Introduction to Digital Modulation Analysis

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**Basic Concept**

**Digital Modulation**

Digital Modulation function is widely used in Wireless communication. The Digital codes or signals are modulated by different kinds of variable analog carrier to enhance the power transmission efficiency and avoid the interference by other communication bands in air. The basic digital modulation includes ASK/FSK technologies which simplified the communication logistics and is widely used in simple Wireless application like IoT, Industrial 4.0 etc.

\[ s(t) = s(t) \cos(\omega_1 t) + \overline{s(t)} \cos(\omega_2 t) \]

\[ s_{FSK}(t) = s(t) \cos(\omega_1 t) + \overline{s(t)} \cos(\omega_2 t) \]
**Basic Concept**

**FSK Modulation**

Frequency shift key is a modulation method in simple wireless application like IoT, Industrial 4.0 area which includes the Micropower, Short distance communication like Automobile Keyless comm, Zigbee, NFC, or RFID etc. The modulation principle is indicated as below diagram for your reference.

**Frequency Shift Keying (FSK)**

![Diagram of Frequency Shift Keying (FSK)](image)

**Baseband Data**

```
1  0  0  1
```

**BFSK modulated signal**

```
f_1  f_0  f_0  f_1
```

where $f_0 = A \cos(\omega_c - \Delta \omega)t$ and $f_1 = A \cos(\omega_c + \Delta \omega)t$
Feature:
1. Simple S1220 Demodulation software.

Advantage:
1. Real-time S1220 Demodulation parameters display and eye diagram analysis.
2. Fast acquisition and measurement capabilities.

Benefit:
1. Easily observe the ASK/FSK demodulation characteristics.
2. Clear pattern decoding to help engineer to find the root causes.
Required Equipment List

1. DSA875/832/832E Spectrum Analyzer
2. DSG3060/3030 RF Signal Generator
3. DSA Utility Kit
4. Ultra Sigma Software
5. Ultra IQ Station Software
6. S1220 ASK/FSK Demodulation Software
FSK Demodulation Setup

1. Connect the SMA cable between DSA875 and DSG3060
2. Connect DSA875 “10MHz Out” port at rear panel to DSG3060 “10MHz in” port at rear panel
3. Connect the USB A to B type cable between PC, DSA875 and DSG3060 (2 USB cables needed)
FSK Demodulation Setup

4. Press “FREQ” button on DSG3060 and set the carrier frequency to 433.92 MHz.
5. Press “LEVEL” button on DSG3060 and set the power level to -26dBm.
6. Open Ultra Sigma Software and make sure DSA875 and DSG3060 have been connected to PC successfully.
7. Open Ultra IQ Station Software and select “Open an existing workspace”
8. Users can see the IQ Signal pattern generation platform on the screen as below
9. Press “Instrument” item on top of the interface and let the DSG3060 USB address connect to PC
10. Select “Compile” item and press “Run” to upload and implement the IQ Pattern into DSG3060. Then press “ESC” on DSG3060 to escape the remote mode, and turn on “IQ”, “MOD” and “RF” button on it.
11. User can observe 3 spectro-line on DSA875
12. Press “ESC” to escape the remote mode and then press “FREQ” button on DSA875 and set the center frequency to 433.92MHz.
13. Press “SPAN” button on DSA875 and set the span value to 300KHz and the FSK spectrum can be shown on the screen.
14. Press “MEAS” button on DSA875 and enable the “DMA” mode, and user can see the word sentences on screen.
15. Open S1220 ASK/FSK Demodulation Software
16. Press “Device” item on left upper side of the interface and connect the DSA875 by USB address
17. Select “Meas” item and select the “Demodulation Configuration”
FSK Demodulation Setup

18. Setup the configuration parameters as below table:

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demod Type</td>
<td>FSK</td>
</tr>
<tr>
<td>Center Freq</td>
<td>433.92 MHz</td>
</tr>
<tr>
<td>Symbol Rate</td>
<td>9.6 Ksp</td>
</tr>
<tr>
<td>Meas Filter</td>
<td>Gauss (FSK)</td>
</tr>
<tr>
<td>Trig Type</td>
<td>Free</td>
</tr>
<tr>
<td>Length</td>
<td>70</td>
</tr>
<tr>
<td>Alpha/BbT</td>
<td>0.35</td>
</tr>
<tr>
<td>Filter Symbols</td>
<td>10</td>
</tr>
<tr>
<td>Trig Level</td>
<td>0.00 dBm</td>
</tr>
<tr>
<td>Trig Delay</td>
<td>0.00 s</td>
</tr>
<tr>
<td>Trig Edge</td>
<td>Pos</td>
</tr>
</tbody>
</table>

Select OK to confirm changes.
FSK Demodulation Setup

19. User can observe the Demodulation result as below interface
20. Select “Meas” item and press “Ref Symbol”
FSK Demodulation Setup

21. Set the Ref Symbol as “1110000110”
22. User can compare the red symbols at right bottom side of the interface and judge if it’s correct or not.
THANK YOU