Digital Communication Signals

Digital signals also have some generally identifying characteristics. They often have a more constant envelope than the analog ones. This is due to the fact that digital bits are usually being transmitted whether the voice is loud or low.

Table 3. Spectrum Width Characteristics of Selected Digital Signals

Signal Type	Width
CDMA (IS-95)	1.23 MHz
W-CDMA	~4 MHz
TV Digital Broadcast	5 to 7 MHz
TV Digital STL	7 MHz
Paging FSK	10 kHz
US-TDMA	30 kHz
GSM	200kHz
SMR	20 kHz

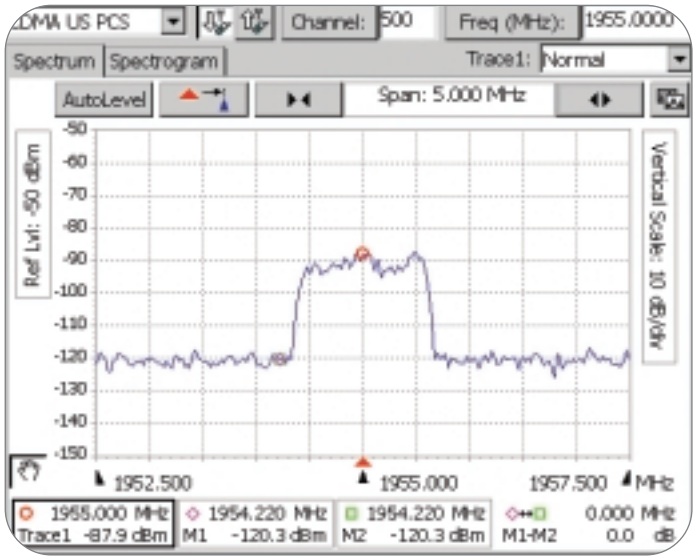
GSM Cellular

GSM has a distinctive rounded look due to its GMSK modulation, as shown in Figure 21. Since it is a TDMA signal, it may appear and disappear intermittently, depending on how many timeslots are active. Voice channels usually come and go quite rapidly as the individual timeslots are transmitted. The BCCH channel (like the paging channel in AMPS) is usually continuous.

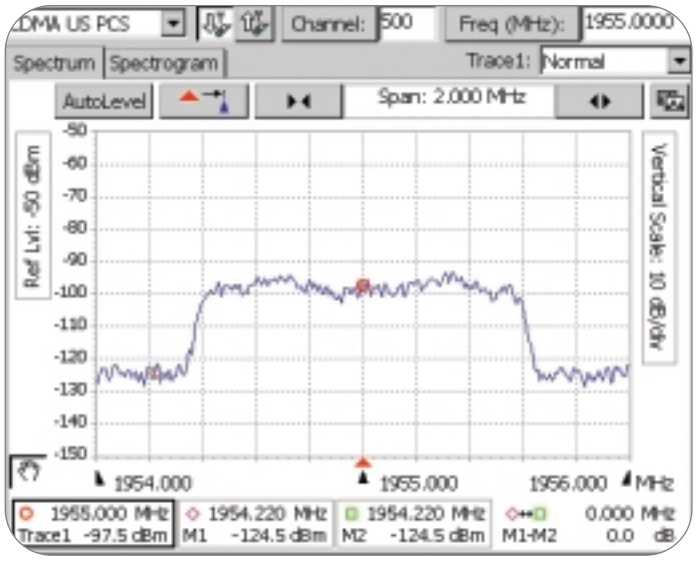
▶ ***Figure 21.*** *A GSM cellular signal.*

CDMAOne Cellular

The CDMA signal in Figure 22 has the familiar "Bart's Head" appearance. It is spread evenly across the entire 1.2288 MHz bandwidth. As more phone calls are added to this signal, it will simply increase slightly in amplitude, it will not have any noticeable change in its shape in a spectrum view. In Figure 23, the CDMA signal is displayed using a 2 MHz span.



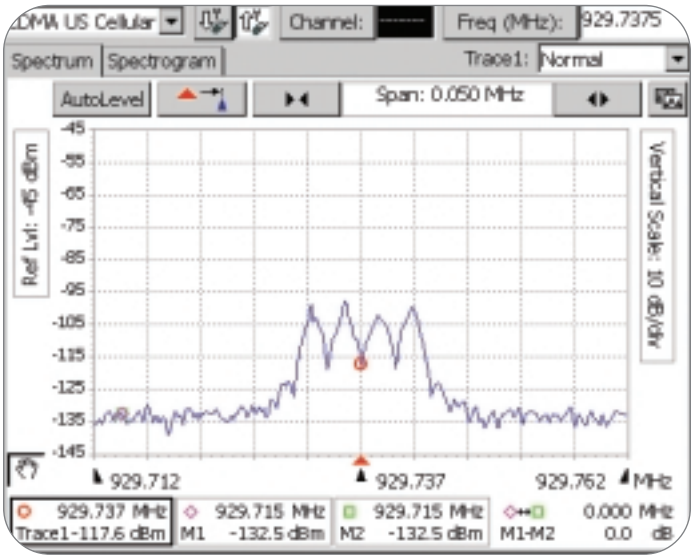
▶ ***Figure 22.*** *CDMAOne (using 5 MHz span).*



▶ ***Figure 23.*** *CDMAOne (using 2 MHz span).*

4FSK

4FSK is another digital transmission type used for paging and public-safety transmissions. This signal has four distinct frequencies that will tend to merge and fill in the gaps between the frequencies as the data rate increases, as shown in Figure 24.



▶ ***Figure 24.*** *4FSK paging.*

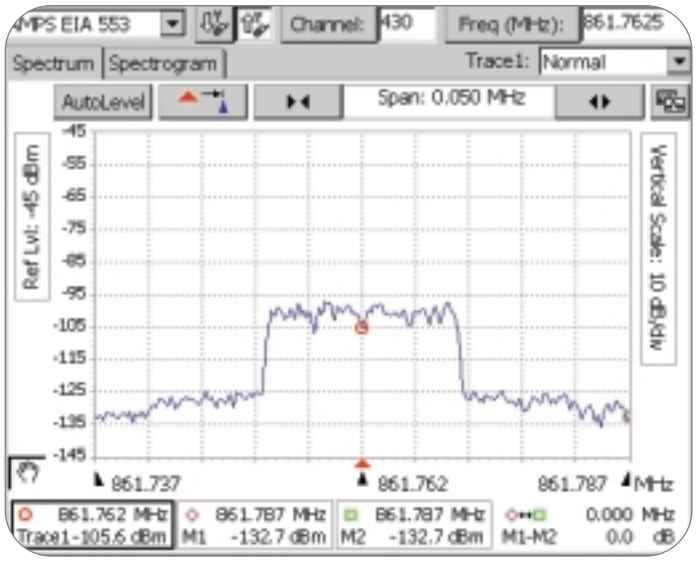
IS-136

Originally known as NADC (North American Digital Cellular), this signal is about 30 kHz wide, as shown in Figure 25. It was designed to fit into one AMPS FM cellular channel. It has a much flatter top than GSM, but not quite as flat as CDMA.

▶ ***Figure 25.*** *IS-136.*

Specialized Mobile Radio (SMR)

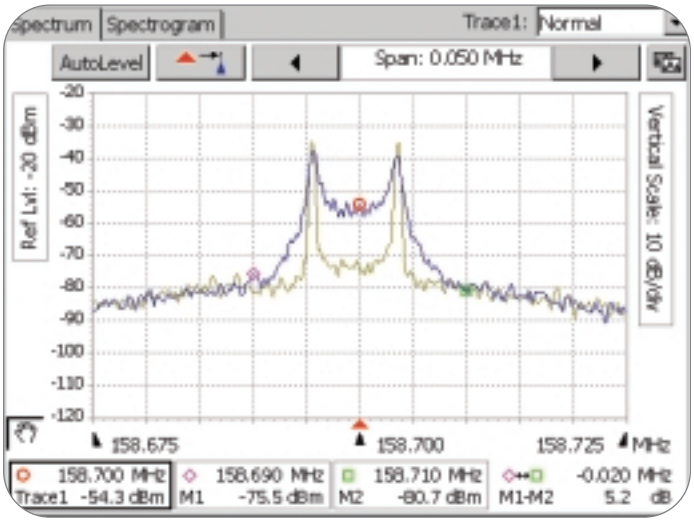
Figure 26 shows a signal from SMR, which is marketed as a cellular service in the U.S.A. Its assigned transmission frequencies lie directly between U.S.A. cellular receive and transmit bands. The signal is usually a bit narrower than IS-136, and has a much flatter top. This example is from a system marketed under the Motorola trademarked proprietary name of IDEN.



▶ ***Figure 26.*** *SMR (specialize mobile radio) signal.*

FSK Paging

This signal has two distinct frequencies for the digital "ones and zeros" when it is idling. As the data rate and random transmission data increase, the frequencies will become less distinct and the trough in the middle will fill in. In Figure 27, the orange trace is the typical idling spectrum – much of the time this signal will be more filled-in, as with the blue trace. The amount of fill usually changes continuously with the various data payloads being transmitted.

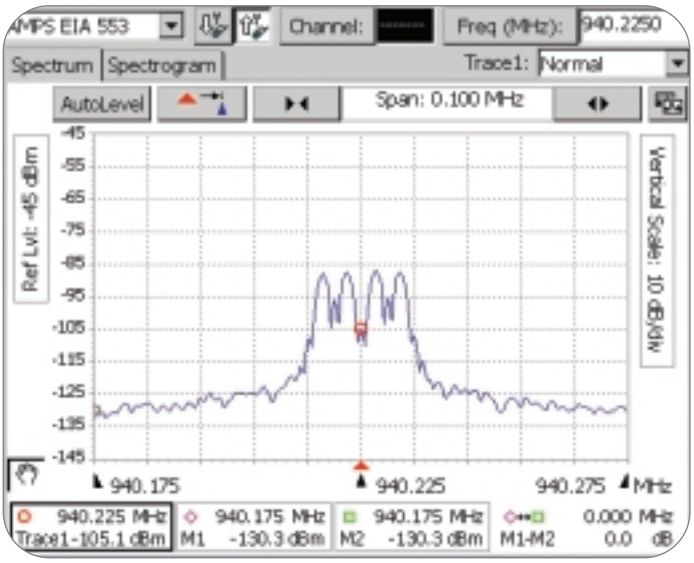


▶ ***Figure 27.*** *FSK paging.*

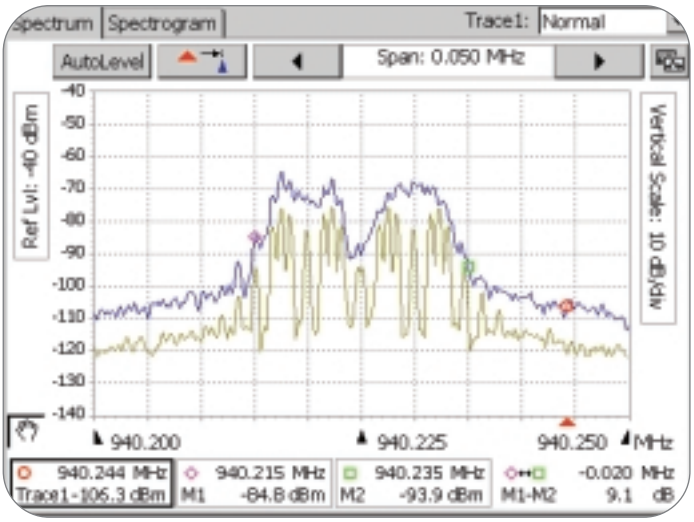
Narrow-PCS

This digital signal is from a Narrow PCS cellular system in the U.S.A. In a wide span it wiggles slightly, as shown in Figure 28a.

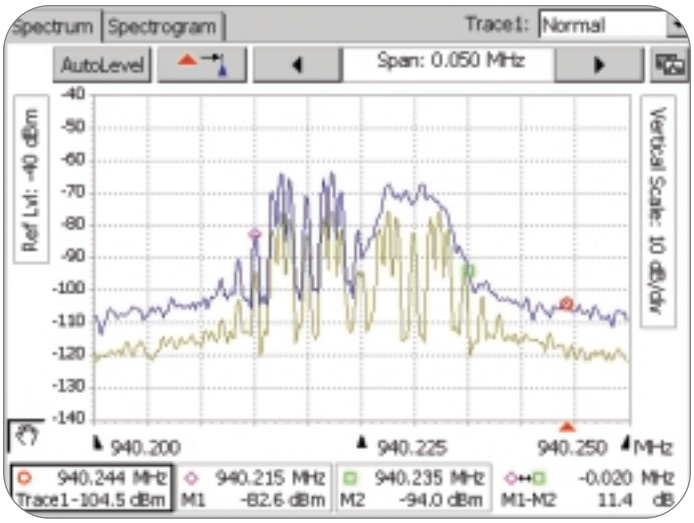
However, in a slightly narrower span, as shown in Figure 28b, it has a unique manner of alternating between the orange trace of distinct frequency sidebands, and the blue trace showing broad filled-in sidebands. Even more unusual is the fact that the upper and lower sidebands may change independently at times, as shown in Figure 28c.



▶ ***Figure 28a.*** *N-PCS transmission.*



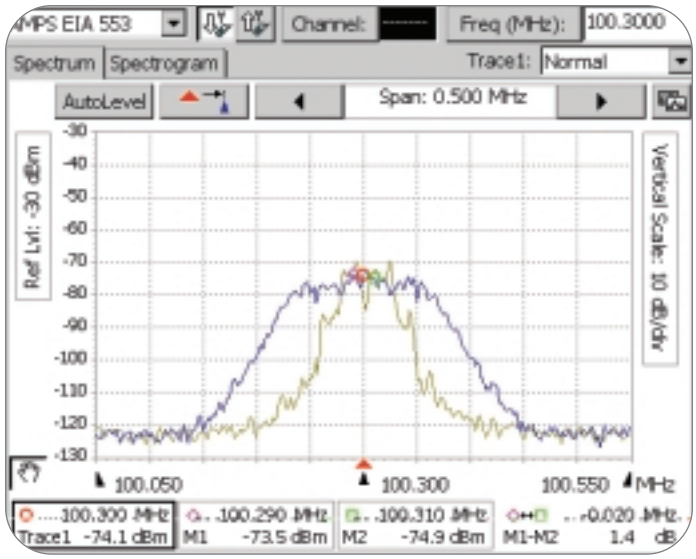
▶ ***Figure 28b.*** *N-PCS seen in a narrower span.*



▶ ***Figure 28c.*** *N-PCS spectrum varies continuously.*

STL Systems

Digital STL (Studio-to-Transmitter Link) systems are operated in the 2 GHz band. These are usually QAM modulated with approximately 7 MHz of bandwidth. Their spectrum looks similar to IS-136, except for the much wider frequency span. Analog STL for audio may be at 900 MHz or 2 GHz. Analog STL for TV video signals are 15 or 30 MHz wide FM. The spectra of both are similar to broadcast FM, as shown in Figure 29.



▶ ***Figure 29.*** *Broadcast FM.*

Summary

These have been some selected example signals that you may see in everyday use while you look at all of the RF signals that surround your wireless system. These examples can help you identify what is and what is not a problem for you.