KP Electronic Systems, Ltd.

MT150WP

WIRELESS VHF WAT-NET™ TRANSMITTER

Theory of operation & tuning procedures

File:
Revision Details

Rev.	Date	Description	Reason of change	Affect Paragraph/ Documents	Initiator
1.0	2.08.2004	Initial release			V.Dashinsky

Name	Title	Date	Signature

Revision History

Rev.	Date	Description	Reason of change	Affect Paragraph/ Documents	Initiator

MT150WP
Circuit description

MT150WP is a long-range synthesized radio alarm transmitter that is operated in VHF 136-174 MHz frequency band, and is intended for the operation into WAT-NET™ network. The MT150WP detects pulse on its inputs from water meters measuring devices and transmit it by one or four messages to WAT-NET™ monitoring center.

When the number of the pulse is equal to the "Trans Scale" defined by the GUP10 utilities program or, else take place signal from internal timer or test button, the MT150WP also transmit data to monitoring central station. The MT150WP transmit data according to the WAT-NET™ data communications protocol.

MT150WP consists of a single electronic board mounting inside a plastic housing. The metal plate is used for the MT150WP board and a plastic housing fastening.

The MT150WP board contains three major parts;
-   Synthesized RF, FM transmitter
-   Digital encoder, based on Intel 87C52 micro controller.
-   Analog voltage control block
-   Power supply and power switches.

Theory of operation
(Refer to the Circuit Diagram)

The pulse from water meters measuring devices is follow through J11 input connector, passing trough U9 MC14017B decade counter and turn "ON" Q204 switch .The R120, C99 RC section is discharged to ground and Q19 switch pass VBAT voltage to VT+ track. The VT+ voltage activates U6, U7 and U4 power supplies.

VCC voltage powering the U1 micro-controller. The micro-controller is initialize Tx mode and encodes the input data in FSK tones for the transmitter.

When a transmission is initiated, a repetitive word block is prepared by the micro - controller for transmission.

When PTT1 line is pulsed too low, the micro-controller sends the programmed frequency to the synthesizer and allows it to build up the carrier frequency. Subsequently the PTT2 line is also pulled too low and the amplifier link raises the RF signal from synthesizer to a power of minimum 2 watt.

The Tx data is then activated and allow for the audio data to modulate RF signal.

The micro-controller checks automatically the battery voltage before and during each transmission. If the battery voltage is lower than 10.5volts, a low battery message is transmitted   and, if is lower than 8.5 volts, transmission is stopped.

MT 150WP has a self–test button, allowing the user, to test the proper operation of all circuits. As soon as it is pressed, the self-test LED 2 flashes:
-   Once   System OK
-   Three times Battery fault (voltage lower than 8.5volts)
-   Four times Unlock frequency
-   Six times Low battery (voltage lower than 10.5volts)

When the Q19 gate voltage will rise up to pinch-off voltage, the Q19 transistor switching off the transmitter circuits, micro-controller and in this case the sleep mode take place.
The U11 timer is intend for the periodic timer diagnostic mode.

RF Transmitter

The transmit frequency is built around Fujitsu PLL MMB1501 chip U3.It uses 12.8MHz for reference frequency oscillator and 6.25KHz for step frequency.
The loop filter is a low pass filter that attenuates noise and rejects the loop reference frequency. The loop filter consists of R33, R26, R38 and C17, C18, C19 passive elements. The voltage across C19 is the steering line voltage, which controls the VCO frequency.
VCO consists of a BJT oscillator Q2 whose frequency is determined by D2 and L1.
As the steering line varies over the range of 0.5V to 4.5V DC, the capacitance of the varactor D2 decreases as voltage is raised, causing the oscillator frequency to increase.

Transistor Q5 is the buffer amplifier and raises the RF output of the VCO to the level required by the RF power amplifier.
The 2 watts VHF power amplifier cover the range of 136-174MHz. It consists of three stages. The firs stage, Q6 is Class "A" and has a gain of 15db and delivers 100mw of output power. The second stage, Q8, is operated in Class "A" and has 9db of gain. Its output level is 0.8 watt.
The three stages, Q4 a Class "C" RF final power amplifier .It can output 2 watts.
The harmonic filter is an Elliptic low-pass filter with a 3db frequency of approximately 200MHz, and less than 1db insertion loss in the pass-band.
The PTT1 switch consists of Q9, supplying the synthesizer and VCO 5volts DC.
 The PTT2 switch supplies the amplifier bias of 5 volts DC also supplies output power amplifier VBT voltage.

Digital Encoder

The digital encoder is based an Intel 87C52 micro-controller.
It scans its inputs P0.4…. P0.7 The battery voltage check is made trough P1.6.

The micro-controller switches the transmitter on using PTT1 through P2.2, PTT2 through P2.3.

The micro-controller encodes the data to FSK audio tones through port P1.2, which passing through buffer-amplifier Q3 and injected to PLL modulation input through C25, R40 passive RC network and modulated output RF signal.

The micro-controller programs the PLL U3 IC trough P3.4, P3.5; P3.6.The E2prom U2 is used for storing communications parameters and input data.

Tuning Procedure

Alignment of the mt150WP transmitter is carried out in the following order:
- Connect Power meter to J5 antenna connector.
- Connect a Power Supply of 12.5 volt DC to the J3 power connector.
- Programming the MT150WP is carried out with a connection to a PC through an adapter RSINT001 to J9 on board connector and running KP's GUP10 utility program. In this way, the following communication parameters can be modified: Number of words in a burst, data repetition, test repetition, transmitter count scale, frequency (MHz) and installer code. When the General MAIN screen is displayed, click PROMT to connect the MT150WP .The specific MAIN program screen is displayed.
Click READ to display the factory set MT150WP parameters matching the selected protocol.
Change the parameters according to your requirements. Click SEND to set the new parameters. Disconnect the MY150WP from PC.
Press the self-test button and observe LED2 according to the Circuit Description.
- Ensure the MT150WP power output is a minimum of 2 watt.
- Connect a Frequency counter through min 30db attenuation to the antenna connector. Check and adjust TRIMMER c12 (PS side) to the specified frequency.
- Connect a Deviation meter, in the same condition as the frequency meter, and check
 the modulation for the specified channel spacing (6.25KHz)
- Connect a Spectrum Analyzer and check the level of frequencies for the minimum specified.