# Differences Between OOK and CCSK Modulation

## Spectral Spreading

The new Schlumberger endpoint supports the same code channels, carrier frequencies, and peak transmit power for the On Off Keying (OOK) as for the new Cyclic Code Shift Keying (CCSK). Spectral spreading in CCSK is the same as for OOK. It uses a 63-chip maximal sequence, clocked at approximately 1.2 MHz and bi-phase modulated onto the RF carrier at.

## Data Modulation

CCSK packets differ from OOK packets mainly in the form of the data modulation. CCSK uses 16 possible data symbols (as opposed to the two symbols, On and Off, used by OOK). Each symbol represents 4 digital bits of information, or one hexadecimal digit. One symbol is sent with each complete cycle through the 63-chip spreading sequence. Therefore the symbol rate in CCSK is the same as in OOK, but the data rate is four times as fast. This modulation will be denoted as 16CCSK to distinguish it from a special modulation used in the CCSK sync word.
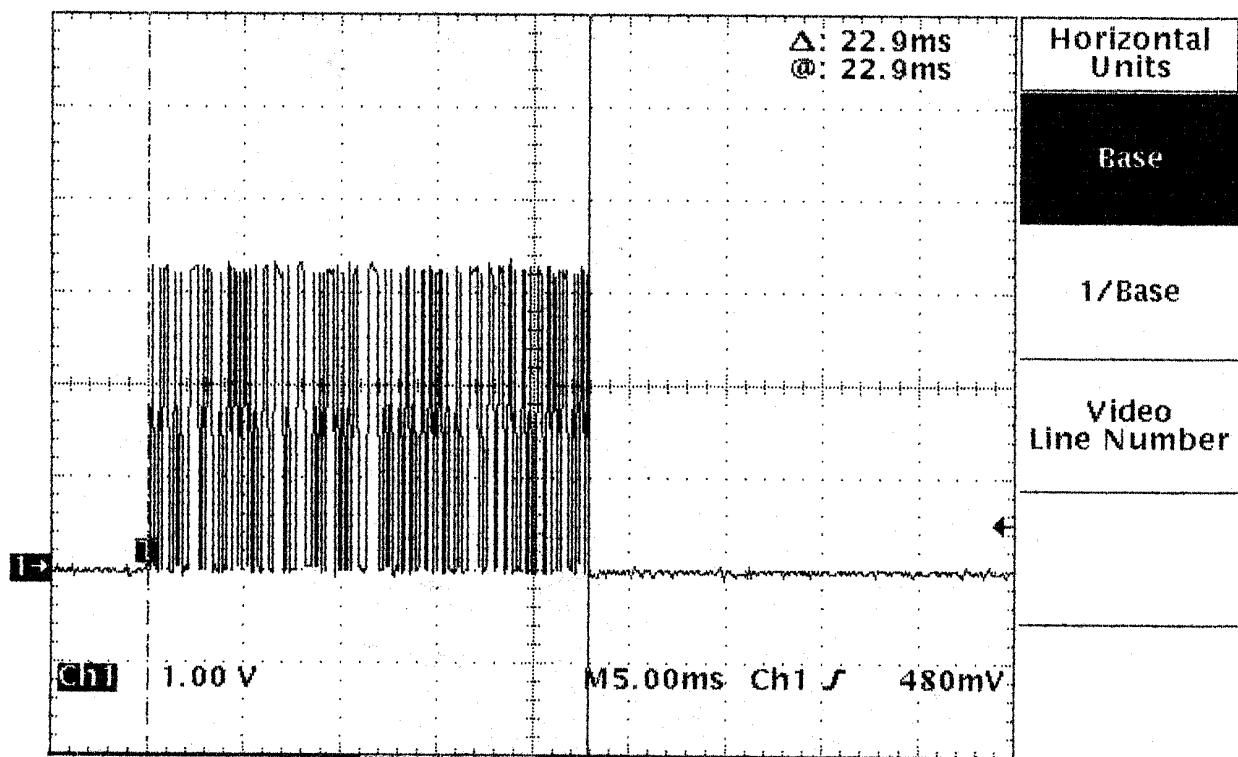
As in with OOK, CCSK data is sent in units of 8-bit bytes. From the preceding statement it can be seen that each byte can be represented as two 4-bit nibbles which equate to two 16CCSK data symbols. In CCSK the least significant nibble is transmitted first.

The 16CCSK symbols are designated symbol 0 through symbol 15. Symbol N differs from symbol N-1 in that it begins at a different phase of the spreading sequence. The code phase offset between symbols is two chips. For example, sending a continuous stream of symbol 0 is identical to sending continuous On symbols in OOK. To switch to symbol 1, the transmitter must advance its code generator so that the 61st chip of the sequence begins on the symbol boundary. After what would be the end of the sequence in OOK, symbol 1 wraps around to chips 1 and 2 to complete the symbol.

In 16CCSK the transmit duty cycle is 100%. However since the data rate is higher than in OOK, the total energy transmitted in any packet will be less than or equal to that transmitted in the corresponding longer OOK packet. See Figures 1 and 2 showing the difference in the packets lengths
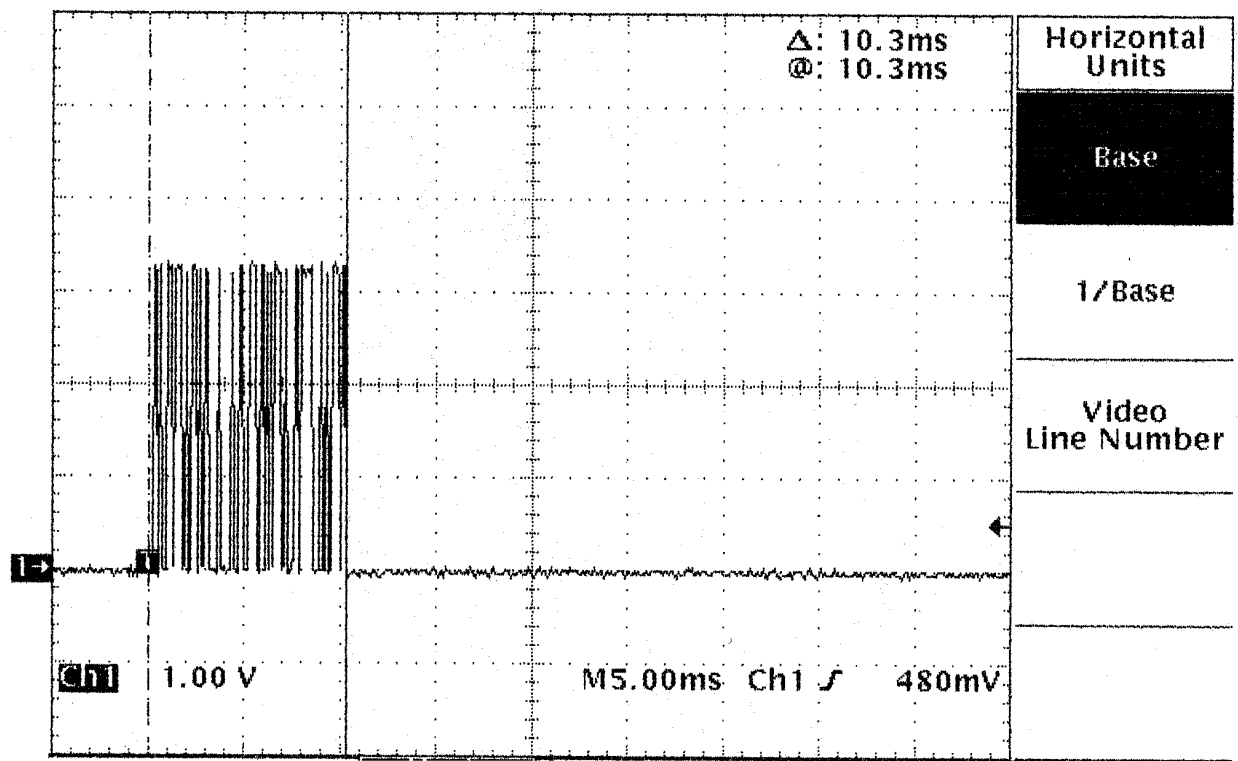
The following table shows the starting chip and data content of each 16CCSK symbol.

| Symbol Number | Starts on Chip Number | Data Content |
| --- | --- | --- |
| 0 | 0 | 0x0 |
| 1 | 60 | 0x1 |
| 2 | 58 | 0x2 |
| 3 | 56 | 0x3 |
| 4 | 54 | 0x4 |
| 5 | 52 | 0x5 |
| 6 | 50 | 0x6 |
| 7 | 48 | 0x7 |
| 8 | 46 | 0x8 |
| 9 | 44 | 0x9 |
| 10 | 42 | 0xA |
| 11 | 40 | 0xB |
| 12 | 38 | 0xC |
| 13 | 36 | 0xD |
| 14 | 34 | 0xE |
| 15 | 32 | 0xF |

Packet Length with 26 Bytes of Payload and OOK Modulation
Figure 1



Packet Length with 26 Bytes of Payload and CCSK Modulation
Figure 2