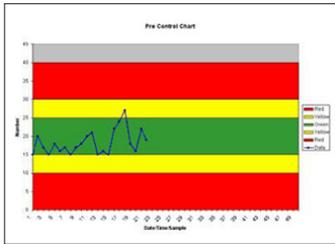
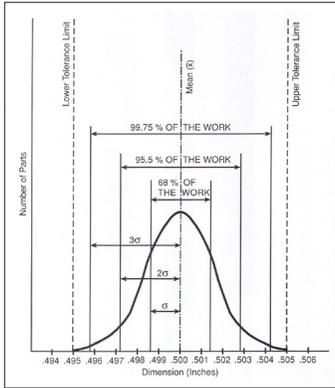


## Integrated Wireless Handheld Gaging for the Shop Floor

User Benefits and Successful Implementation



In the 1980s the concept of data collection for process control took a major leap forward. This was about the time that a combination of electronic technology and economics allowed gaging to become digital. With a digital signal available, it became possible to transfer information via cable directly from a gage or digital indicator to the data collector. This made it much more practical to make process control decisions based on statistical analysis.



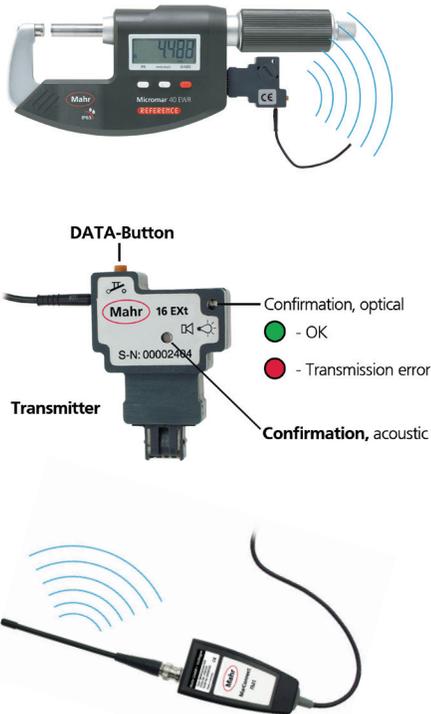
The importance of collecting data for process control has been used since the 1950's — first starting out as manually created charting.

Electronic data collection also spurred a major improvement in data quality. Prior to this advancement, data was handwritten onto a sheet of paper and then logged into a computer, or it was logged into the computer directly at the point of gaging. One can easily understand how any operator – no matter how astute and focused – could easily transpose numbers when measuring hundreds of parts, skip digits, or just enter wrong numbers. These types of errors were virtually eliminated by having data go directly to the data analysis software. When electronic data collection strategies were first implemented, collection efficiencies and error reduction improved dramatically over manual collection methods.

In recent years, checking parts at a gaging station with a hand tool or a dedicated fixture gage connected to a computer via a cable for data collection was the norm. Many hand tools and digital indicators had data output built in, and collecting data was easy and highly cost effective. It was also inexpensive, fast, reliable, and provided a great solution for many process and quality control applications. But that methodology wasn't as helpful when the part couldn't be brought to the bench. Running a long cable from the gage to the computer was troublesome, and if multiple dimensions needed to be checked with different gaging, a collection of long cables quickly became a hazardous, snarled mess.

Next in the technology evolution, plug-in wireless radio transmitters were applied to gaging operations, which eliminated the cables and provided other benefits, however that phase was rather short-lived. They were more costly than wired systems and ergonomically cumbersome when taking measurements in the machine tool's work area.

Recently, measurement technology in manufacturing environments has taken another leap. Just as cell phones and integrated wireless computer peripherals have become common, integrated wireless technology is moving out onto the shop floor. Small transmitters are being built into digital indicators that allow them to transmit data to the gaging computer. Each integrated transmitter in the digital indicator uses slightly different signal coding that allows many gaging stations to communicate to a single computer simultaneously. Today these integrated transmitters are not that much more expensive than data cable, making the cost more than justifiable when cabling alone won't get the job done. Now, with these minute transmitters, very large parts can be measured where they are housed, or parts can be measured in the machine tool without having cables get caught in the cutting tools and machine interior. Plus, many digital indicators provide feedback by generating a signal to the operator that the transmission was received and acknowledged by the computer. This is practically instantaneous so as not to slow the operator down, and most transmitters can be configured to provide a go or no-go signal to the user depending on whether the part is within tolerance.



Initially, wireless gaging employed add-on transmitters and separate receivers.

Another application for these new integrated wireless gages is when multiple digital indicators are being used on one gaging fixture. In the past, each digital indicator would have its own cable, and since there are so many, some type of interface box



Integrated wireless is ideal for point of manufacture inspection, making measurements directly in the machine with immediate feedback to the machine controller.

would be required to handle multiplexing the signals to the computer. With the integration of the integrated transmitters, both the cabling and the multiplexers are eliminated, plus operators have neater-looking gaging stations. Further, the PC running the data collection software can be requested by the operator to gather the data from the multiple digital indicators.

Eliminating cables is helpful, improves safety and eliminates clutter, however the greatest boon for this integrated technology is right at the machine tool. Transmitted wirelessly into the machine tool's controller, the data can be put to use as part of the tolerance offset calculations. As the operator measures the parts, the data is used to assign the proper offsets, greatly improving the quality and throughput of the machine tool. Out-of-spec parts are essentially eliminated, and the ability of the machine to make parts to the desired dimensions is greatly improved. At the same time, the data can be stored for long-term archiving, recording when the part was measured and by whom. It can also be used for tracking and improving operator throughput.

Today the measurement-gathering loop is evolving to closure, with a combination of digital gaging for accurate shop floor measurement, unrestricted and integrated wireless transmission of reliable data, and statistics for process control. These new tools allow for truly effective use of measurement data.

### Tools for Integrated Wireless Shop Floor Measurement

While many types of bench and handheld gages are now integrating wireless transmitters, for the scope of this discussion we shall focus on integrated wireless digital indicators and calipers. These gages are designed using a Personal Network Technology originally designed for the medical industry. Since it was developed specifically for medical applications it had to be low power and highly reliable. Designed for low power, 2.4 GHz operations, this proven protocol is perfectly suited for the kind of low data rate sensors used in hand tools and digital gages. These transmitting nodes operate for months, sometimes years, on a coin cell battery compared to hours or weeks using other technologies. In gage applications, this technology facilitates the collection, automatic transfer and tracking of sensor data for monitoring the measurement data.

Requirements for a basic system include:

- Integrated wireless gage
- Windows®-based PC computer (industrial laptop) with MS-Excel database program
- Dedicated gaging software and USB drive-type receiver

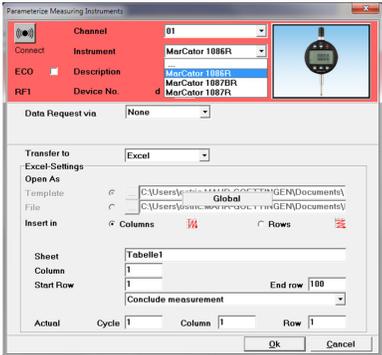
Using Mahr Federal's "MarConnect" as an example, the most basic integrated wireless system consists of:

- 1 MarCator Digital Indicator or MarCal Digital Caliper – both featuring integrated wireless data transmitters
- 1 wired gage with footswitch
- MarCom Basic data acquisition software
- i-Stick receiver via conventional USB port



With integrated wireless, the hand tools look like any other tool and the data collection is transparent to the user.

As an option for manufacturers, Mahr Federal offers a higher-level package surrounding its MarCom Professional 5.0 software. Up to eight integrated wireless devices can be configured with each i-Stick used, providing the capability to network multiple gages into a single workstation. In essence, what can be established with this package is a personal wireless network at each workstation. Each station might be comprised of a dedicated computer, receiver and multiple integrated wireless gages, creating a complete quality monitoring system.

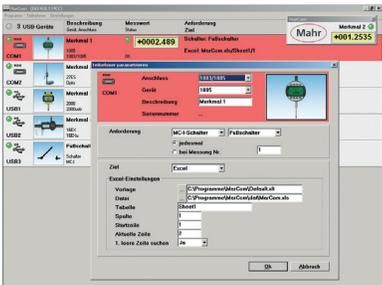


### Functionality and Benefits of Integrated Wireless Gaging

Triggered by the measuring device, keyboard, timer function, remote control or foot switch, the measurement data is sent from the gage to the wireless receiver. The receiver, in turn, is connected with the data acquisition software. The receiver is located in the USB port of the PC. The computer hardware is supported by the data acquisition software, which enables setup of measuring stations with wireless data transfer to the PC. Measured values can be transmitted into existing MS-Excel templates or a text file via SPC software using a virtual interface box (MUX50 format) or via keyboard code. Mahr Federal’s MarCom control is highly flexible in that the measured values of the connected measuring devices can automatically be transferred into separate columns, tables or sheets. This increases the reliability and accuracy of measurement data documentation. At the same time, this particular software ensures that the data can also be passed to virtually any SPC or CAQ software seamlessly. Since the MarCom software operates in the background, operators discover that their usual way of gaging remains the same as before.



Confirming reliability of the transmitted data, the devices display messages to assure users that the data has been transferred and whether the device is within receiving range of the receiver – generally within 20 feet is required. For added security, each i-Stick in the Mahr system has its own unique transmission code.

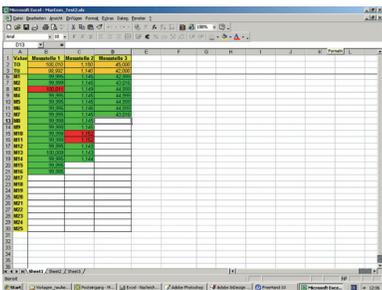


### More Benefits of Integrated Wireless Gaging – Cost, Freedom of Movement, Ergonomics

In addition to ease of use, portability and reliability of these new integrated wireless systems, cost-effectiveness is a significant and compelling benefit.

As the wireless interface is integrated into the digital measuring instruments, they are extremely energy efficient. In addition, contrary to conventional wireless data transmission systems, no additional battery is required.

Further, the initial investment is very low. Once again taking Mahr’s system as an example, the cost for one integrated wireless caliper, the MarCom Basic software and i-Stick receiver is approximately \$325. The software and receiver cost about as much as a data cable. The add-on “radio” type transmitter systems that a lot of manufacturers are still using can cost over \$900 per unit.



Easy-to-use applications allow for quick set up of the gaging network and easy implementation into Excel.

Perhaps most impressive are the incalculable savings in terms of more accurate data collection, real-time monitoring, and less scrapped workpieces when integrated into the machine tool process. That alone could mount into the hundreds of thousands of dollars each year.

Integrated wireless offers users considerably more freedom of movement than cabled devices. Whether at a measuring station or measuring on or at the machine tool measuring large workpieces, operators are not obstructed by any cables or a bulky radio transmitter. This benefit translates to better ergonomics for the operator who doesn't have to get in awkward positions to adequately measure a workpiece.

## MAHR FEDERAL CUSTOMER CASE STUDIES HIGHLIGHTING INTEGRATED WIRELESS GAGING TECHNOLOGY

### **CASE STUDY #1: Saving your team from possible injury and cutting QC costs**

A contract manufacturer was using an alignment bar in a large housing to determine if various components were in correct position before continuing with assembly. Operators would affix eight mechanical indicators to the bar and align the bar's longitudinal axis with the centerline of the component's axis to determine six radial diameter locations and two lateral face locations. They would then zero the gages in a starting position and rotate the bar a set amount and observe another set of readings, which required putting the body in an awkward position to see the dial adequately. The operators read the numbers to another person who wrote the numbers on a sheet. The procedure was repeated for two additional rotational positions of the bar.

The company recently replaced the mechanical indicators with MarConnect

indicators along with MarCom Pro software. Measurements now go directly into an Excel spreadsheet by pressing a single function button once on the nearby computer. Only one operator is needed and he doesn't have to contort himself to read the indicators. While a wired solution might have achieved similar results, the over 20 ft. workpiece is much better measured by a wireless system.

### **CASE STUDY #2: Turning QC time into productive time**

Operators at a New Jersey manufacturing firm wrote down measurements throughout each day and then spent at least 30 minutes at a computer terminal transferring the information into a database program at the end of each shift. By switching to MarConnect integrated wireless gages, the company was able to use that half hour for production instead. This paid for the system in only a week or two

and even justified the installation of large screen monitors to provide real-time SPC feedback to the operators, further improving productivity.

### **CASE HISTORY #3: New plant warrants latest technology**

When an Ohio customer decided to build a new plant, they knew they wanted to collect data, of course, but didn't want the hassle of connecting yards and yards of connecting cable. They reviewed several suppliers of digital indicators with wireless interfaces and chose Mahr's system of integrated wireless gages and i-Stick receivers. They liked the hassle-free use of not having cables or plug-in transmitters that constantly got in the way and consumed many batteries. They presently have two computers running MarCom Pro.

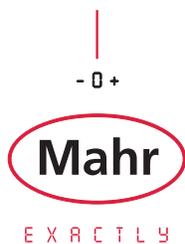
## Conclusion

In light of the current trend of factories evolving towards “smart,” completely digital environments, there is no question that embarking on a plan to implement wireless instruments and tools is inevitable for manufacturers. In fact, for those companies that are just starting on the journey, implementing new tools such as digital, wireless gages could be a wise entry-level experience into the world of wireless technology on the shop floor. These instruments require very little investment and have the potential for a great many benefits, namely:

- Efficient, accurate measurement data entry
- Flexible, real-time manipulation and monitoring of data
- Less cluttered work areas
- No tripping over gage-related cables or being obstructed by cables during measurement operations
- Improved operator ergonomics during measurement functions
- Significant cost savings over plug-in transmitters
- Cost savings in workpiece scrap and inaccurate data entry
- Energy-efficient operation

## Source and for more information

Mahr Federal Inc., a member of the Mahr Group, has over 150 years of experience providing dimensional measurement solutions to fit customer application needs. The company manufactures and markets a wide variety of dimensional metrology equipment, from simple and easy-to-use handheld gages to highly sophisticated measurement systems for form, contour, surface finish and length. Mahr Federal is also well known as a builder of custom-designed gages and a provider of calibration and contract measurement services. Mahr Federal’s calibration laboratories are accredited to ISO/IEC 17025:2005 NVLAP Lab Code 200605-0. For additional information visit <http://www.mahr.com>.



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