

## Datapaq Transmitter TX1000-1004

### Introduction

#### **Description:**

The TX1000-1004 is a custom designed transmitter commissioned by Datapaq Limited for the R.F link between their kiln data loggers and the Datapaq re-packaged version of the RTCom-Global receiver.

The unit is initially to operate on the FCC part-90 licensed telemetry band (464.075 to 464.875 Mhz band) and later will be modified to operate on the 433-434MHz European, 458.50-458.90MHz MPT1329 UK and 472.10 to 472.2MHz Australian, licence exempt telemetry bands.

The unit features synthesised frequency generation, channel selection DIL switch, < 10mW ERP and 7.5V operation.

#### **Specification:**

Supply voltage	5.5 to 8.0V dc (7.5V nominal) 55mA @ 7.5V
Data input	TTL 4.7K Ohms 5V logic
Specification	To FCC part 90
Modulation	Frequency Modulation
Deviation	2.5KHz nominal
Channel Spacing	25KHz

## Technical description

The transmitter is of a synthesised design, the circuit diagram for which is given in drawing RT0105-1.

The design is based around the Philips SA8025ADK fractional-n frequency synthesizer IC, U1, which is operating from a 10.0000MHz reference frequency oscillator.

### **Power supply:**

Power for the unit is derived from via three voltage regulators, U9, U11 and U12. U9 provides a constant 3V for the operation of the control microcontroller. U11 provides a controlled supply for the frequency synthesizer and U12, 5V for the power amplifier and VCO.

The duty of U9 and U12 is under the control of the microcontroller.

### **Reference Oscillator:**

The reference oscillator for the synthesizer is based upon a high stability 2.5ppm crystal which is controlling the oscillation frequency of the feedback oscillator Q5. VR2 is provided to permit fine trimming to remove any initial errors.

### **Voltage Controlled Oscillator:**

The VCO is based upon a feedback oscillator stabilised using a coaxial resonator. The coaxial resonator is used in its sub resonance mode where it exhibits the characteristic of a highly stable inductor. The control voltage for the VCO is fed in via R62 which comes directly from the phase comparator of the synthesizer.

The output from the VCO is buffered amplified by Q2.

### **Power Amplifier:**

The power amplifier is coupled to the output buffer of the VCO via C36 while the power for the frequency synthesizer is derived via R60 and C37.

The P.A comprises of two stages (Q3 & Q4), both utilising tuned collector load. The Q3 stage effectively acts as a voltage amplifier and the Q4 stage as a power amplifier.

**Harmonic Filter:**

The output from the P.A is coupled and matched to the antenna via a two stage harmonic filter (VC1, L5, C61, L6, C65). It is designed to have a cut off frequency above the operating frequency and at the same time provide an impedance match for the antenna.

**Antenna:**

The antenna design is very unusual. Its efficiency may not be the best achievable but it has been designed to withstand the harsh oven temperatures and to be tolerant of closely placed metallic objects, such as heat resistant boxes etc.

**Microcontroller:**

The microcontroller provides both control for the transmitters synthesizer and processes the incoming data stream. The microcontroller used is the PIC16C73A-5020. This is configured to have one 8-input wide input port with pull up resistors to read and set the operating mode and frequency, one serial UART configured for communication to the data logger and control lines used to control the synthesizer.

**PORT ASSIGNMENTS:****@ PIC PINS**

RA0	(output)	=	Tx data
RA1	(output)	=	Synth Clock (input)
RA2	(output)	=	Synth Data (input)
RA3	(output)	=	Synth Strobe
RA4	(output)	=	n/c
RB0	(input )	=	Switch SW8
RB1	(input )	=	Switch SW7
RB2	(input )	=	Switch SW6
RB3	(input )	=	Switch SW5
RB4	(input )	=	Switch SW4
RB5	(input )	=	Switch SW3
RB6	(input )	=	Switch SW2
RB7	(input )	=	Switch SW1
RC0	(output)	=	n/c
RC1	(output)	=	n/c
RC2	(output)	=	n/c
RC3	(output)	=	Synth + Clock enable
RC4	(output)	=	VCO +PA enable (High = on)
RC5	(output)	=	n/c
RC6	(output)	=	n/c

Operating Modes

Mode	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
NORMAL	X	X	X	X	X	X	0	0
TX (ON) + Data	X	X	X	X	X	X	1	0
TX (ON) un-mod	X	X	X	X	X	X	0	1
TX on Free Run	X	X	X	X	X	X	1	1

**Normal:**

The transmitter transmits data entered via the data input pin. Upon the presence of data the unit wakes up from its idle mode, reads the DIP switch, calculates the programme constants and programs the operating frequency.

After a delay it then wakes up the VCO and the PA stages. Data is then transmitted.

**Test Mode [TX(on) + Data]:**

The transmitter again wakes up as in the normal mode but this time produces a carrier modulated with a square wave carrier. (Frequency TBA)

**Test Mode [TX(on) + (un-mod)]:**

The transmitter wakes up as in the normal mode but the transmission is not modulated (held at logic low).

**Test Mode [ TX(on) Free run ]:**

The VCO and PA are switched on without the synthesizer being programmed. Application: For factory testing of the VCO gain and span.

Frequency Programming Table for FCC part 90 Band

Frequency	SW1	SW2	SW3	SW4	SW5	SW6	NM1	NM2	NM3	NM4	CN	NR	NF
464.075	0	0	0	0	0	0	30	0	3	0	196	50	4
464.100	1	0	0	0	0	0	30	0	3	0	196	50	5
464.125	0	1	0	0	0	0	30	0	3	0	196	50	6
464.150	1	1	0	0	0	0	30	0	3	0	196	50	7
464.175	0	0	1	0	0	0							
464.200	1	0	1	0	0	0							
464.225	0	1	1	0	0	0							
464.250	1	1	1	0	0	0							
464.275	0	0	0	1	0	0							
464.300	1	0	0	1	0	0							
464.325	0	1	0	1	0	0							
464.350	1	1	0	1	0	0							
464.375	0	0	1	1	0	0							
464.400	1	0	1	1	0	0							
464.425	0	1	1	1	0	0							
464.450	1	1	1	1	0	0							
464.475	0	0	0	0	1	0							
464.500	1	0	0	0	1	0							
464.525	0	1	0	0	1	0							
464.550	1	0	0	0	1	0							
464.575	1	1	0	0	1	0							
464.600	0	0	1	0	1	0							

Note: 32 bit A word format is to be used, hence A1 is used.

A1(MSB)(32-bit):

[0][ NF(2).. NF(0) ] [NM1(11) .....NM1(0)][ NM3(3)..NM3(0)][ NM2(3)..NM2(0)][CN(7)..CN(0)]

B (24bit):

[1000][NM4(3..NM4(0)][CN(7).....CN(0)][ CK ][ CL ][ PR ]

C (24bit)

[1001][ ..... na ..... ][PA][0000000]

D (24bit):

[1010][NR(11).....NR(0)][SM][EM][SA][EA][FMOD][LONG]

PR	=	10
NF	=	000
FMOD	=	1
LONG	=	1
CN	=	See table
CL	=	00
EM	=	1
EA	=	0
SM	=	00
SA	=	00
NR	=	50
NA	=	00
PA	=	00