Operational Description of WT21-N

FCC ID: QOQWT21N

1 General Description

WT21-N is a Bluetooth HCI module based on CSR's Bluecore6 chip. The module is intended for applications where a host processor is capable of running the Bluetooth software stack. The module does not have internal memory for storing any parameters and thus all the required parameters, such as crystal frequency and output power, are loaded at the boot up of the module.

The module is Bluetooth qualified as a controller subsystem. General operation and the RF characteristics are as defined in Bluetooth core spec version 2.1/2.1+EDR. The maximum peak output power of WT21-N is 10 dBm measured from the RF pin of the module. For detailed operational description, please see the datasheet of WT21.

2 RF Receiver

The receiver features a near-zero IF architecture that allows the channel filters to be integrated onto the die. Sufficient out-of-band blocking specification at the LNA input allows the receiver to be used in close proximity to GSM and WCDMA cellular phone transmitters without being desensitised. The use of a digital FSK discriminator means that no discriminator tank is needed and its excellent performance in the presence of noise allows WT21 to exceed the Bluetooth requirements for co-channel and adjacent channel rejection.

For EDR, the demodulator contains an ADC which digitises the IF received signal. This information is then passed to the EDR modem.

3 RF Transmitter

The transmitter features a direct IQ modulator to minimise the frequency drift during a transmit timeslot, which results in a controlled modulation index. Digital baseband transmit circuitry provides the required spectral shaping.

3.1 Basic Rate Modem

The basic rate modem satisfies the basic data rate requirements of the Bluetooth v2.1 + EDR specification. The basic rate was the standard data rate available on the Bluetooth v1.2 specification and below, it is based on GFSK modulation scheme.

The inclusion of the basic rate modem allows WT21 compatibility with earlier Bluetooth products.

3.2 Enhanced Data Rate Modem

The EDR modem satisfies the requirements of the Bluetooth v2.1 + EDR specification. EDR has been introduced to provide 2x and 3x data rates with minimal disruption to higher layers of the Bluetooth stack. WT21 supports both the basic and enhanced data rates and is compliant with the Bluetooth v2.1 + EDR specification.

At the baseband level, EDR utilises both the same 1.6kHz slot rate and the 1MHz symbol rate as defined for the basic data rate. EDR differs in that each symbol in the payload portion of a packet represents 2 or 3-bits. This is achieved using two new distinct modulation schemes. Table 1 and Figure 1 summarise these. Link Establishment and management are unchanged and still use GFSK for both the header and payload portions of these packets.

Data Rate Scheme	Bits Per Symbol	Modulation
Basic Data Rate	1	GFSK
EDR	2	π/4 DQPSK
EDR	3	8DPSK (optional)

Table 1: Data Rate Schemes

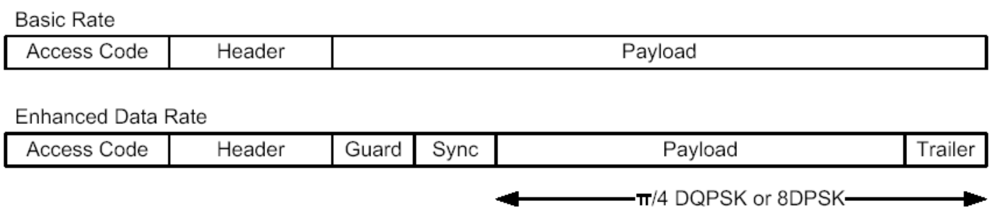

Figure 1: Basic Rate and Enhanced Data Rate Packet Structure

3.3 Enhanced Data Rate π /4 DQPSK

The 2x data rate for EDR uses a π /4-DQPSK. Each symbol represents 2-bits of information. Figure 2 shows the constellation. It has two planes, each having four points. Although it seems there are eight possible phase states, the encoding ensures that the trajectory of the modulation between symbols is restricted to the four states in the other plane.

For a given starting point, each phase change between symbols is restricted to +3π /4, +π /4, -π /4 or -3π /4 radians (+135°, +45°, -45° or -135°). For example, the arrows shown in Figure

4.3 represent trajectory to the four possible states in the other plane. Table 2 shows the phase shift encoding of symbols.

There are two main advantages in using π /4 DQPSK modulation:

- The scheme avoids the crossing of the origin (a +π or -π phase shift) and therefore minimises amplitude variations in the envelope of the transmitted signal. This in turn allows the RF power amplifiers of the transmitter to be operated closer to their compression point without introducing spectral distortions. Consequently, the DC to RF efficiency is maximised.

- The differential encoding also allows for the demodulation without the knowledge of an absolute value for the phase of the RF carrier.

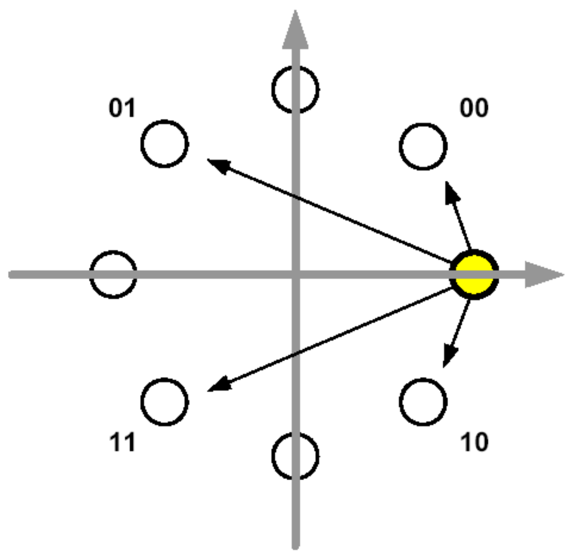

Figure 2: π /4 DQPSK Constellation Pattern

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Bit Pattern	Phase Shift
00	π/4
01	3π/4
11	-3π/4
10	-π/4

Table 2: 2-Bits Determine Phase Shift Between Consecutive Symbols

3.4 Enhanced Data Rate 8DPSK

The 3x data rate modulation uses 8DPSK. Each symbol in the payload portion of the packet represents 3 baseband bits. Although it seems the 8DPSK is similar to π /4 DQPSK, the differential phase shifts between symbols are now permissible between any of the eight possible phase states. This reduces the separation between adjacent symbols on the constellation to π /4 (45°) and thereby reduces the noise and interference immunity of the modulation scheme. Nevertheless, because each symbol now represents 3 baseband bits, the actual throughput of the data is 3x when compared with the basic rate packet.

Figure 3 shows the 8DPSK constellation and Table 3 shows the phase encoding.

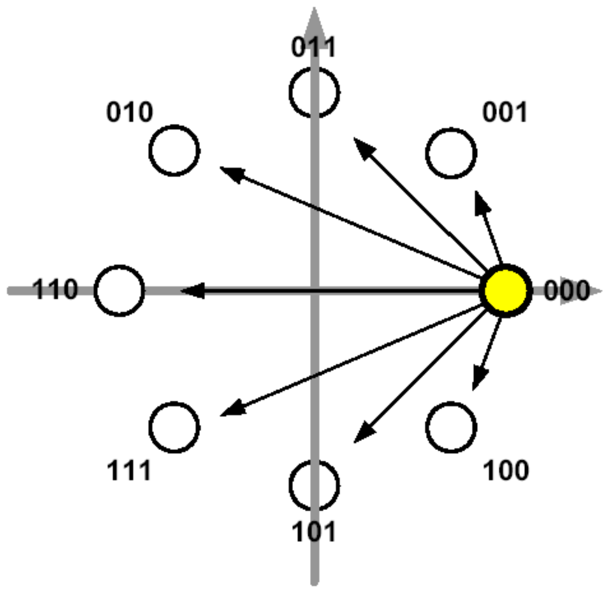

Figure 3: 8DPSK Constellation Pattern

Bit Pattern	Phase Shift
000	0
001	π/4
011	π/2
010	3π/4
110	π
111	-3π/4
101	-π/2
100	-π/4

Table 3: 3-Bits Determine Phase Shift Between Consecutive Symbols