

## Model HL-2.5KFX

### Theory of Operation

#### *Product Explanation and About Its Major Circuitry*

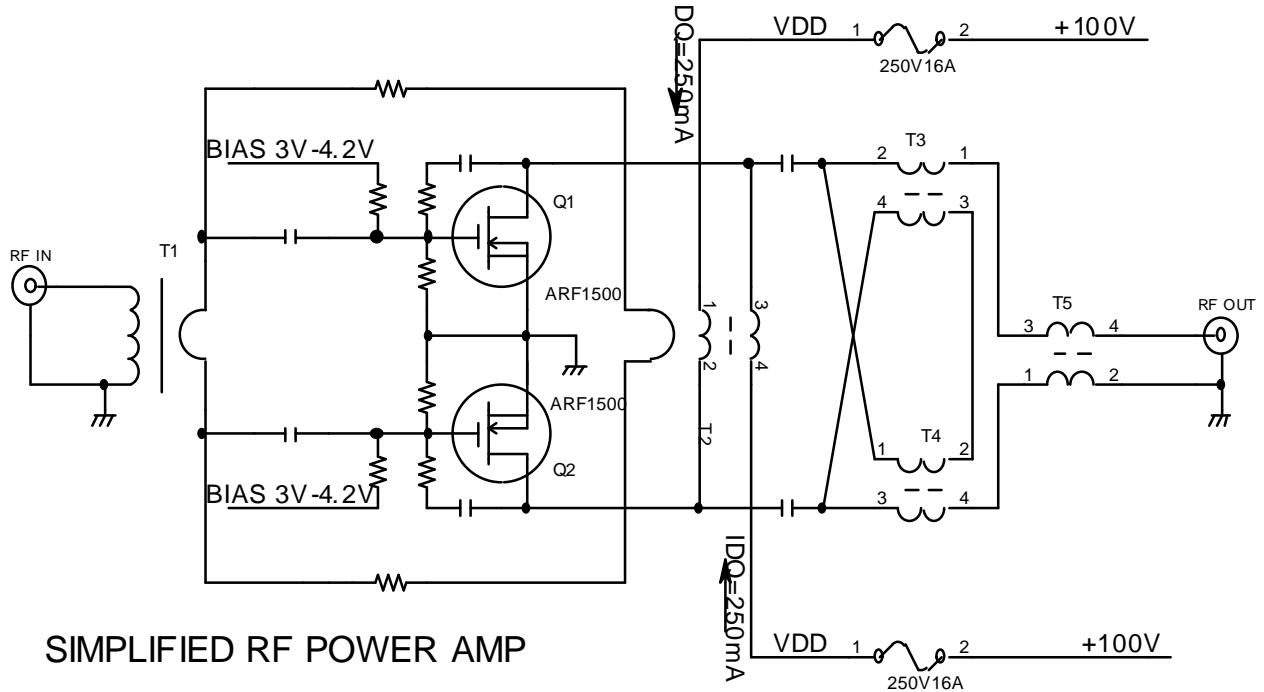
This is a linear power amplifier for the HF band amateur radio station.

It is designed for the use of the senior classes amateur operators, and is capable of delivering 1,500W, when combined with most of modern HF transceivers.

#### 1. Features

- Broad-band power amplification adopting the high power RF MOS FET (ARF1500) originally developed for industrial applications.
- Lightest and most compact design in the industry in its class.
- Quiet operation due to large, high efficiency cooling system together with the continuously speed variable fan.
- Various intelligent protection circuits commanded by 16 bit advanced micro processor.
- Band data collaboration with the modern HF radios of major brands.
- Our own THP-TUNE, interface for the easy cooperation with our auto antenna tuner.
- Intuitive operation touch due to the user-friendly layouts of rotary and see-saw switches as well as LCD panel.
- Proven balanced design with the feed backs from the experienced DX enthusiasts.

## 2. PA



PA consists of a pair of Microsemi ARF1500, in class AB push-pull configuration.

Drain conditions are,

$$VDD = 100V$$

$$IDQ \text{ (when with no drive)} = 250 \text{ mA/each FET}$$

To achieve the gain flatness over the designed frequency range, multiple loops of NFB are applied,

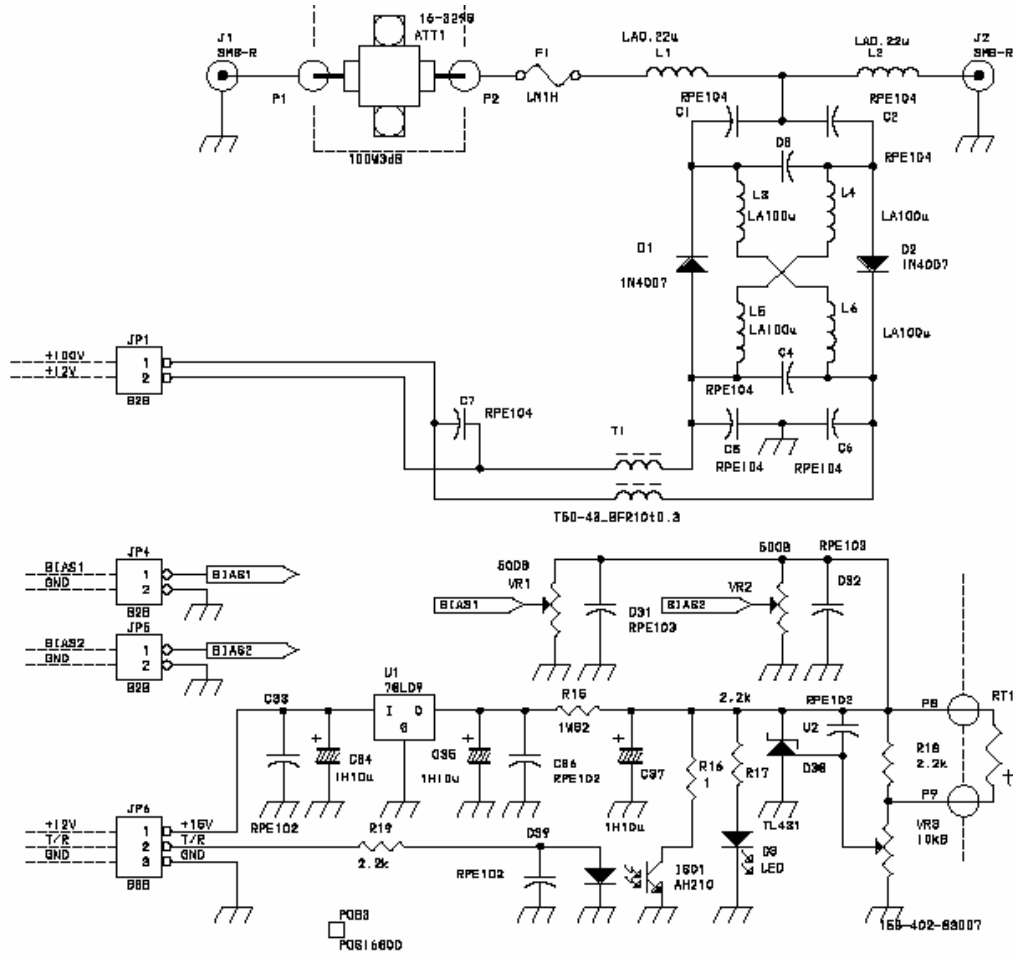
NFB from a coupling coil to T2, DC power feeding transformer.

NFB from Drain to Gate of FET.

Impedance transformation ratio of input transformer, T1 is frequency switched for either 4 to 1, or 5 to 1 of winding ratio.

16A fuse is equipped in each drain current pass so that the whole system is shut down when the sensor detects a blown fuse.

### 3. Input Limiter Circuit/ Bias Circuit

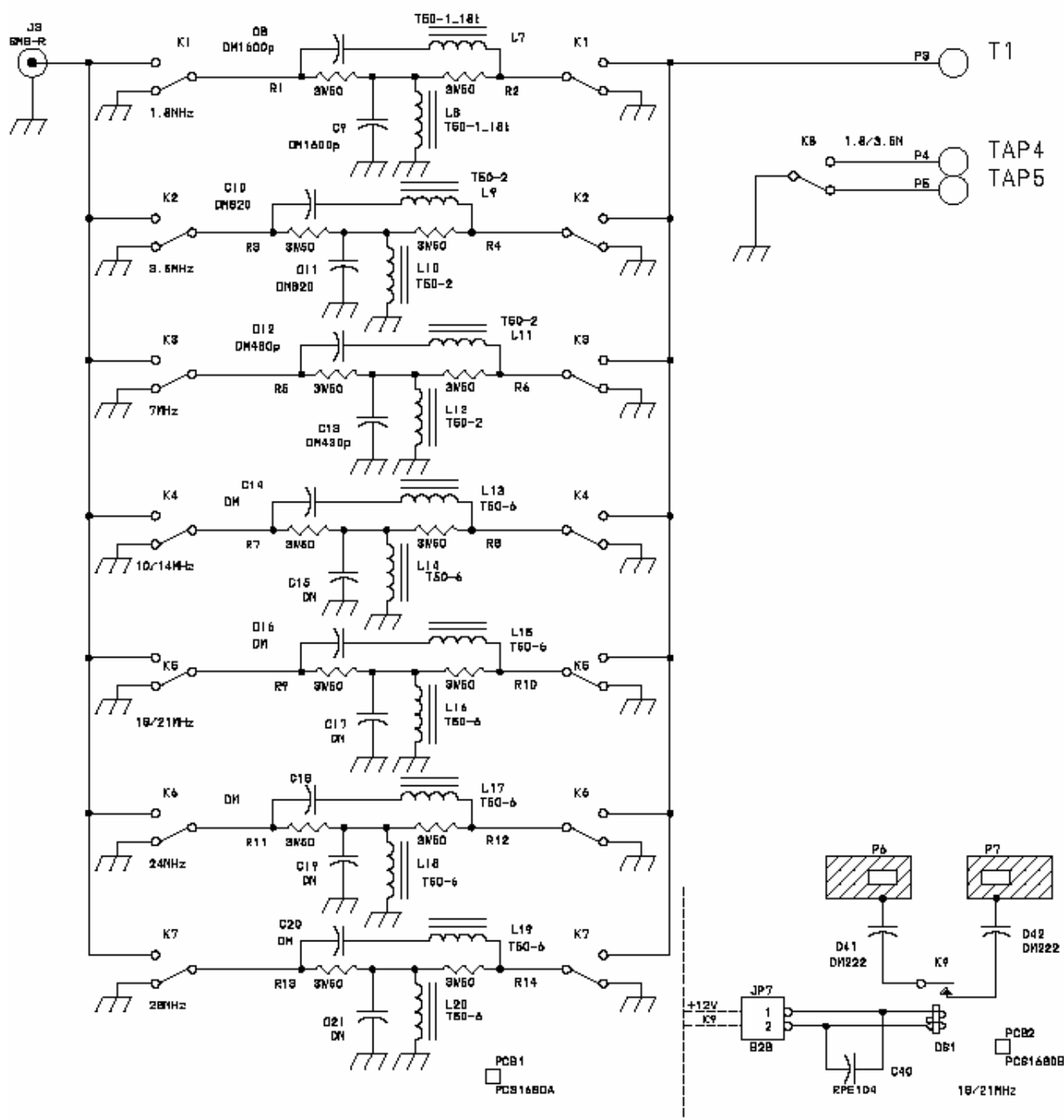


To set the input (drive) power level of the amplifier to be 100W, 3dB power attenuator is built in the input side.

Also, there are RF diode switch (D1, D2) connected in parallel with PA circuit. These diodes make a fast shut down of the RF drive signal, working in combination with the protection system. When this protection circuit works, forward current flows in the diodes making a short circuit across the input terminal of PA and the ground. The attenuator resistor, at this time, becomes a protection resistor towards the driving source (transceiver) and shows input SWR of 2. Fuse F1 has been put in series with the attenuator as an additional protective means for the PA.

Shunt regulator IC, TL431 is used in the bias circuit, that is temperature compensated with a thermistor. Bias output is shut down through a photo-MOS FET for the purpose of fast send-receive switching.

## 4. Input Equalizer

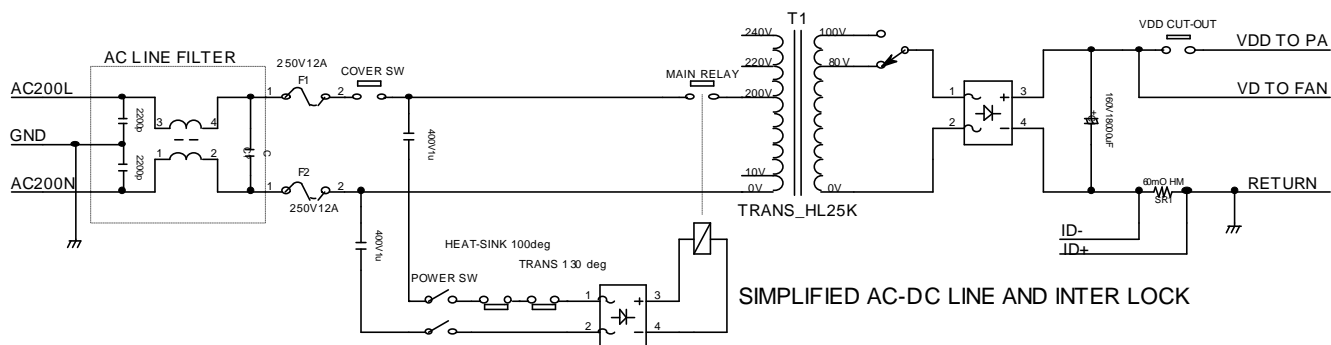


Just in front of the PA, there is an input equalizer.

It contributes to the gain flatness over the designed frequency band width as well as to IMD improvement and prevention of parasitic oscillation.

The equalizer is basically a bridged L/C network.

## 5. Main DC Power Supply and Safety Circuit

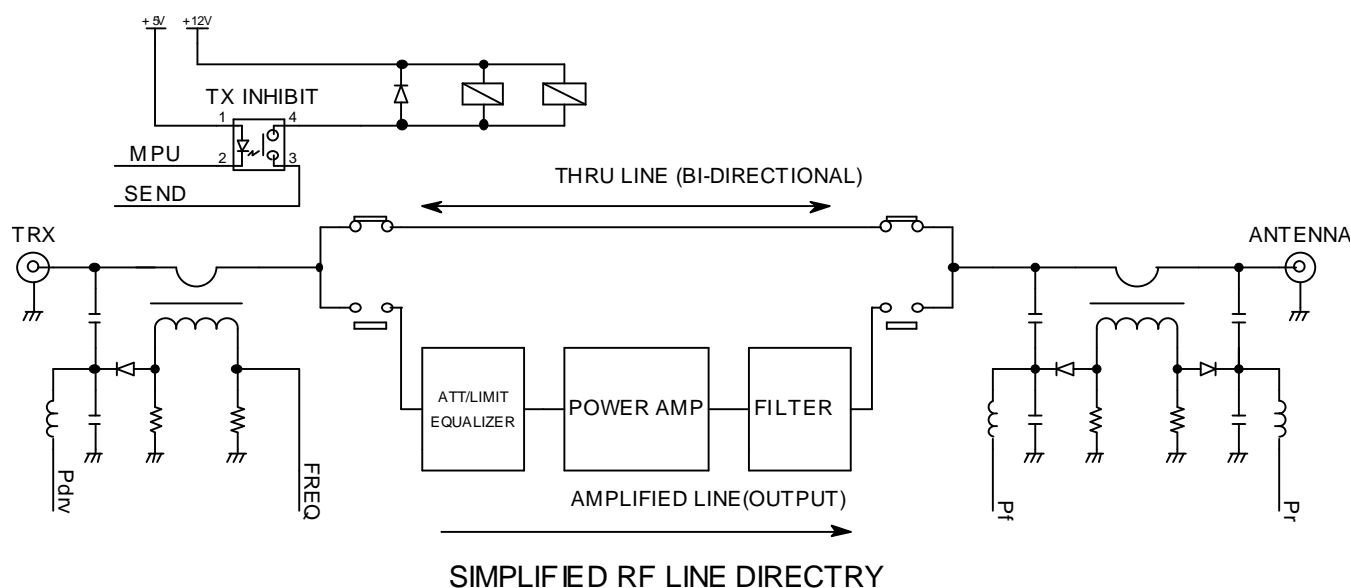


AC mains are indirectly turned on by the Main Relay. In series to this relay, there are connected thermal switches for PA heat sink (100 °C) and power transformer (130 °C) that work independently from other electronic protection circuits. Threshold values are set much higher than other protections, and they do not turn on in the normal operating conditions.

AC line filter has 15 amps of current capacity.

Capacitance against ground is 2,200pF per phase. AC rectification for drain DC voltage is made through diode bridge, and is filtered with 18,000  $\mu$ F of electrolytic capacitor. This power supply system works from AC line voltages of 210V through 250V only.

## 6. Transmitting RF Signal Pass

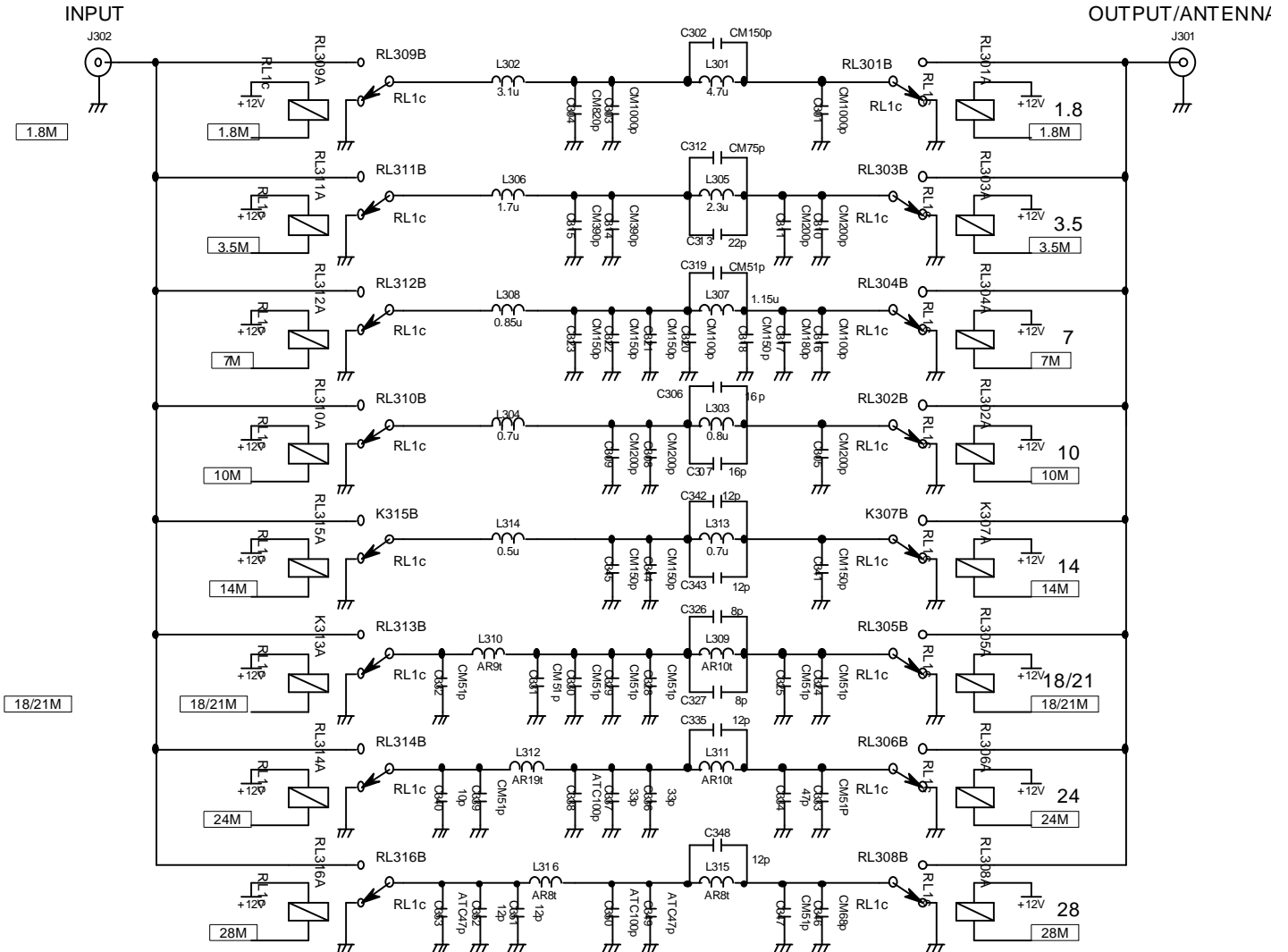


When the amp is keyed, IN/OUT antenna relays are closed and amplified signal will reach ANT terminal. When RX and/or when amp is at STBY, the relays become open to make a thru-line pass between TRX and ANT.

Both at input side and output side of PA, there are RF directional couplers that monitor incoming drive power, outgoing forward power, and reflected power from the load.

To comply with FCC rule (26.0-28.0 MHz inhibited), incoming RF signal is sampled by RF power detector, and is transferred to the frequency detector system comprised of MPU.

## 7. Output L.P.F.

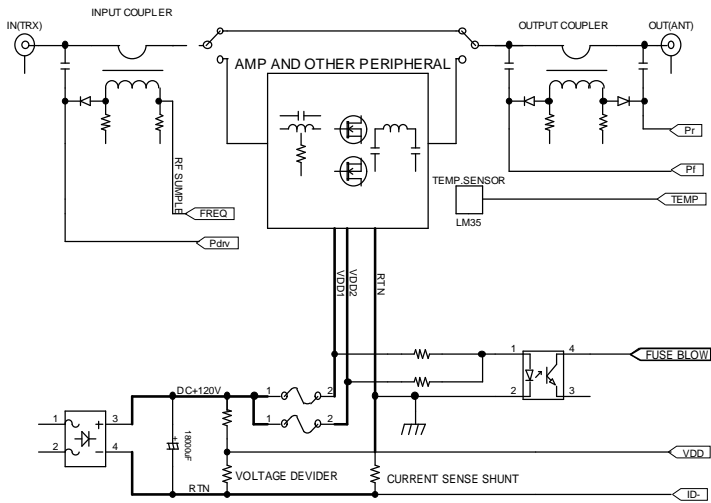


The filter section consists of eight(8) band-division low pass filters to be selected by IN/OUT relays of the respective bands.

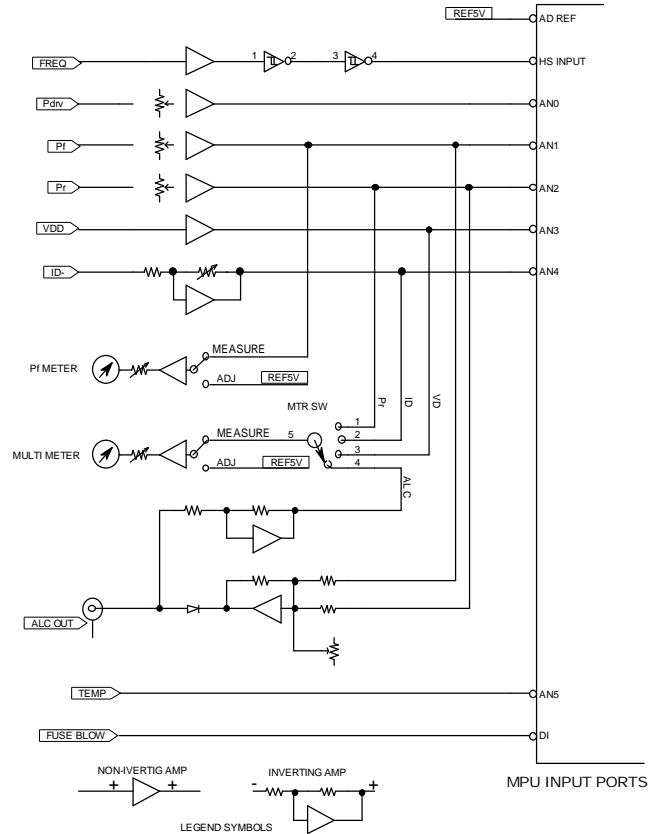
Basic circuit is a two stage type low pass filter.

## 8. Metering, Analog Management and Protection

SIMPLIFIED MESURING SENSOR CURCUITRY



SIMPLIFIED METERING AND PROTECTION CIRCUITRY



All the analog sensors of HL-2.5KFX are scaled to be 0 to 5V range and are numerically controlled by ten bit AD converter of MPU (PIC16F472).

Panel meter scales are calibrated to the same reference voltage (5V) of AD converter so that the meter match the numerical status of MPU.

Also the protection functions are executed through the numerical data comparisons inside of MPU,.

Sampling intervals are approximately 20mS.

Detailed explanation of the protections are covered in the instruction manual.