Theory of Operation and Technical Description of DPT-450

General

The DPT-450 is a UHF transmitter intended for use in one-way digital paging. Refer to the schematics 5A270 pages 1 and 2 along with the attached block diagram.

This device is an FM only transmitter, designed to transmit digital data. The data rate may be up to 3500BPs and the modulation deviation set up to ±4.5KHz.

The frequency range is 450-470MHz. It is designed to put out 3 watts of RF power, but internal non-user accessible control allows adjustment down to .5 watts. The unit is marketed as a 2 watt continuous duty cycle transmitter.

User I/O

DC power is applied to JP1. U3 regulates it to 5V, U4 provides a regulated 8V and U2 provides a clean regualted 5V to the VCO.

Input from the paging terminal is via JP2. Pin 4 is the keyline and transmit data is on pin 5.

The transmitter is keyed by activating the signal on pin 4. When the CPU (U6) sees that it is active, it turns on Q12 which turns on Q11, which provides DC to the RF amplifier stages of the transmitter.

U7 has a built-in watchdog timer, that monitor CPU operation. If the CPU fails, U7 resets the CPU, automatically turning off the transmitter.

Modulation Signal Filtering

The data to transmit enters via pin 3 of JP2. It is limited to 0V and 5V by U9A&B. The output of this limiter is filtered by a ten-pole active filter made up of U10 and associated components. It has a 3dB cut-off of 2800Hz, and a typical rise-time response of 145uS. It is intended to optimally filter 2400 baud POCSAG data.

The output from U10 is applied to the VCO to FM modulate it. The level(gain) is set by R70. The modulation is also buffered by U11 and U10A, and applied to the TCXO, thus enabling modulation down to DC.

CPU Control

The CPU, U6 program's the units PLL chip (U1). The frequency is stored in EEPROM (U7). The EPROM is programmed via commands from an external RS-232 port (P1). The

polarity of the keyline and the polarity of the transmit data are also configured via this serial interface.

The CPU also reads the temperature of the PLL's reference crystal by measuring the resistance of a thermister glued to the side of the crystal. U11B form a simple digital-analog (DAC) converter. The CPU ramps the DAC, and U11A compares the voltage of the DAC to the voltage across the thermister (RT1). The CPU adjusts the voltage on a varactor (D2) in the TCXO circuit to keep the frequency of the crystal oscillator (Q14) on frequency. The correction voltage is store in EEPROM indexed to the current temperature.

Q24 is an electronic serial number IC.

Synthesizer

Q26 is a VCO, controlled by the varactor D15-17. The RF from Q23 is amplified by Q25 and Q13, and fed to the PLL IC U1. U1 outputs a correction voltage on pin 6. This voltage is filtered by R8,R9,C8, C10, and C14 and then applied to D1. The free-running frequency of the VCO is set by D1 and L3.

Output from the VCO is taken from the buffer Q25, and amplified by Q16.

In the standby mode, D5 does not conduct. When the Keyline is asserted, +8VTX has 8 volts on it, making D5 forward biased via L5. When it conducts, it passes RF out of the VCO.

Amplifiers

RF from the VCO goes through D5 (only in the TX mode), and is amplified by Q18, Q19, Q17, and then to 6 watts by Q7.

Q7 is the final RF power amplifier. It draws less than 1.6 amps. Its driver, Q17 draws less than 200mA, and its collector voltage is set by the power control loop to be between 2 and 6 volts.

The DC voltage on the collector of the driver transistor, Q17, is adjusted by Q20. Changes in this voltage control the RF power output. D10 samples and rectifies a small amount of RF output power. This sampled signal is fed to Q21 and Q22, a differential amplifier. The reference of the differential amplifier is set by R84. The output of the differential amplifier is fed to Q20, which controls the RF output. D11 limits the power control voltage (APC) fed to Q17 to about 6V.

Spurious/Harmonic Emission Supressing

The RF output from Q7 is low-pass filtered by L10-12 and C66-69 to remove harmonic content. This filter provides a reduction of harmonic output of at least 70dB from 300-2000MHz.

TCXO

Q14 is an oscillator circuit, with Y1 setting its frequency of oscillation at 14.4MHz. The output of this oscillator is fed to the PLL IC (U1) as its frequency reference. Its stability establishes the stability of the transmit signal.

The TCXO is modulated by the transmit data signal applied to the varactor D3.

A correction voltage from the CPU is applied to D2, to slightly adjust the frequency of oscillation based upon the measured temperature of Y1.

MNT-DPT-450

Electromagnetic Engineering Services, Incorporated
Spurious Emissions Data Sheet
(3m Open Area Test Site)

Client: **Sonik**
EUT: **Paging Exciter**
Model #: **DPT-450 (450.1MHz)**

Conducted by: C. Richard
Date of Test: **06-08-98**
Test Distance, Amp. gain: **3 m, 0 dB**

Frequency (MHz)	Spectrum Analyzer Reading at 3m (dBμV)	Antenna Polorization (vertical or horizontal)	Amp. Gain & Cable Loss, Distance & Antenna Factor Correction for 3 m (dBuV/m)	Total Interference Level at 3 m (dBμV/m)
450.100	56.2	h	24.9	81.1
900.200	28.8	h	34.9	63.7
1350.300	35.3	v	29.4	64.7
1800.400	41.5	v	32.2	73.7
2250.500	30.1	h	33.8	63.9
2700.600	29.6	v	35.6	65.2
3150.700	29.2	v	37.5	66.7
3600.800	27.5	v	39.1	66.6
4050.900	22.0	v	39.9	61.9
4501.000	16.4	v	40.3	56.7

Emissions Data 1

Test Conditions: Standard radiated emissions test set up on FCC registered open field site. The highest emissions for all antenna heights, polarities, and table orientations are the only emissions recorded.

MNT-DPT-450

Electromagnetic Engineering Services, Incorporated
Spurious Emissions Data Sheet
(3m Open Area Test Site)

Client: **Sonik**
EUT: **Paging Exciter**
Model #: **DPT-450 (460MHz)**

Conducted by: C. Richard
Date of Test: **05-19-98**
Test Distance, Amp. gain: **3 m, 0 dB**

Frequency (MHz)	Spectrum Analyzer Reading at 3m (dBµV)	Antenna Polorization (vertical or horizontal)	Amp. Gain & Cable Loss, Distance & Antenna Factor Correction for 3 m (dBuV/m)	Total Interference Level at 3 m (dBµV/m)
460.100	76.2	v	25.2	101.4
920.200	32.4	h	35.1	67.5
1380.300	41.6	h	29.4	71.0
1840.400	49.2	v	32.2	81.4
2300.500	33.4	v	33.8	67.2
2760.600	39.2	v	35.6	74.8
3220.700	34.9	v	37.5	72.4
3680.800	22.1	v	39.1	61.2
4140.900	19.3	v	39.9	59.2

Test Conditions: Standard radiated emissions test set up on FCC registered open field site. The highest emissions for all antenna heights, polarities, and table orientations are the only emissions recorded.

MNT-DAT-450

Electromagnetic Engineering Services, Incorporated
Spurious Emissions Data Sheet
(3m Open Area Test Site)

Client: **Sonik**
EUT: **Paging Exciter**
Model #: **DPT-450 (470.1MHz)**

Conducted by: C. Richard
Date of Test: **05-19-98**
Test Distance, Amp. gain: **3 m, 0 dB**

Frequency (MHz)	Spectrum Analyzer Reading at 3m (dBμV)	Antenna Polorization (vertical or horizontal)	Amp. Gain & Cable Loss, Distance & Antenna Factor Correction for 3 m (dBuV/m)	Total Interference Level at 3 m (dBμV/m)
470.100	73.5	v	25.4	98.9
940.200	25.0	h	35.3	60.3
1410.300	42.2	v	29.4	71.6
1880.400	38.5	v	32.2	70.7
2350.600	38.6	h	33.8	72.4
2820.600	31.5	v	35.6	67.1
3290.700	24.8	v	37.5	62.3
3760.800	26.4	v	39.1	65.5
4701.000	16.9	v	40.3	57.2

Test Conditions: Standard radiated emissions test set up on FCC registered open field site. The highest emissions for all antenna heights, polarities, and table orientations are the only emissions recorded.