

TELSON INFORMATION & COMMUNICATION CO., LTD.

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THEORY OF OPERATION

(MODEL : PAM1021)

I . FREQUENCY GENERATION

The frequency generation circuit is composed of the synthesizer IC U201 and the VCO. The block diagram illustrates the interconnect and support circuitry used in the design. Refer to the schematic for reference designator.

The supply for the synthesizer is regulated 4.0 volts which also serves the rest of the radio. In addition to the VCO, The synthesizer must interface with the logic and AF filter circuitry. Programming for the synthesizer is accomplished through the clock, data and strobe signals (pin 52, 46 and 57) from the microprocessor IC701.

A serial data is sent whenever the synthesizer is programmed. While unlock is indicated by a low voltage on this pin. The audio signal from the AF filter is modulated by D301 of VCO.

PLL FREQUENCY SYNTHESIZER

The U201(PLL IC) includes all the functions such as the phase comparator, the programmable divider, the lock detector, and reference oscillator.

The synthesizer uses a 21.25 MHz crystal (X301) to provide the reference frequency for the system.

The loop filter, composed of R317, R316, R315, C324, C323, C322, C321 provides the necessary DC steering voltage for the VCO as well as filtering of spurious signals from the phase detector. The pre-scaler for the PLL is internal to U201 with the value determined by the frequency band of operation.

The 21.25 MHz crystal (X301) is the temperature compensation circuit to maintain the frequency within the allowable error range even on -20 °C.

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VCO

The VCO, in conjunction with the synthesizer (IC U201), oscillates 467.5125 MHz to 467.675 MHz in the transmit mode and 446.1125 MHz to 446.275 MHz in the receive mode. The VCO consists of the colpitts oscillator of the Q302. A sample of the RF signal from the enabled oscillator is routed from Q303, C301, through to the pre-scaler input (IC U201 pin 16). After frequency comparison in the synthesizer, a resultant control voltage is received at the VCO. This voltage is a DC voltage between 1.0 and 4.5 volts when the PLL is locked on frequency.

In the receive mode, the RF signal through Q303 is the local oscillator RF injection and it is applied to the first mixer at Q103.

In the transmit mode, the RF signal at Q303 is run to the input of the pre-drive transistor (Q204 base). This RF signal is the Tx RF injection. Also in transmit mode, The audio signal to be frequency modulated onto the carrier is received by the transmit VCO modulation circuitry at audio in.

During reception, a relative low frequency should be oscillate compared to transmission. Therefore, the D301 is adversely biased by the Q305, and as a result, the C313 which is added in serial to the resonance circuit of the VCO is removed to oscillate the desired reception frequency.

II. RECEIVER

The receiver of the UHF consists of 4 major blocks each: the Front-end, the Mixer, the First IF and the second IF/Demodulator IC.

FRONT - END

The UHF Front-end contains two separate circuits ; the RF Amplifier and SAW Filter. The RF Amplifier, consist of two transistor Q101 and Q102 is the cascade in all-bipolar form which is also referred to as common emitter-common base (CE-CB) connection. This Amplifier has approximately 20dB gain owing to high output impedance , a noise figure of approximately 3dB and is supplied by the receive 4.0V line.

The SAW Filter is BPF of high stability and reliability with good performance and is fixed-tuned design to eliminate the need for tuning and to provide narrow-band operation. The 3dB bandwidth is approximately 6MHz, centered on 465MHz with an insertion loss of approximately 4dB.

The net-gain from the Front-end selection is approximately 20dB in the center of the band, falling to approximately 4dB at band edges, with a center band noise figure of approximately 5.5dB.

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MIXER

The Mixer operates with a local oscillator drive level minimum -4dBm. The mixer provides excellent isolation between the ports and operates over a large bandwidth. The received signal is mixed down to 21.7MHz, the frequency of the first IF.

FIRST IF

The first IF consists of a 21.7MHz crystal filter and amplifier. The crystal filter provides second image protection and intermodulation protection with approximately 3.75kHz bandwidth(3dB) for 12.5kHz models. The IF Amplifier, Q104, provides approximately 10dB of gain at 21.7MHz.

SECOND IF/DEMODULATOR IC

The Second IF/Demodulator IC(DBL5018-V; U301) accepts the 21.7MHz IF input and mixes it with a second local oscillator signal(21.25MHz). This produces a second IF of 450kHz, which is filtered externally by a ceramic filter and passed back into the IC for amplification.

The signal is passed to a quadrature detector for demodulation and, after being filtered, is passed to the output. The IC, along with some external components, controls the squelch sensitivity, squelch tail, and hysteresis. Internal variable resistor, VR101, controls the noise squelch setting.

III. TRANSMITTER

The PAM1021 transceiver is composed of five basic circuits : a Pre-Driver, Driver, Final Amplifier, Antenna Switch and a Harmonic Filter. Refer to the block diagram and the schematic for more information.

POWER AMPLIFIER

The Power Amplifier consists of three stages : a Pre-Driver, Driver, Power Amplifier. It requires a supply voltage of 6.0 volts, and is capable of supplying maximum 0.5W(ERP).

ANTENNA SWITCH

The antenna switch circuit consists of two pin diodes (D201 and D202). In the transmit mode, Tx B+ is applied to the circuit to bias the diodes "on". The shunt diode (D202) shorts out the receiver port and the PI network, which operates as a quarter wave transmission line and transforms the low impedance of the shunt diode to a high

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impedance at the input of the harmonic filter.

In the receive mode, The diodes are both off, hence, there exists a low attenuation path between the antenna and receiver ports.

HARMONIC FILTER

The harmonic filter consists of part of L201, L202, C201, C202, and C203. The design of the harmonic filter is 5th order chevyshev filter with 0.5dB ripple. This type filter has the advantage that it can give greater attenuation in the stop-band for a given ripple level.

IV. AUDIO PATHS

RX AUDIO PATH

After de-emphasis and volume adjustment VR, it is fed to the Audio Power Amplifier, ICU901. This is a Bridged-tied Load amplifier with a fixed gain of 40dB, developing 300mW output at less than 5% harmonic distortion into the 4 Ω internal loudspeaker with nominal 6V battery and supply. Maximum audio power output is greater than 1W.

LIST OF TEST EQUIPMENT

| ITEMS | TEST EQUIPMENT | MANUFACTURER | SERIAL NO. | REMARKS |
|------------------------|----------------|-----------------|------------|---------|
| SIGNAL GENERATOR | HP 8664A | HEWLETT PACKARD | 3546A01073 | |
| SPECTRUM ANALYZER | HP 8568B | HEWLETT PACKARD | 3340A21567 | |
| | HP 8561E | HEWLETT PACKARD | 3650A01804 | |
| COMMUNICATION TEST SET | HP 8920A | HEWLETT PACKARD | 3141A00525 | |
| FREQUENCY COUNTER | HP 53181A | HEWLETT PACKARD | 3418A00199 | |