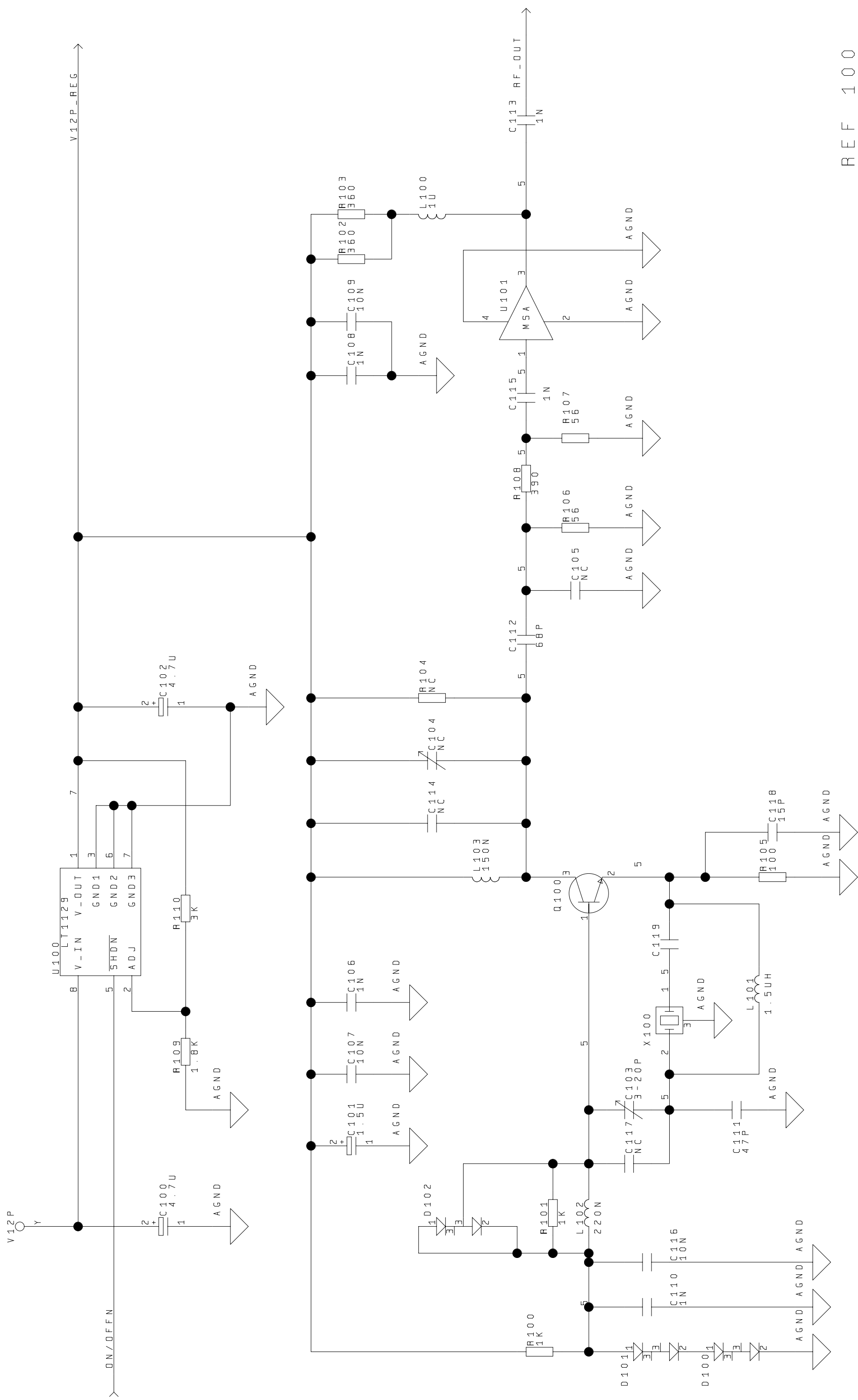
The purpose of the onboard monitor circuitry is to give the Monitor card MO 1374 information about the status of the transmitter. The AMUX_ADR[3:0] from the MO 1374 is applied to the analogue multiplexer. These four lines select one of sixteen possible signals to be measured.

The signals measured are:

- PA 20 VDC supply voltage
- PA current drain @ 20 VDC
- Detected RF level from demodulator
- Keying envelope from demodulator
- Positive/negative modulation peaks
- LF AGC voltage
- Driver AGC voltage
- RF level DC voltage from LF generator
- Supply voltage status

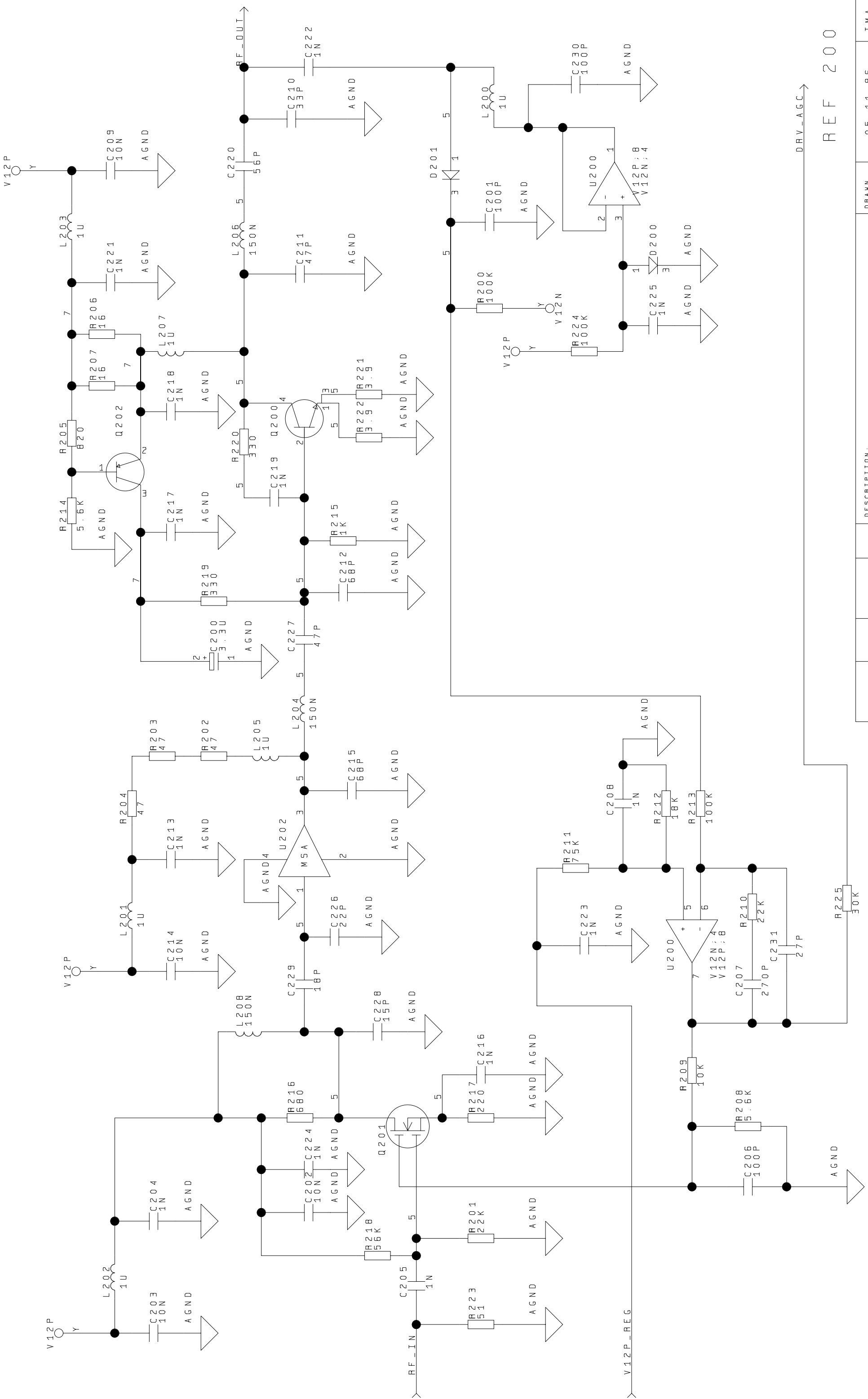
The signal information is sent to the MO 1374 monitor unit as a differential analogue test signal from the MUX.

1.2 *Schematics*

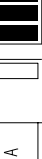


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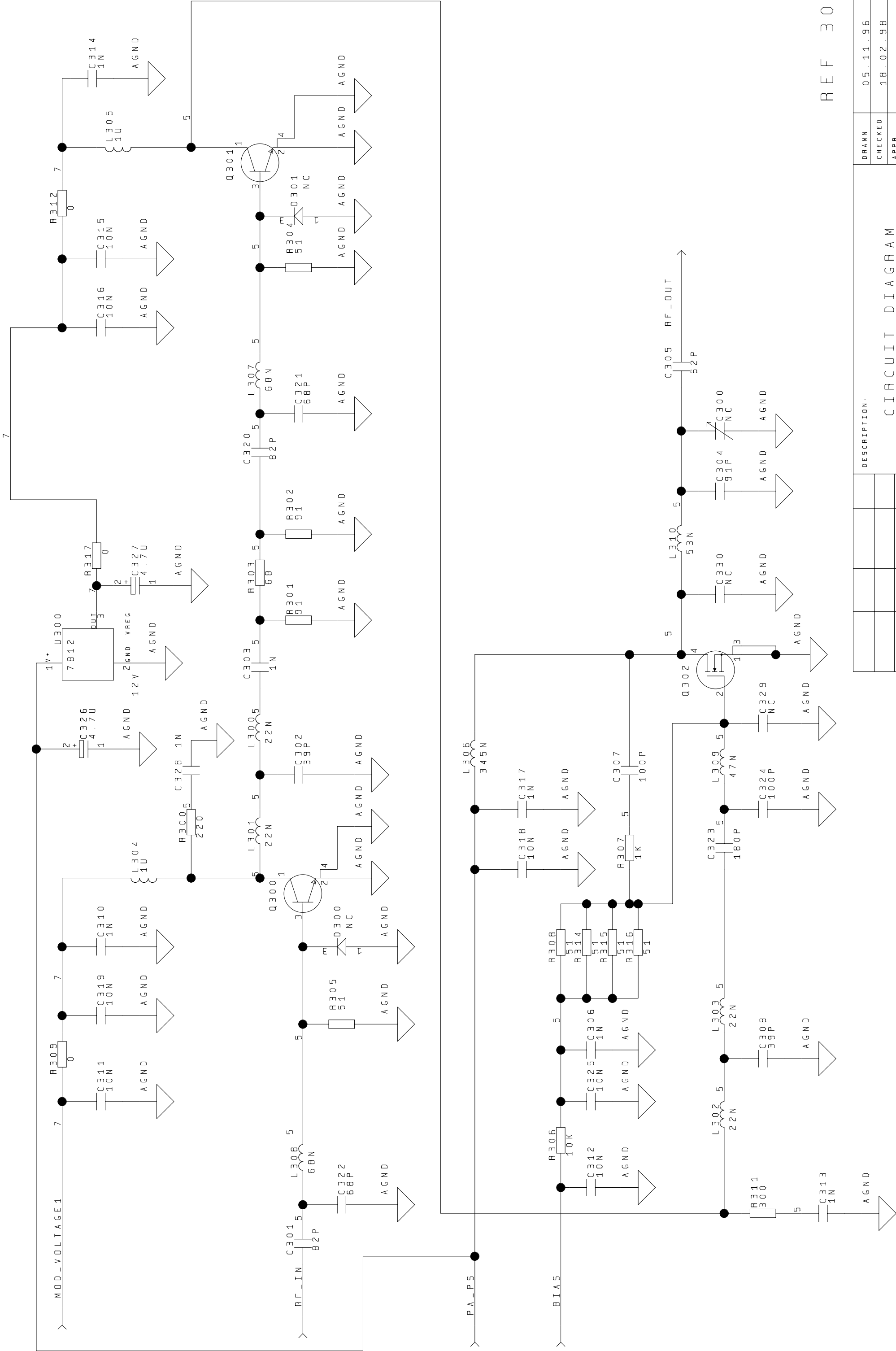
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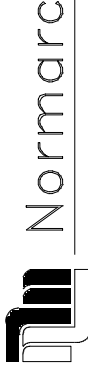
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2989	2	050697	TMA										
REF. NO.	ISSUE	DATE	SIGN	Copyright and all modification rights reserved NAVIA AVIATION AS, NORWAY									



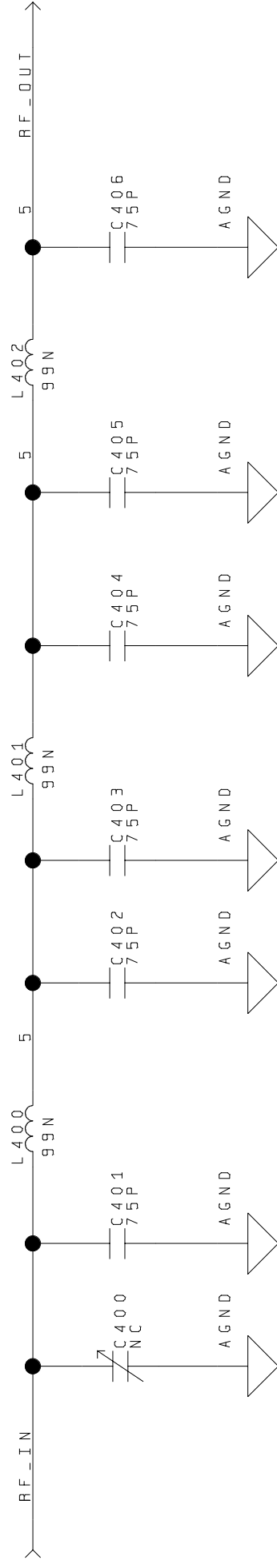


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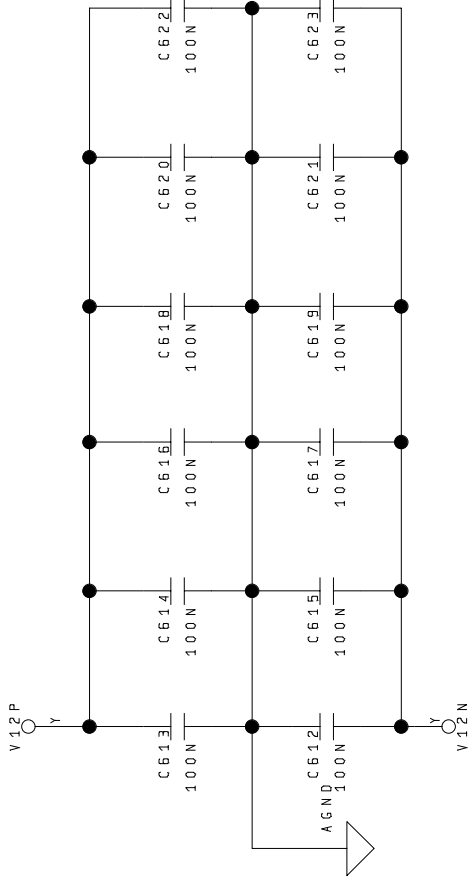
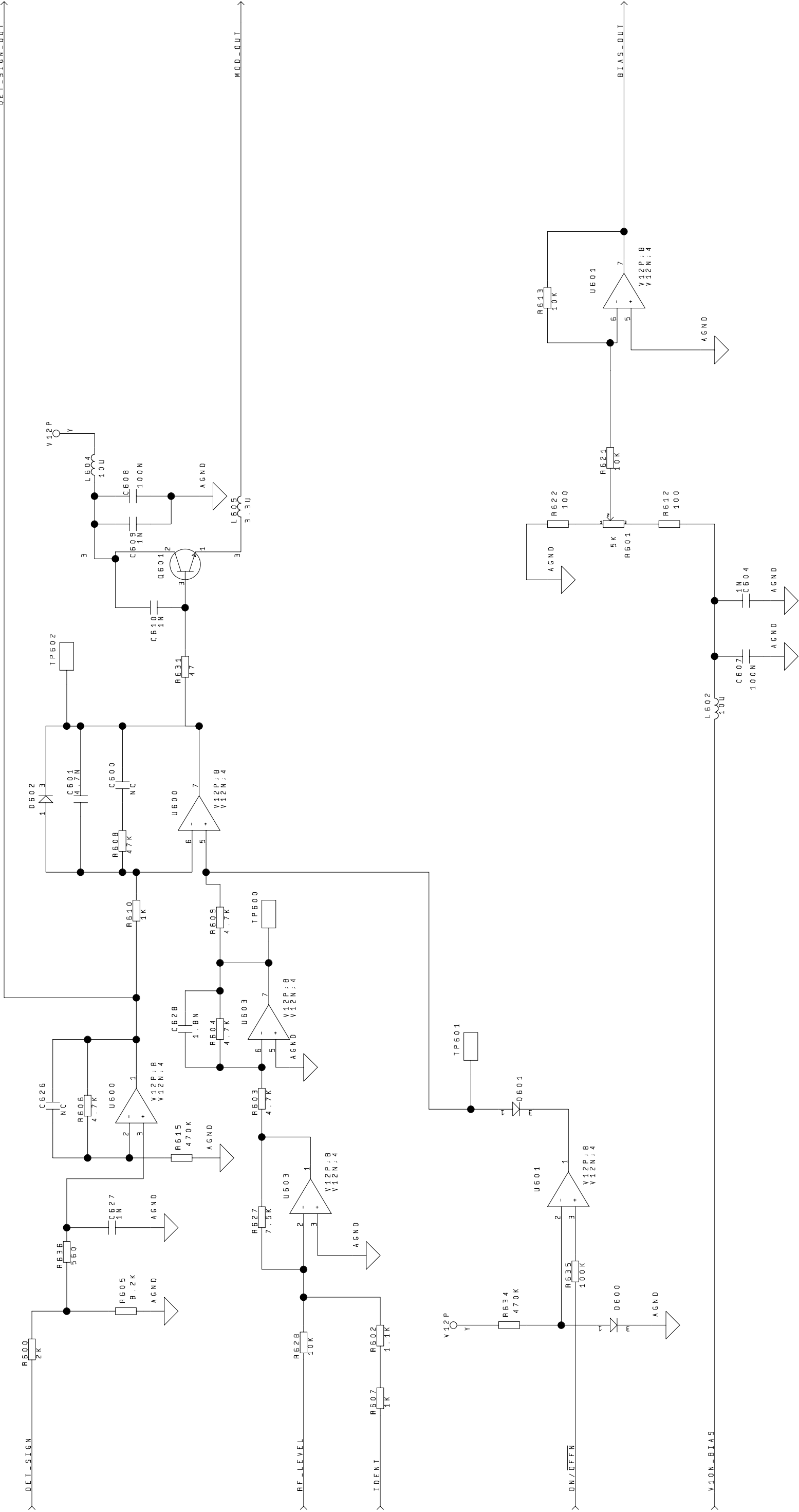


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047E2

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								PROJECT :					



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2989	2	050697	TMA								DWG. NO. :	
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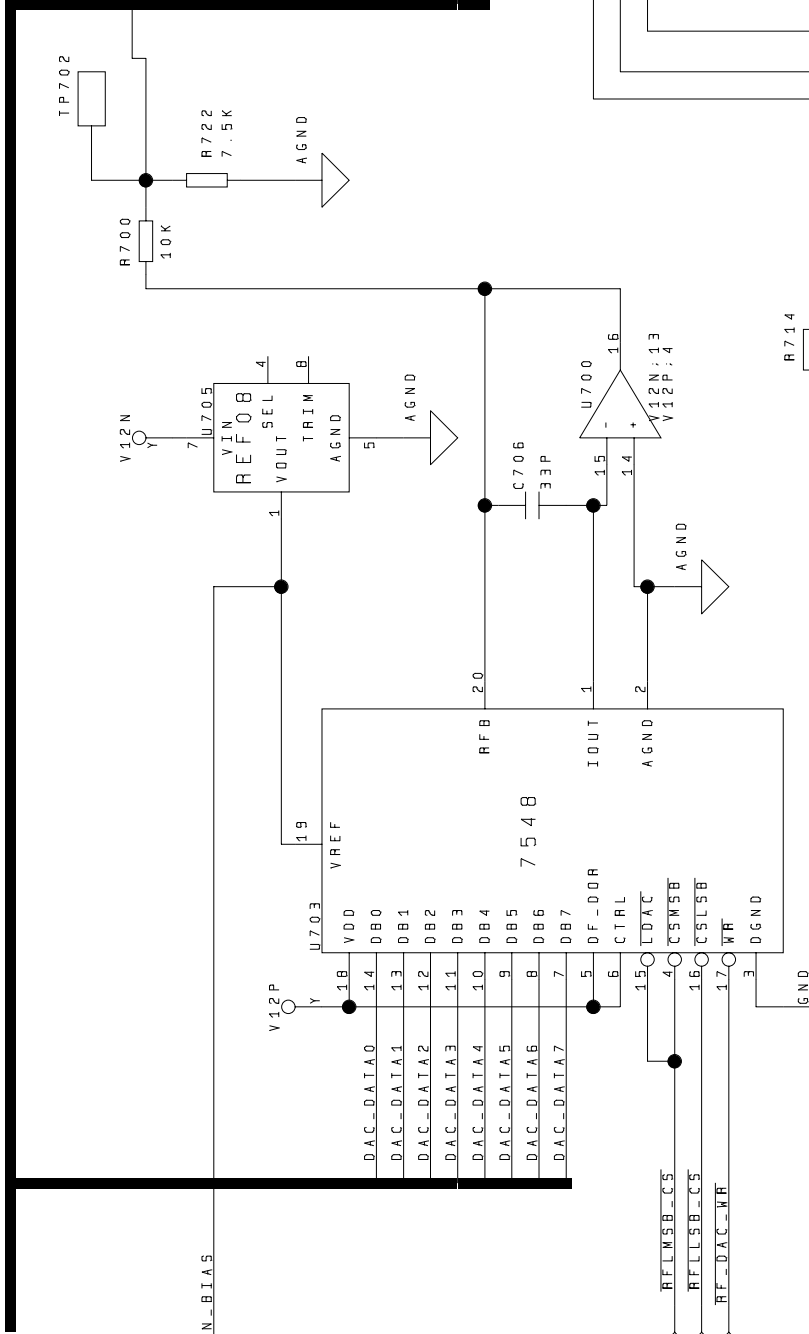


Normarc

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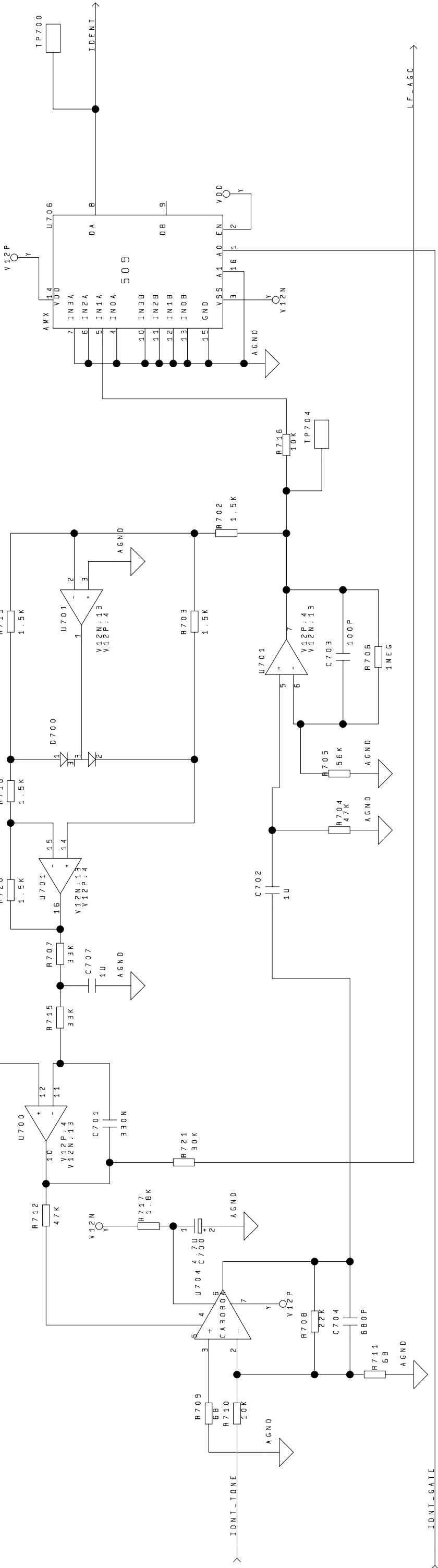
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V10N_BIAS

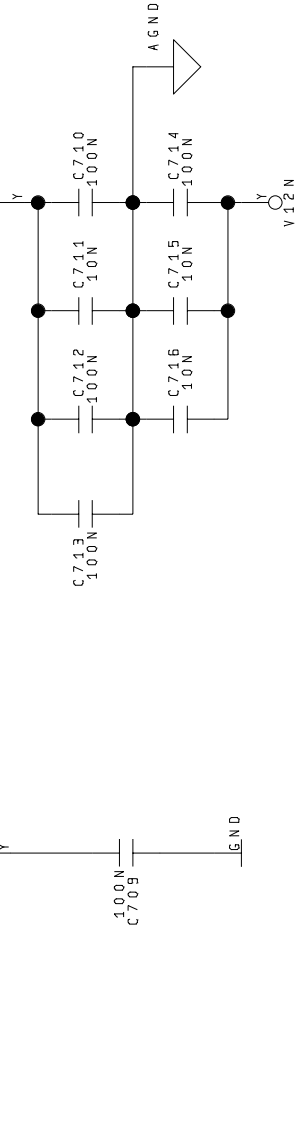


RFLMSB-CS
RFLLSB-CS
RF-DAC-WR

W00MSB-CS
W00LSB-CS
W00-DAC-WR



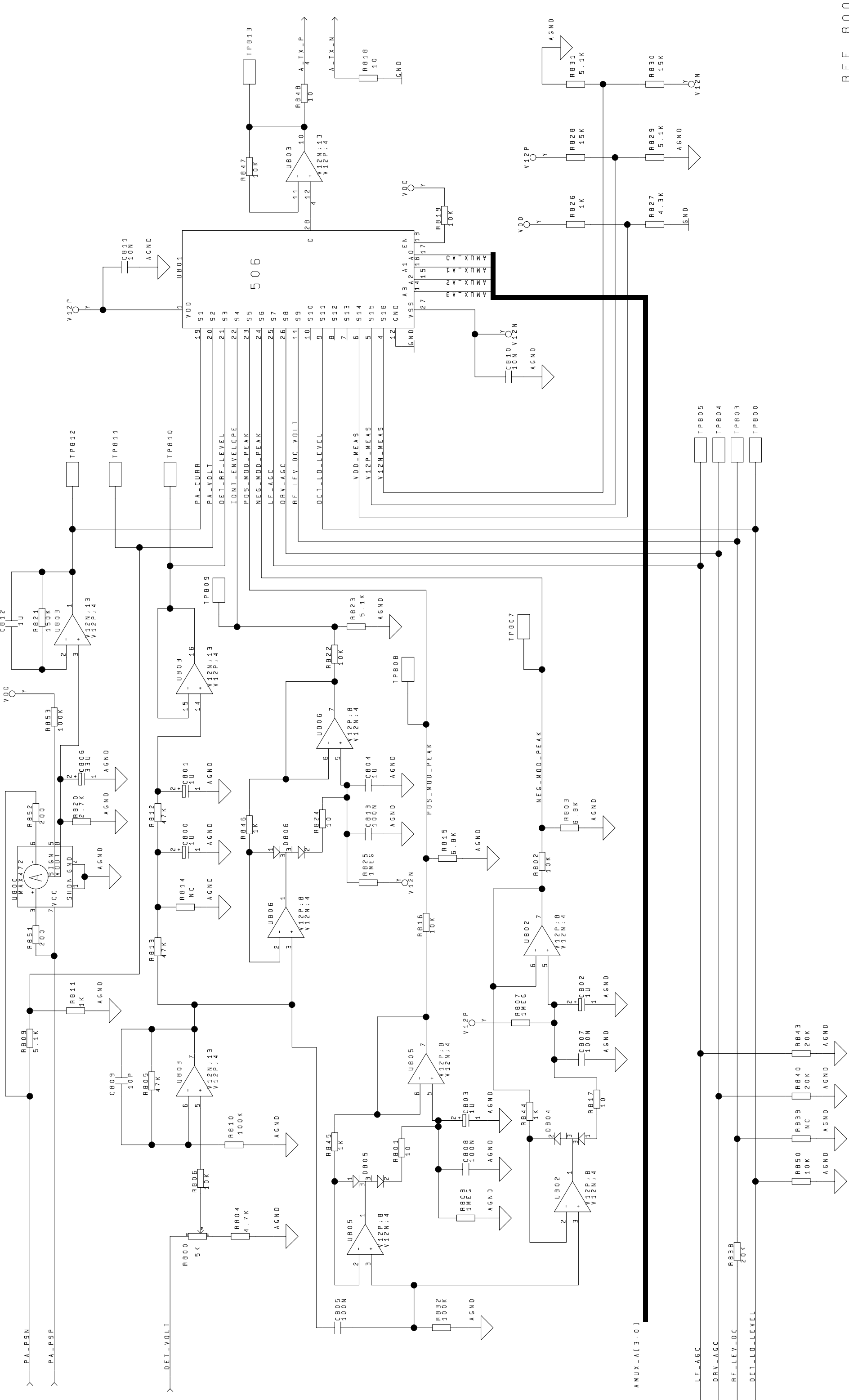
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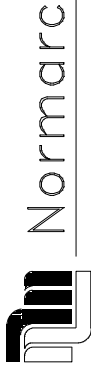


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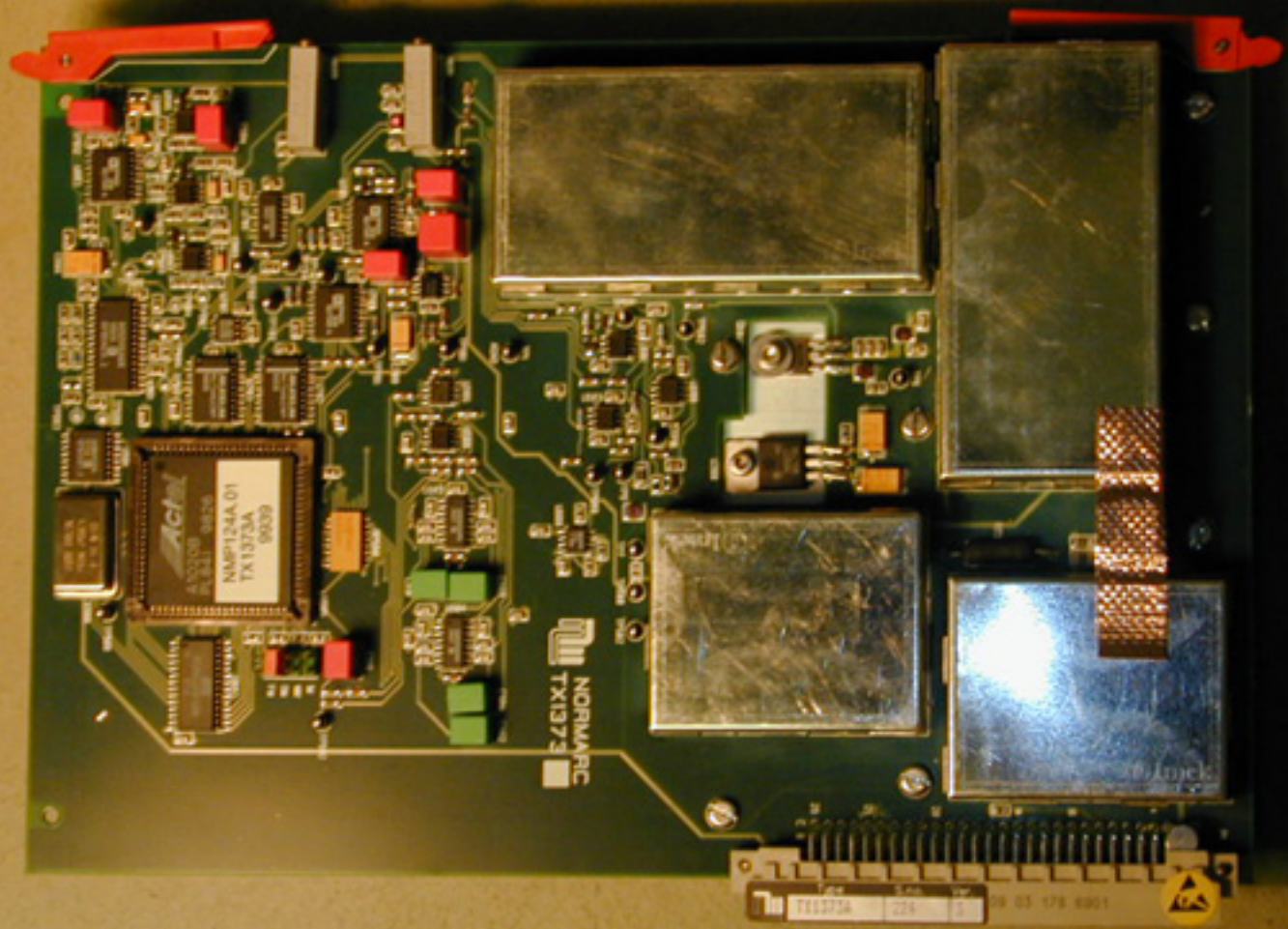
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				PROJECT : PHAROS		



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1.3 *Photos*

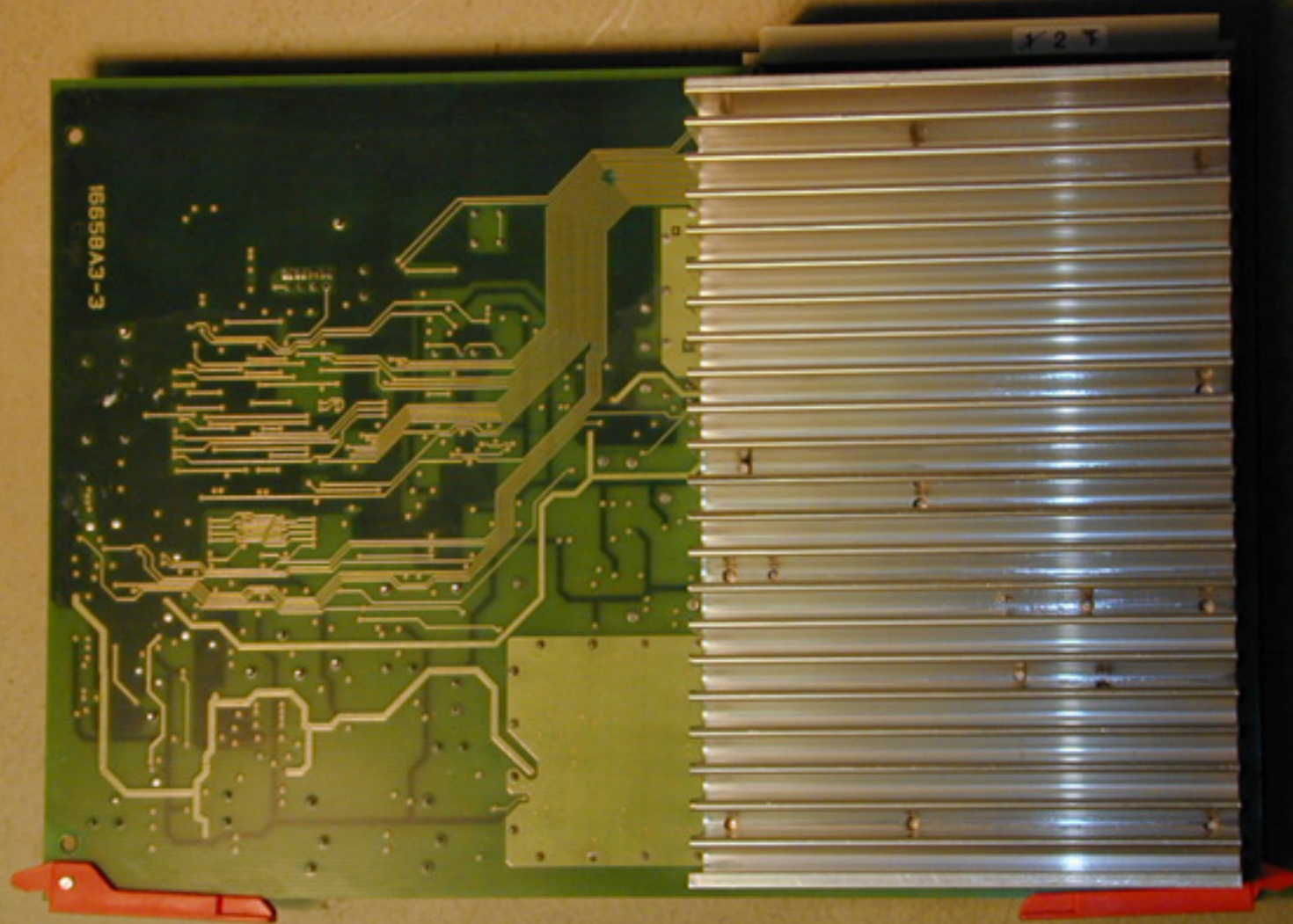


Actel
NMP124A.01
TX1373A
9909

NORAMPC
TX1373

TX1373A 226 3 09 03 178 6001





2 Tests and adjustments

2.1 Preparations

Terminate the RF OUT terminal with a 50Ω load (antenna or dummy). The transmitters are factory adjusted to 2 watt output power. Let both transmitters run for ½ hour at this power to achieve a stable working temperature before any fine tuning is carried out.

2.2 Configuration settings

Follow this procedure to set the configurations in the Marker Beacon according to desired system configuration.

2.2.1 General Configuration

The static control strap on the Connection interface board sets hardware configuration, remote access configuration and shutdown configuration. Figure 2-1 shows where the static control strap is located on CI 1376.

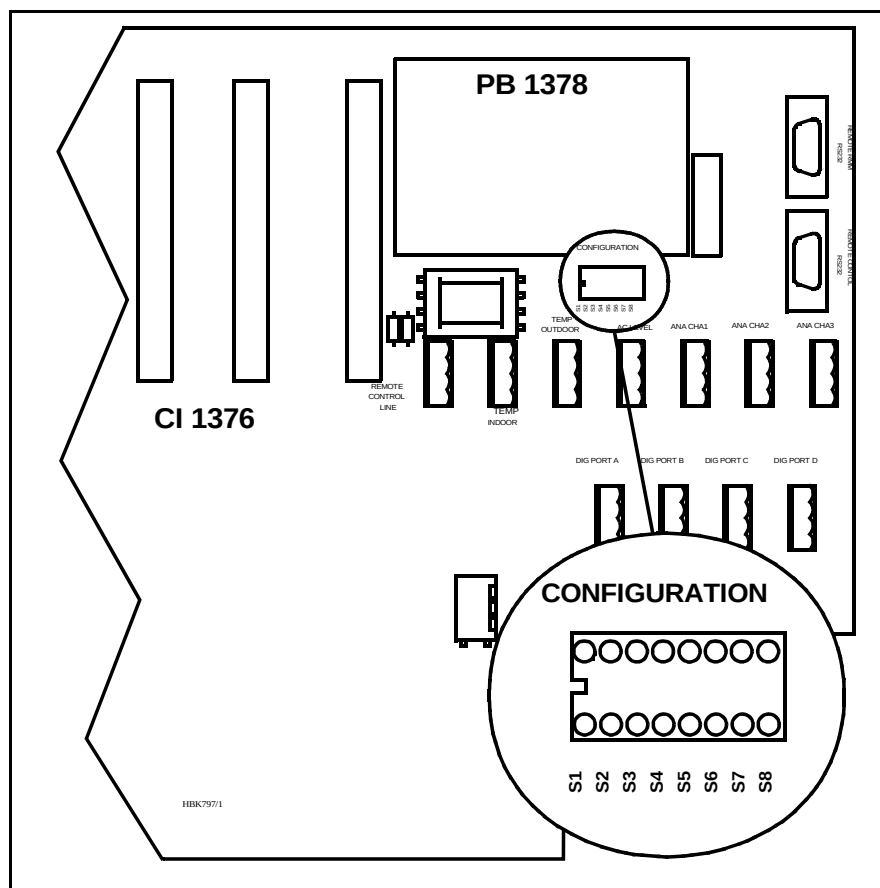


Figure 2-1 Location of Static Control Strap on CI 1376

Set the configuration for the MB according to Table 2-1.

Strap no	State	Function
S1	Strap IN	2 power supplies (NM 7050 B/D)
	Strap OUT	1 power supply (NM 7050 A/C)
S2	Strap IN	Access Grant disabled
	Strap OUT	Access Grant enabled
S3	Strap IN	2 monitor units (NM 7050 C/D)
	Strap OUT	1 monitor unit (NM 7050 A/B)
S4	Strap IN	Lost contact with remote control will NOT cause shutdown
	Strap OUT	Lost contact with remote control will cause shutdown
S5	Strap IN	Standby transmitter failure will NOT cause shutdown
	Strap OUT	Standby transmitter failure will cause shutdown
S6	Strap IN	Access level 2 on RMM remote port enabled
	Strap OUT	Access level 2 on RMM remote port disabled
S7	Strap IN	Access level 3 on RMM remote port enabled
	Strap OUT	Access level 3 on RMM remote port disabled
S8		Should always be left open.

Table 2-1 MB Configuration settings

S1 and S3 will decide the model (NM 7050 A, B, C or D) and show up in the **Link Status** window in the RMM program and the **Initial Window** in the LCD menu. A disagreement between the settings and the actual number of modules will cause a *MAINTENANCE WARNING* on the **Front Panel** and an *ERROR* in the **Maintenance** window.

With S2 = *IN* the ACCESS GRANT switch on the **Remote Control** will have no effect. You may still acquire ACCESS LEVEL 2 and 3 on the **RMM remote port** if the settings of S6 and S7 permits.

S4 decides whether lost communication with the **Remote Control** will cause shutdown (no TX to air) or not.

S5 instructs the transmitter control software whether a failed standby transmitter will be shut down or continue to transmit.

S6 and S7 decide the highest ACCESS LEVEL permitted on the **RMM remote port**. All access levels are available on the RMM local port regardless of S6 and S7.

2.2.2 Setting inner, outer or middle marker

To configure the beacon for outer, middle or inner marker set the straps (S1-S4) on the transmitter board(s) according to Table 2-2.

Strap	Function with strap in
S1	Beacon is INNER marker
S2	Beacon is MIDDLE marker
S3	Beacon is OUTER marker
S4	Beacon is FAN marker

Table 2-2 Marker function configuration

Figure 2-2 shows where the straps are located on the transmitter board(s).

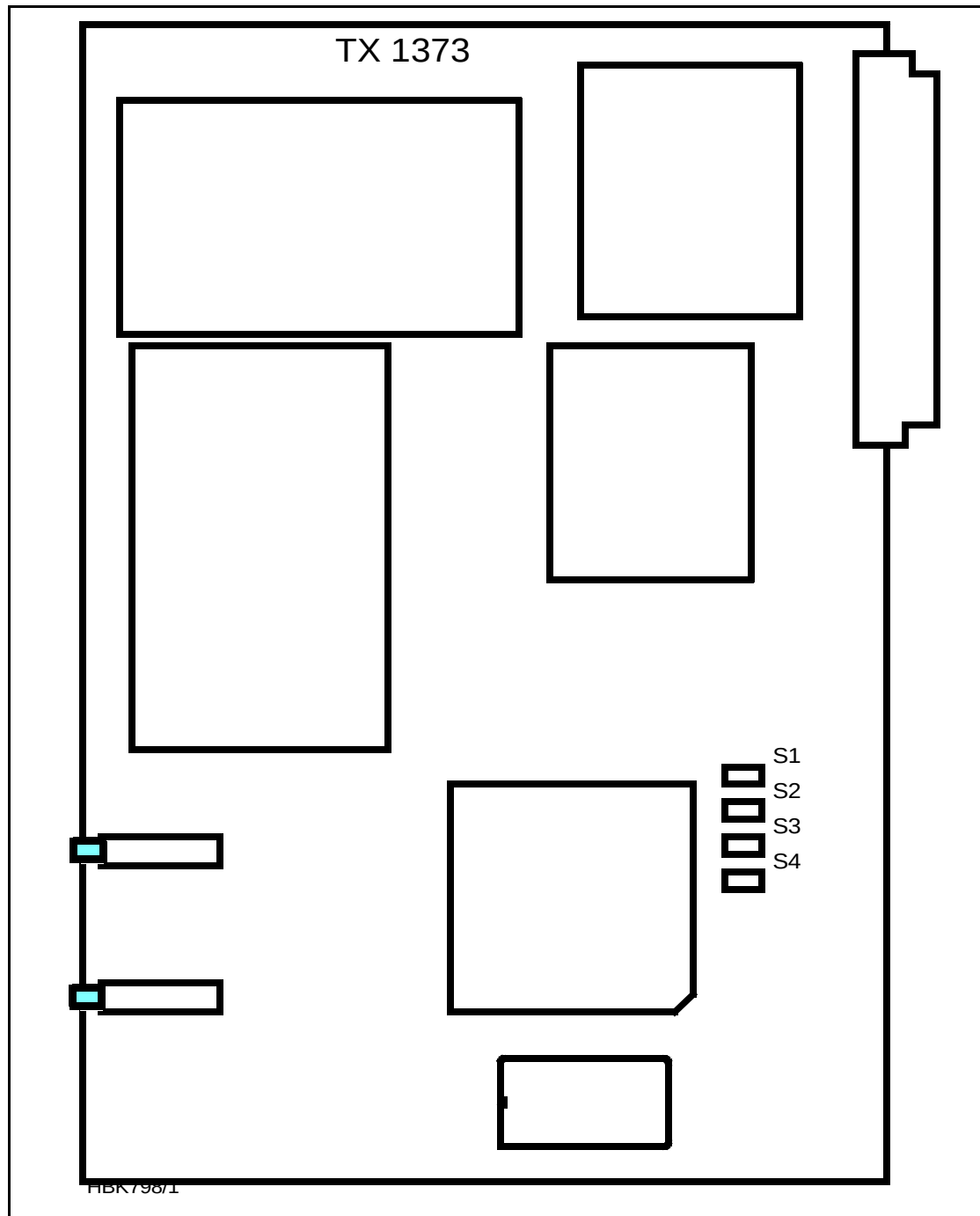


Figure 2-2 Location of Marker Beacon type straps on transmitter board

2.3 Adjustment points

The adjustment points are shown in Figure 2-3 and explained below. The figure shows a fully equipped system, NM 7050D, see chapter 3 for configuration details:

1. Battery charging voltage (nom 27.4V@20°C)
1. Bias for power transistor (use factory settings)
1. Battery protection cut-off voltage (nom. 22V)
1. Tx Detected Rf level (nom. 2.5V@4W carrier)

1. Monitor RF level (nom. 3V@nominal output power)
1. Monitor frontend input filter centre frequency (use factory settings)
2. Real time clock fine tuning(use factory settings)

The adjustment points marked *Use Factory Settings* should not be touched.
The baseband level has to be adjusted at installation.
The other are factory pre-set but may be adjusted.

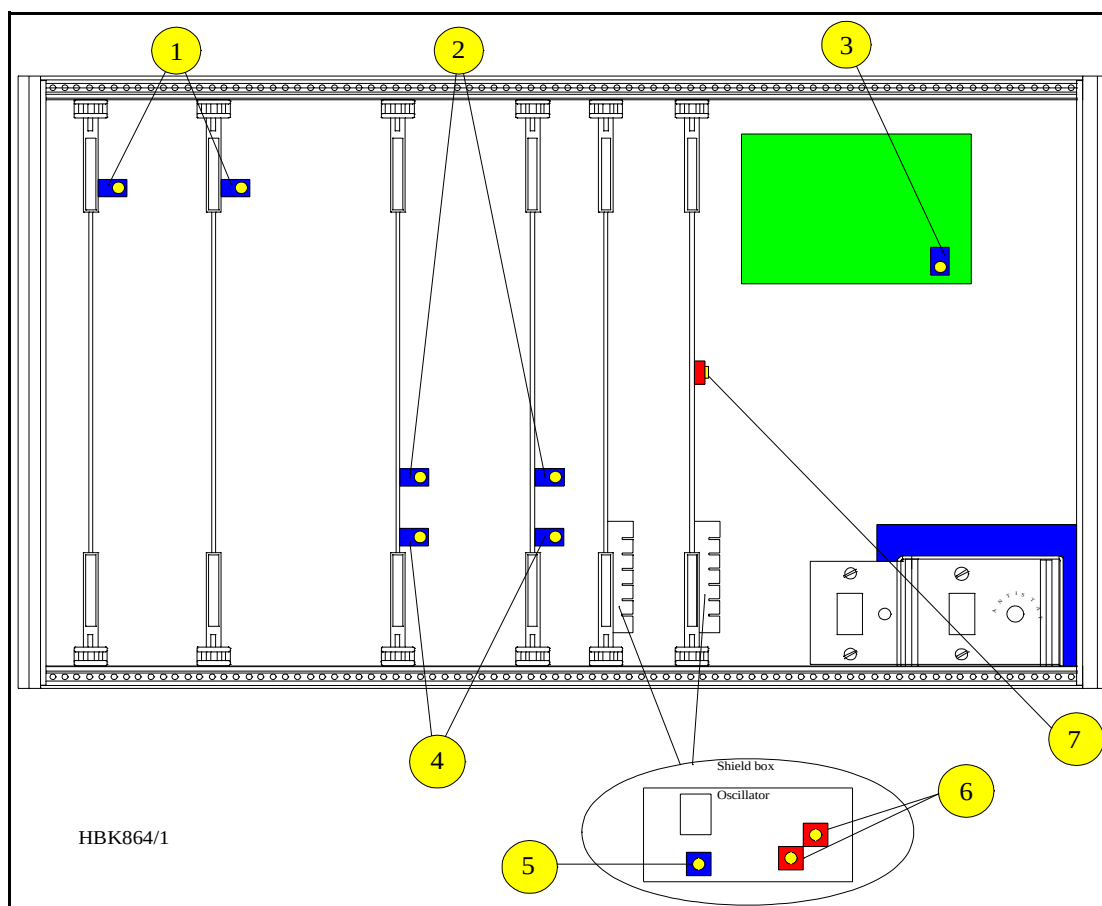


Figure 2-3 Adjustment points

2.4 Adjustments at installation

These procedures have to be carried out at installation in order to set up your equipment right.

2.4.1 Transmitter output power adjustment

This adjustment is most easily done with the RMM PC program but the local keyboard/display may be used.

- Make sure the output signal RF OUT is terminated with a 50Ω load (antenna or dummy load).
- If this is an Inner Marker make sure the external attenuator is installed.
- Start the RMM program on the PC (see chapter 10)
- Open the **TX settings** window, RF LEVEL for TX1 and TX2 are to be adjusted.
- Open the **Maintenance** window. RF LEVEL for TX1 and TX2 are to be watched.

- Set *LOCAL* mode with the REMOTE/LOCAL switch.
- Set *MANUAL* mode with the AUTO/MANUAL switch.
- Set *TX1* to air with the CHANGEOVER button
- Adjust RF LEVEL in **TX settings** until you read the desired output power on RF LEVEL in **Maintenance**.
- Check that you read the desired modulation depth in **Maintenance**.
- Set *TX2* to air and repeat the two previous steps.

2.5 *Other adjustments*

These adjustments are normally not required, the factory settings should be sufficient.

2.5.1 **Output power readout calibration**

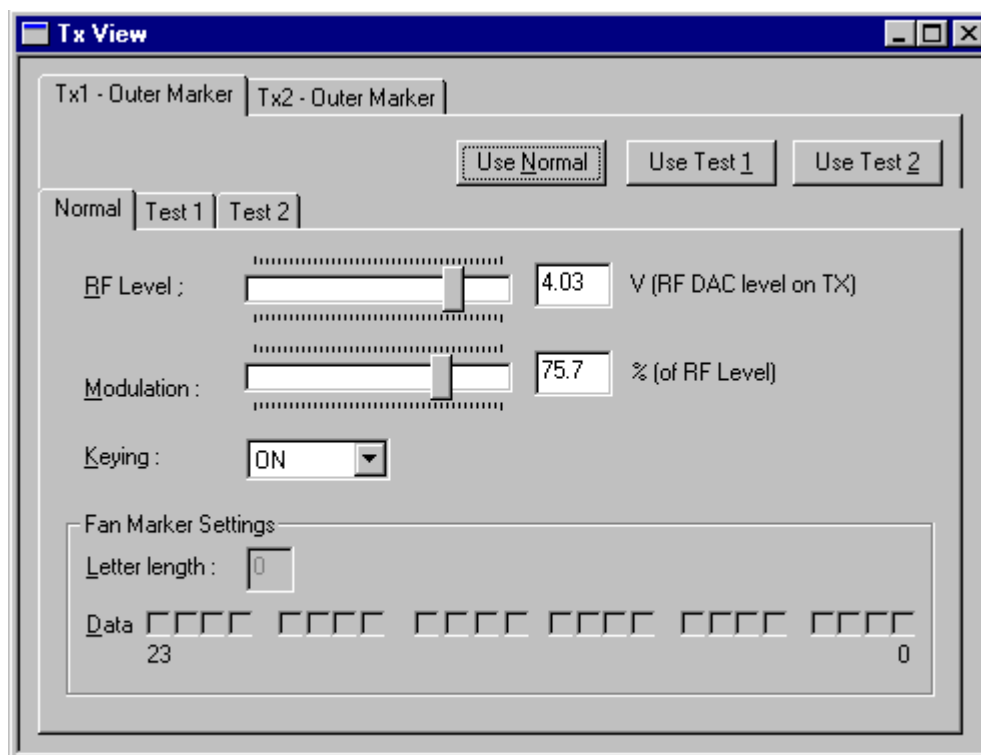
The CARRIER POWER parameter in the RMM **Maintenance** window is the internal wattmeter. It is factory calibrated, but may be recalibrated by following this procedure. The software adjustments are most easily done with the RMM program, but may be carried out from the front panel.

- Connect a reference wattmeter to the output signal RF OUT.
- Set *TX1* to air.
- Watch the maintenance parameter CARRIER POWER
- Adjust the **TX settings** parameter RF LEVEL until the watt meter shows 2W
- Check that the **Maintenance** parameter CARRIER POWER on *TX1* is accurate to within 5%.
- If not, adjust the **Carrier Power** potentiometer on *TX1* until the parameter shows 2.00W
- Repeat for 1W and 0.5W
- Repeat for *TX2*..

Inner Marker uses an external 10 dB attenuator, use 0.2W, 0.1W and 50mW to calibrate. CARRIER POWER is measured prior to the attenuator, but the software will automatically compensate for the 10dB.

2.6 *TX setting through RMM*

This view is used to tune the transmitters RF OUTPUT LEVEL, MODULATION DEPTH and KEYING. There are also two test set-ups which are pre-set values used to provoke alarms in maintenance situations.

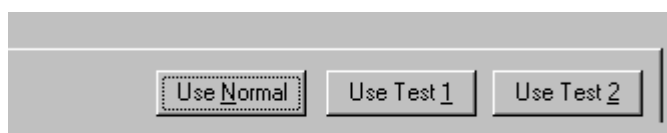


H1030/3

Figure 2-4 The TX settings view

ALTERING VIEWS

- You may select between TX1 and TX2 by clicking the TX1 or TX2 tabs.
- You may select transmitter set-up by clicking the NORMAL, TEST1 or TEST2 tabs.

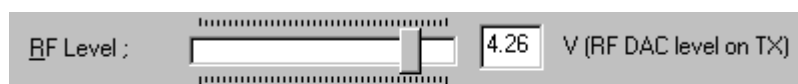


H1031/2

Figure 2-5 Selecting test settings

You may choose between three pre-set transmitter settings by clicking the USE NORMAL, USE TEST 1 or USE TEST 2 buttons.

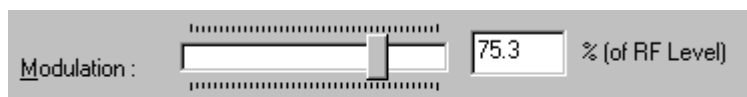
Note that when leaving access level 2/3, the Normal set-up will be loaded into the transmitters. This is also the case when turning the transmitter from off to on.



H1032/2

Figure 2-6 Adjusting the RF level

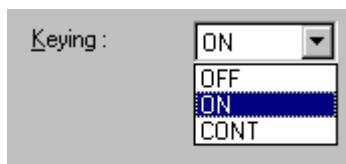
The RF LEVEL (output power) is adjusted by dragging the RF LEVEL knob. The value in volts in the window to the right shows the control voltage to the power amplifier. If you want a power indication in Watts, open the maintenance window and watch the CarrierPower parameter for the selected TX1373.



H1033/2

Figure 2-7 Adjusting the modulation depth

Similar to above, the MODULATION DEPTH is adjusted by dragging the MODULATION knob. The value is given in percent. This percentage is not the same as the modulation depth in the monitor, but the percent of the RF Level DAC that is used to feed the modulation circuitry in the transmitter.



H1034/2

Figure 2-8 Setting keying type

There are three possible keying alternatives: *NORMAL*, *CONTINUOUS* and *OFF*, the two latter used for test or maintenance purposes.

FAN MARKER

If the station is configured as a *FAN MARKER*, the keying may be set quite freely. Each of the 24 Data boxes corresponds to one tick which endures for approximately 150ms. An X indicates sound while an empty box indicates silence. LETTER LENGTH is how many ticks are used in a sequence. The table below shows the expected lengths for keying elements:

Keying element	#ticks
Dot	1
Dash	3
Space	1
Letter space	2

Table 2-3 Fan Marker keying elements

Let's say you want to transmit an X. Then you should program *DASH-SPACE-DOT-SPACE-DOT-SPACE-DASH-LETTER SPACE*. This gives a LETTER LENGTH of $3+1+1+1+1+1+3+2=13$ as shown in Figure 2-9

[illegible]

Figure 2-9 Fan marker keying programming.

Note that the Fan Marker settings are available only when the transmitter are configured as Fan Marker.