Picking the right wattmeter for Digital Applications

In modern communication systems, digital delivery methods have become prevalent. These applications provide a discrete data stream that allows for greater immunity to noise as well as reduced bandwidth. Transmission systems now have to utilize complex modulation or combining of many carriers in order to deliver this digital data stream. One problem associated with these transmission systems is they can no longer be measured accurately with a conventional diode-based power measurement. In order to fit the needs of these expanding digital applications, square-law detectors can be used to give accurate average power measurements.

A square law detector uses the same techniques as full-wave diode detectors, but keeps the input low enough to remain in the square-law region of the diode. In that region, the response of the diode is relative to the square of the voltage, and therefore is relative to power. This linear response not only makes displaying the data easier, but gives increased unit-to-unit repeatability by removing the uncertainty of the diode region transitions. Data has shown that those square law detectors give a response akin to equivalent thermal power[1]. Because of that response, these detectors are suitable for measuring average power in any signal, analog or digital.

These square law detectors have been utilized in a number of meters to fit the needs of many different applications. Here are some examples of digital signals where square law sensors could be utilized effectively.

Commercial Broadcasting

In broadcasting in the United States, the FCC has a requirement that power output to the antenna be measured with a calibrated power meter or indirect power measurement. While the conventional detectors could meet the calibrated power meter requirement in analog conditions, digital broadcasting applications like IBOC Radio and Digital Television cannot be measured accurately by conventional methods. Broadcasting also places a high premium on alarms that can shut the transmitter down. If something were to happen to the antenna, high reflected power could cause damage to hundreds of thousands of dollars worth of equipment, depending on how many systems are combined. In addition, these broadcasting applications are required to do spectral measurements to make sure they are not bleeding over into other channels, causing interference. An additional port on a power meter would make spectral testing easy to perform.

The BPME and the TPM were designed for these broadcasting applications. The BPME offers digital power measurement with alarms for high forward power, low forward power, and high VSWR. The third port allows easy access to spectral compliance testing, and the Ethernet port provides easy remote

access to any site with an internet connection. The TPM offers forward and reflected power measurements with a simple voltage output for each. With the additional forward and reflected directional coupling ports, the non-directional sampler port, and the ability to calibrate the device in-situ without taking a site down, the TPM is ideal for integration into remote monitoring systems.

Wireless Communication

Wireless has been utilizing digital modulation for years. Discrete digital signals, unlike analog signals, can utilize Forward Error Correction (FEC), which gives users better reception and better coverage than ever before. Depending on the kind of testing being done, there are different needs for power measurement within the wireless field. If statistical analysis of call volume on a TDMA signal like GSM is required, then you would prefer advanced power measurements like Duty Cycle, Complementary Cumulative Distribution (CCDF), and burst average power. This helps identify if a site is overloaded and whether a new site needs to be put up. If you're more interested in troubleshooting a site that's having problems, then a rugged, handheld power meter capable of measuring forward and reflected power might be more applicable.

The model 5012 best fits the needs of site analysis measurements. It can provide all the advanced measurements mentioned above as well as peak and average power measurements for digital signals. In addition, it can connect directly to a laptop to log data over time if long term trending data is required. For troubleshooting, the DPS Series (5010B and 5014) combined with the 5000-EX or a laptop can be utilized. The 5000-EX can provide one-button VSWR measurements in a light, rugged package. Additionally, the APM-16 can be used for any die-hard fan of the model 43. It has the same form and fit, while providing accurate average power measurements on digital systems.

Public Safety

Public safety has always relied on mission critical radio communication. Routine power measurement during maintenance is critical to identify any problems with antennas or amplifiers on repeaters or base stations. With the implementation of P25, a complex modulation scheme, communications have become more resilient to noise. Regardless of how resilient a signal is, if something happens to an antenna, communications may not get through. That's why it's important to maintain regular maintenance and monitoring on these systems.

Once again, people familiar with the model 43 will find the APM-16 provides a seamless transition into digital power measurement for maintenance and troubleshooting. However, with mission critical communications, you want to be aware if something is preventing a signal from getting through. The ACM series Antenna and Cable Monitors provide a low cost solution for in-line power measurement

with alarms for low forward power, high forward power, and high VSWR. This will give early warning should any problems prevent the system from operating at full capacity.

Military

Military applications are moving forward with advanced modulation and encryption techniques using the Joint Tactical Radio System (JTRS), a software defined radio. For these applications, rugged reliability is priority number one with quick and easy measurements. As an added bonus, any power measurement capable of measuring any signal regardless of modulation provides a way to measure new signal and encryptions without requiring additional calibration.

While the APM-16 and the 5000-EX can be used for fast, rugged field measurements, each military application may be different. Bird offers a Configurable Power Sensor (CPS) which is easily integrated into test sets or radios, and can measure true average power regardless of the modulation or number of carriers.

Conclusion

While all digital systems will benefit from a meter that can accurately read digital power, each application has its own needs. Some may benefit from data logging and alarms while others may benefit from ease of use or rugged design. Bird offers many different meters to meet the needs of specific applications. In addition, some applications may benefit from a customer measurement solution. In those cases, Bird is willing to work with the customer to solve their problems in the most appropriate way.

References:

1. "RF Broadcast Measurement Technologies for Digital Broadcast Systems," Tim Holt, http://www.bird-technologies.com/techapps/app_notes/RF_BroadcastMeasurement.pdf

$$V_{out} = \left(\frac{V_{in}}{5.77} \right)^2$$

Figure 1: Diode Response in Square Law Region

Table 1: Applications for Digital Power measurement

	Broadcasting	Wireless	Public Safety	Military

APM-16	No	Yes	Yes	Yes
DPS Series	No	Yes	Yes	Yes
ACM Series	No	Yes	Yes	No
5012	No	Yes	No	Yes
BPME Series	Yes	No	No	Yes
TPM Series	Yes	No	Yes	Yes
CPS	No	Yes	Yes	Yes