Measurement Data Management

INDEX

Mitutoyo

Example of Measurement Data Management Sy

A system for recording and analyzing measurement results from various Mitutoyo measuring instruments for quality assurance purposes.

A

Implementation Step 1

Recording measurement results

No more transcribing

Equipped with the data logger function, it allows batch transfer of stored data to a PC with a USB cable.

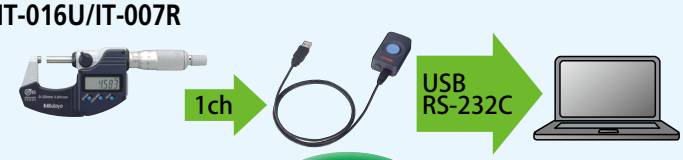
DP-1VA LOGGER A-23

Direct data input to a PC

Connecting cable-integrated USB-ITN

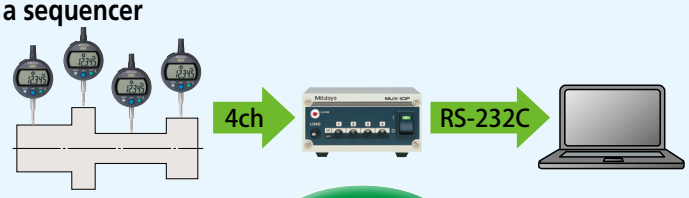
USB Input Tool Direct A-13

Lineup of two models with different output specifications IT-016U/IT-007R



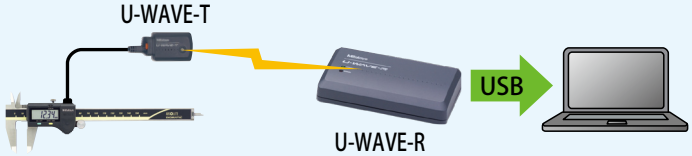
Input Tool Series A-14

Connect to a RS-232C interface PC with 4 channels and a sequencer



Multiplexer MUX-10F A-24

Wireless

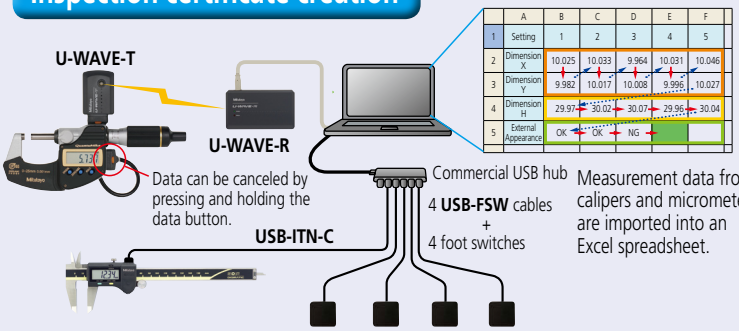


U-WAVE A-15

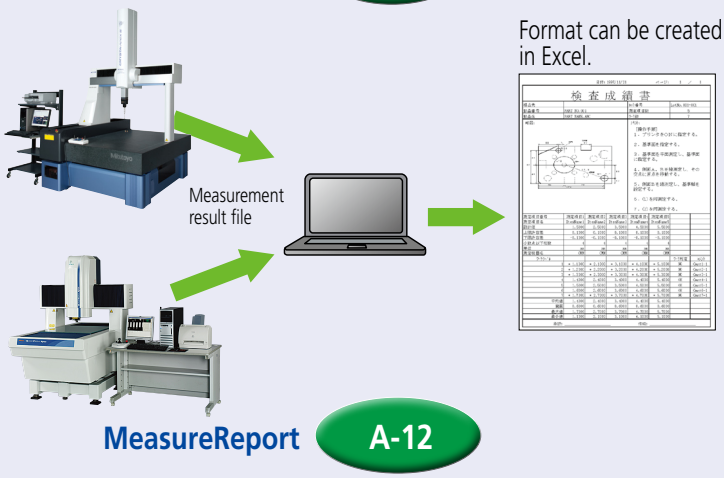
Implementation Step 2

Software dedicated to inspection and quality control

Inspection certificate creation

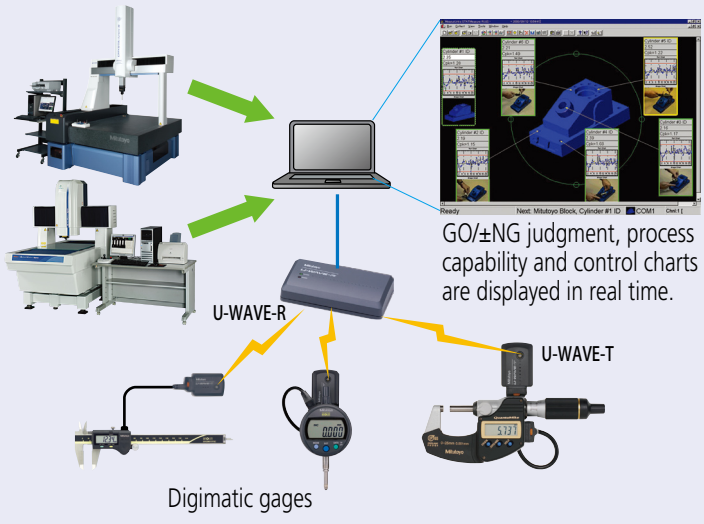


USB-ITPAK A-20



MeasureReport A-12

Statistical Process Control

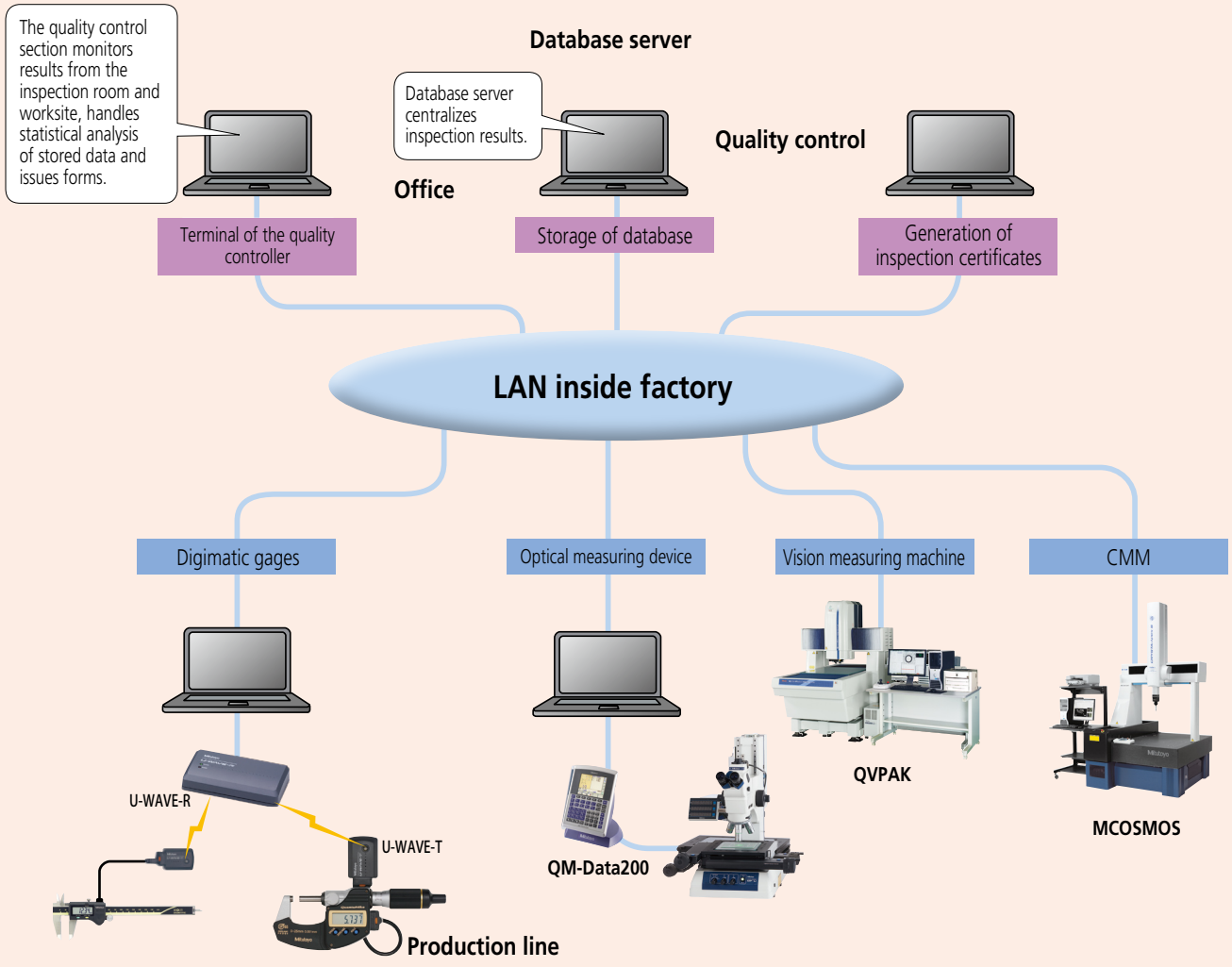


MeasurLink A-5

Implementation Step 3

Creating a quality control network covering a wide area within the factory

Unify management of the quality test using the network in the factory



MeasurLink A-5

Measurement Data Management

Convenient data collection tool and quality control software

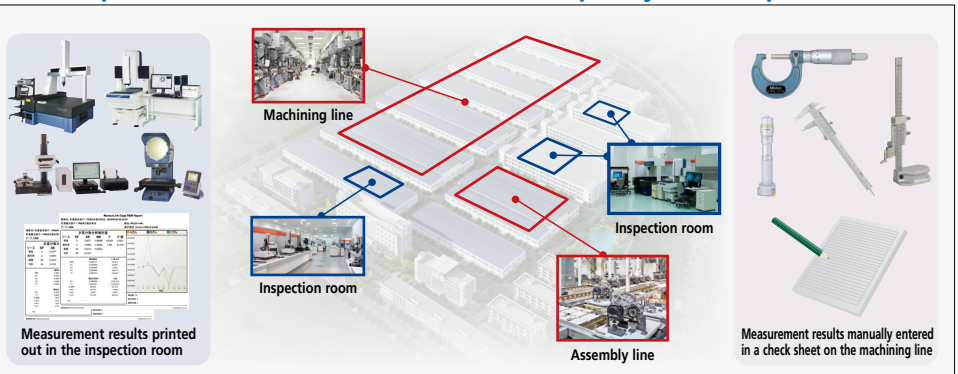
MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
MeasurLink

A

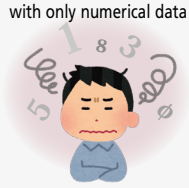
Measurement Data Network System MeasurLink

- MeasurLink is a data management modular software system that enables collecting data from a wide range of Mitutoyo measuring tools and systems including Coordinate Measuring Machines.
  Measurement data storage can be centralized by implementing a network system using a company LAN. Quality information such as checking, monitoring, analysis of the measurement results and creating inspection reports can be shared among separate offices to maximize efficiency.

Is the inspection record data utilized to solve quality-related problems?



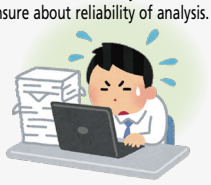
Hard to identify problems with only numerical data



Current problem

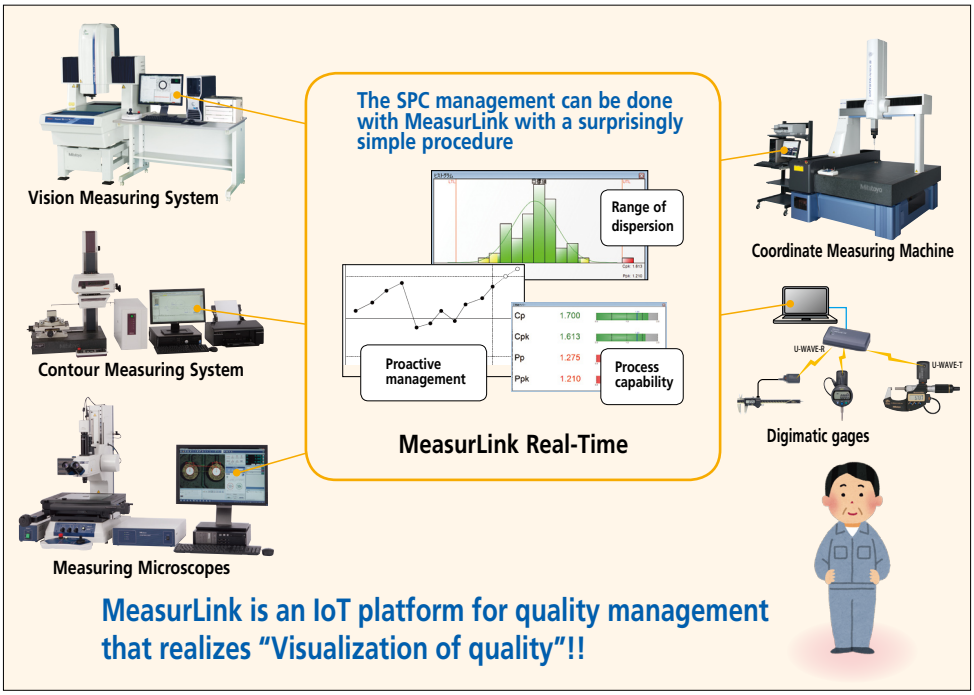
- Data scattered in various locations in the plant
- Numerical data not effectively utilized
- Lack of knowledge about statistical calculations
- Management using spreadsheet software
- Problems need to be tackled by the on-site person in charge

Hard to respond quickly since it takes time to enter and analyze data. Unsure about reliability of analysis.



Isn't there any quicker, simpler and more reliable management method?

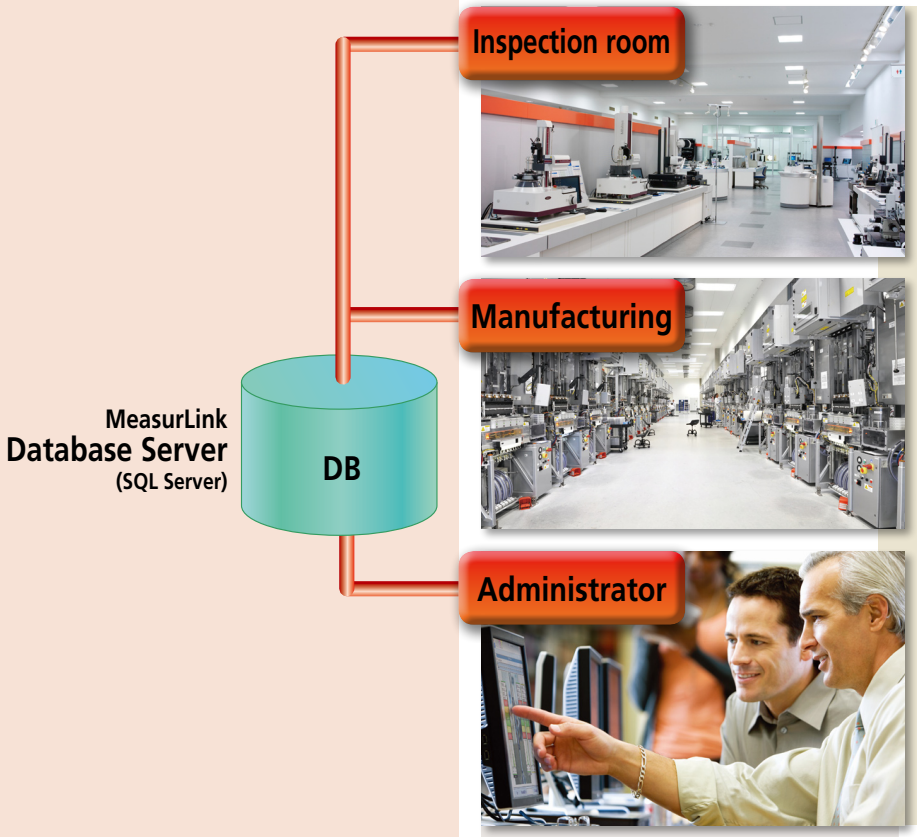
SPC management can be easily done by combining Mitutoyo measuring instruments and MeasurLink!!



MeasurLink is an IoT platform for quality management that realizes "Visualization of quality"!!

Refer to the MeasurLink leaflet (E12028) for more details.

- MeasurLink supports anything from small scale, standalone systems to large-scale systems utilizing a PC network environment. Expansion from a standalone installation to a networked system can easily be performed, allowing a gradual upgrade from a single-test operation in one section to a full-scale operation.



Data collection / Analysis module
MeasurLink Real-Time
(Refer to A-7 for details.)

This SPC software allows data collection from each tool and instrument and still allows real-time display of statistical processing data such as control charts, histograms and process capability indexes.

Automatic reporting program
MeasurLink Report Scheduler
(Refer to page A-8 for details.)

This program automatically outputs reports created by Real-Time or ProcessAnalyzer in the preset schedule.

Process Management for Administrators
MeasurLink Process Manager
(Refer to A-10 for details.)

This administrative software enables centralized monitoring of information from all MeasurLink data collection terminals networked together on the shop floor.

Process Analysis module for Administrators
MeasurLink Process Analyzer
(Refer to A-9 for details.)

This administrative software allows confirmation of measurement results and various statistical analyses by access to the database where the measurement data collected with MeasurLink Real-Time is stored.

Evaluation / Analysis Software for Measurement System Analysis (MSA)
MeasurLink Gage R&R
(Refer to A-11 for details.)

This is evaluation and analysis software compliant with MSA required in ISO/TS 16949.

Gage Management Software
MeasurLink Gage Management
(Refer to A-11 for details.)

This software plans and implements a complete calibration schedule and incorporates a powerful retrieval function in addition to recording and managing the operational state of gages.

Mitutoyo

Measurement Data Management

Convenient data collection tool and quality control software

MeasurLink Data Collection / Analysis Software

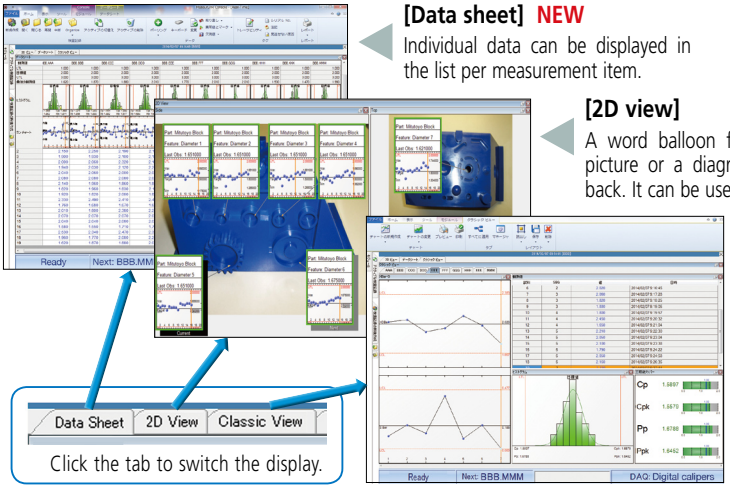
Real-Time Standard (RT Std)
Real-Time Professional (RT Pro)
Real-Time Professional 3D (RT Pro 3D)

MeasurLink Real-time is the Statistical Process Control (SPC) MeasurLink module that collects data from Mitutoyo and third-party measuring devices and systems to provide analysis functionality in real-time by displaying control charts or process capability indexes. Three versions are offered so that a customer can choose the version that best suits the requirements, from a standard version providing basic functionality through to the full-spec version offering data handling using Hoops 3D graphics. (Refer to Table 1 on the next page.)

MeasurLink Real-Time common functions

• Various data views

The measurement results are displayed in various views, including statistical analysis results, data lists, and work process imaging. The display can be switched instantly according to the needs of the operator.



[Data sheet] NEW
Individual data can be displayed in the list per measurement item.

[2D view]
A word balloon function is available having a picture or a diagram of the workpiece on the back. It can be used as work process instructions.

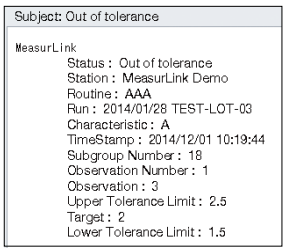
[Classic SPC view]
Graphs and lists can be freely selected to display data for a single measurement items. It is useful for checking detailed information such as date and time of the acquired data.

• Adding traceability information

Traceability information for each workpiece can be added, for example, serial no., lot no., inspector name, machine no., or cause of problems and remedies.
This information can be used as search criteria when extracting data using the filtering function (RT Pro / RT Pro 3D) when a problem occurs.

• Alarm function

The operator is notified when an "Out of Tolerance" or "Out of Control Limit" situation occurs.
The method of notification can be selected from a pop-up window, e-mail (Fig. 1), or log file recording.

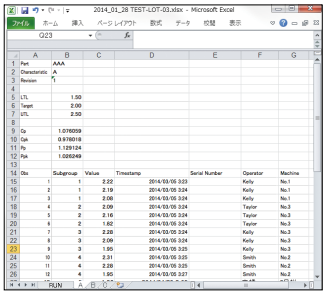

Subject: Out of tolerance

MeasurLink
Status : Out of tolerance
Station : MeasurLink Demo
Routine : AAA
Run : 2014/01/28 TEST-LOT-03
Characteristic : A
TimeStamp : 2014/12/01 10:19:44
Subgroup Number : 18
Observation Number : 1
Observation : 3
Upper Tolerance Limit : 2.5
Target : 2
Lower Tolerance Limit : 1.5

(Fig. 1) Alarm notification by E-mail

• Exporting data to an Excel file

Measurement data can be exported to an Excel file. This function is useful if the data needs to be used in a department that does not have MeasurLink.
(Fig. 2)



(Fig. 2) Export to Excel

RT Std / Pro / Pro 3D common functions

• Connectable measuring instruments
· Measuring tool with Digimatic output (equipped with PC data processing unit)
[Supported interfaces]
Wireless (USB) U-WAVE (VCP)
Wired (USB) IT-016/USB-ITN VCP or HID
Wireless (D-sub 9 pin) IT-007R MUX-10F, DP-1VA LOGGER, and others
• Screen display mode when collecting data
· Classic SPC view
· Data sheet
· 2D view
· Parts data sheet, etc.
• Statistical Analysis result
[Chart]
Xbar-R, Xbar-S, X-Rs control charts, Histogram, Run chart, Pre-control chart, Tear chart, Meta chart, Indicator bar, multivariate data control chart, etc.
[Statistics]
Maximum value, Minimum value, Standard deviation, Average ±3/4/6, Process capability indexes (Cp, Cpk, Pp, Ppk), Defect ratio
• Alarm function
[Target items]
· Out of tolerance
· 1 point exceeds control limit line (following are related to management chart)
· Consecutive 9 points on one side of center line
· 6 points successively increasing or decreasing
Others including 8 judgment criteria for Shewhart control chart
• Adding traceability information
· Measurement date (automatically added)
· Serial No. (Keyboard entry)
· Special causes and remedies
· Selection from comment list registered as an option
· Enter from keyboard when measuring classified title registered as an option (e.g. Lot No. LOT 001)
• Report print out function
· Measurement values, analysis calculation results and various charts can be arranged to output according to requirements.
• Export function of measuring result
· Excel format
· CSV format
• Security function
· Once the access authorization is set, it requires "User name" and "Password" input before the program will start. Data editing actions such as reference, entry and changes require authorization according to the user's role in order to preserve data reliability.
• Operation languages
14 languages are supported:
· Japanese, English, French, German, Dutch, Spanish, Swedish, Polish, Italian, Turkish, Korean,Chinese (simplified characters), Finnish, Portuguese

MeasurLink common functions

• Operating environments
[Operating System]
Microsoft Windows7 (32bit/64bit)
Microsoft Windows 8.1 (32bit/64bit)
(Microsoft Windows 8.1 RT is not supported)
Windows 10 (32bit/64bit)
(Windows 10 Mobile and IoT editions are not supported)
[Data base]
Microsoft SQL Server 2014 Standard Edition
Microsoft SQL Server 2014 Business Intelligence Edition
Microsoft SQL Server 2014 Enterprise Edition
Microsoft SQL Server 2012 Standard Edition
Microsoft SQL Server 2012 Business Intelligence Edition
Microsoft SQL Server 2012 Enterprise Edition
Microsoft SQL Server 2008 Standard Edition
Microsoft SQL Server 2008 Enterprise Edition
Standard / Workgroup Edition

RT Pro/Pro 3D Common functions

• Connectable measuring instrument
· Mitutoyo Measurement Data Management System (equipped with PC data processing unit)
[Supported data processing software]
· CMM: MCOSMOS V3.2 or later
· Vision System:QVPAK V10.0 or later/QSPAK V10.2 or later/QSPAK MSE V3.1 or later/QIPAK V4.1 or later
· Vision unit: QSPAK VUE V4.1 or later
· Surface Roughness / contour instruments: Formtracepak V5.3 or later
· Roundness instruments: ROUNDPAK V5.6 or later
· Hardness testing machines: AVPAK V2.0 or later
• Filter function
Keyword items for data extraction
· Measurement data (year, month, day, time, week, etc.)
· Serial No.
· Traceability information (e.g. Inspectors, Machine No., etc.)
· Alarm item
• Import function for text data
· Default format files (mbf, dfq, etc.)
· Customize function
A template can be created according the ASCII file to be imported.

RT Pro 3D Common functions

• Screen display mode when collecting data
· 3D view

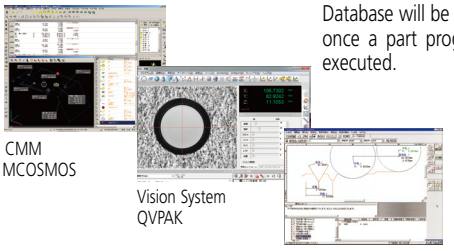
Table 1 Data collection/analysis software Real-Time functional comparison

Functions		Data collection software		
		Real-Time Standard	Real-Time Professional	Real-Time Professional 3D
Collected data display	Classic SPC view	●	●	●
	Data sheet	●	●	●
	2D view	●	●	●
	3D view (HOOPS)			●
Data extract	Filter		●	●
Input from tools and devices	Measuring tools (RS-232C, USB)	●	●	●
	Measuring instruments (DDE)		●	●
Text input	Import (ASCII)		●	●

• Real-time Professional 3D is a full-spec package. The feature to be measured can be displayed in detail using 3D CAD data.

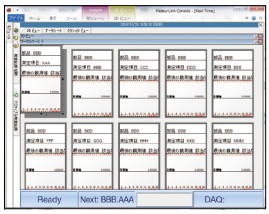
• Automatic linking with part programs

Linking with part programs created in CMM or Vision Measuring Systems, data such as part no.; measurement item; nominal size; tolerance value and more can be loaded from a part program. A database to store all of the data is automatically configured when a part program is run.



Database will be created once a part program is executed.

MeasurLink
RT Pro / RT Pro 3D



Once storage is created, data is automatically written in the database every time the part program is executed, and the statistical result will be displayed.

• Filtering function

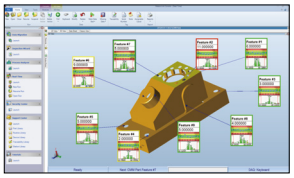
Required data can be easily extracted based on the date and time of the measurement, added comments, or alarms.

• Import function

Measurement data saved in ASCII files can be loaded. Also, a feature to customize a template for loading according to the format is provided.

• Real-time Professional 3D is a full-spec package

The feature to be measured can be displayed in detail using 3D CAD data.



[3D view]

3D graphics library HOOPS displays real view of the workpiece using an hsf file created from 3D CAD data. The displayed workpiece image can be freely turned, translated, or scaled so that you can get a clear view of the feature to be measured
The word balloons and lead lines that display the measurement result and measured feature will move following the CAD data translation.

MeasurLink Automatic Report Generation Program

MeasurLink Report Scheduler

Automatically generates a report created by the Real-Time (Standard, Professional or Professional 3D) or Process Analyzer (Lite or Professional) modules, each of which is connected to the network according to a specified schedule.

The Use of MeasurLink Report Scheduler

• Examples of use

• Automatic generation of a weekly report specified from among last week's data.
• Automatic report generation by extracting only data with tag information about "tool replacement" (due to wear, breakage, etc.)
• Automatic generation of a daily report for each shift by filtering inspection record data on the basis of a shift

MeasurLink Report Scheduler common functions

• Report output destinations

• Printer, file, E-mail (as an attached document)

Measurement Data Management

Convenient data collection tool and quality control software

MeasurLink Optional Process Analysis Software for Administrators

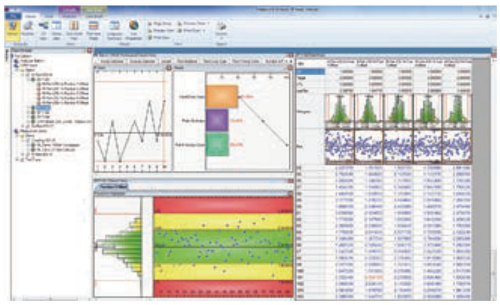
Process Analyzer Lite (PA Lite)

Process Analyzer Professional (PA Pro)

Process Analyzer is an optional software package provided for administrators who are authorized to access the database storing measurement data collected by MeasurLink Real-time for the purpose of checking and analyzing measurement results. Two types of packages are made available: Process Analyzer Lite, the basic version; and the full-spec Process Analyzer Professional version. (See Table 1.)

- **PA Lite is a cost-effective package for viewing the measurement database.**

Data stored in the MeasurLink database can be checked from a selected list.



The same data displayable by data collection software can be displayed, including measurement results, charts, and statistical calculation results with the look and feel of Windows Explorer.

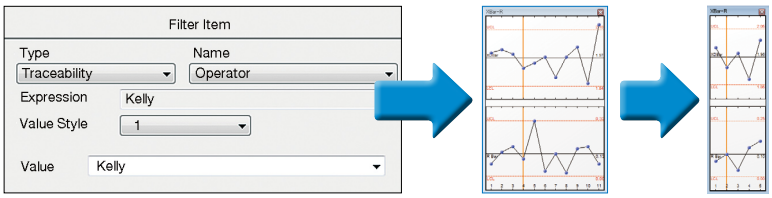
- **PA Pro is a full-spec package that provides additional data check and analysis capability.**

Can also perform various analyses by filtering, data processing, etc., in addition to data checking.

- **Filtering function that allows data extraction and grouping**

Data can be extracted or grouped by selecting the date and time and other traceability information as keywords.

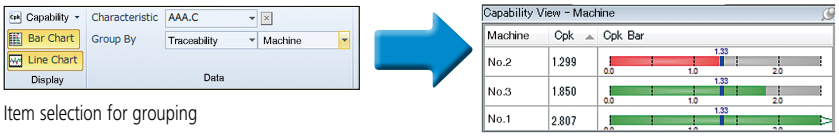
Example) Filtering data by an operator name .... Displays statistical analysis result in charts (Xbar-R, for example).



Filtering item selection menu

Result of filtering in the chart

Example) Grouping by Machine No. ..... Cp, Cpk comparison



Item selection for grouping

Cpk value and bar graph per machine

Table 1 Process Analyzer functional comparison (an option available for administrators)

Function		Process analysis software	
		Process Analyzer Lite	Process Analyzer Professional
Result display	Classic SPC view	●	●
	Data sheet	●	●
	2D view	●	●
Data extract	Filter		●
Data processing	Data file merging, Copying, Editing		●
Masking	Archive data		●

PA Lite/PA Pro common functions

- Result display
  - Classic SPC view
  - Data sheet
  - 2D view
  - Parts data sheet, etc.
- Statistical Analysis result

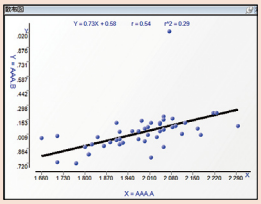
[Chart]
Xbar-R, Xbar-S, X-Rs control charts, Histogram, Run chart, Pre-control chart, Tear chart, Meta chart, Indicator bar, multivariate data control chart, etc.
[Statistics]
Maximum value, Minimum value, Standard deviation, Average ±3/4/6, Process capability indexes (Cp, Cpk, Pp, Ppk), Defect ratio

- Report print out function
  - Measurement values, analysis calculation results and various charts can be arranged to output according to requirements.
- Exporting function of measurement result
  - Excel format
  - CSV format

PA Pro functions

- Statistical analysis result

[Chart]
Scatter plots: The relationship between two items can be plotted.



- Data processing capability
  Files can be managed by merging, copying, and editing. Also, the data archive function allows inclusion of the archived data in the Real-Time list.
- Data processing
  - Data file merging,Copying
  - Editing
- Data processing capability
  Old data can be displayed extracting from the list of the data collection software.
- Electronic certification function
  Conforms to FDA 21CFR PART11

Loggable event

- Start and end of measurement
- Recollection/change of measurement data
- Irregular value occurrence
  (Out of tolerance, out of management, sequence, tendency, etc.)
- Unmissable causes
- Change of process capability index
  (Acceptance to rejection / Rejection to acceptance)

Contents of call-out display

- Station name
  (terminal name of each measuring instrument)
- Inspection procedure
  (measuring procedure name for each part)
- Final revision date/time (data input time, etc.)
- Measured item information: Displays the designated number of items from the top
  (1) Inspection record file name*
  (2) Measurement item*
  (3) Process capability index*
  (Cp, Cpk, Pp, Ppk, etc., multiple selection available)

*Measurement items are sortable (ascending, descending order)

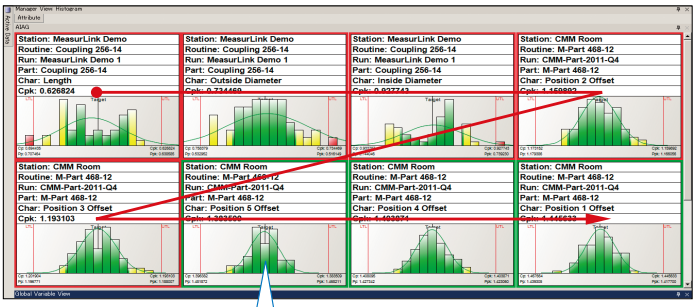
MeasurLink Process Management for Administrators

Process Manager

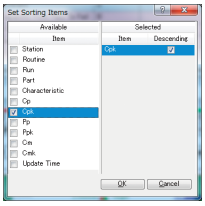
MeasurLink Process Manager enables centralized monitoring of real-time measurement information and checking of detailed information from all MeasurLink data collection terminals networked together on the shop floor. Measurement results can be checked in real-time to enable minimizing defects without visiting the shop floor. In addition to simple GO/NG judgments, use of tools such as Manager View, histograms, process capability indexes, etc., make it possible to find abnormal process trends easily.

• Manager View

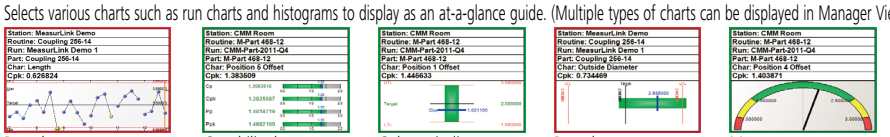
Displays various types of charts as an at-a-glance guide. The administrator can narrow down all items of data currently being measured into a specific monitoring range of those of critical importance or sort those data (in ascending or descending order) on the basis of process capability index.



Possible to sort charts in the view and narrow down the monitoring range.

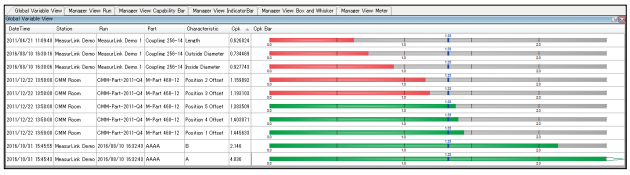


Selects various charts such as run charts and histograms to display as an at-a-glance guide. (Multiple types of charts can be displayed in Manager View.)



Run chart | Capability bar | Column indicator | Box plot | Meter

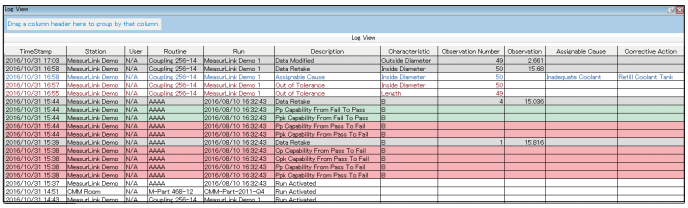
• Global measurement value view



Displays bar graphs that can determine good or bad process capability indexes at a glance. This allows the administrator to sort all current measurement data (in ascending or descending order) on the basis of process capability index, measurement date and time, part name, etc.

• Log view

Displays various types of events that occur during measurement. This allows the administrator to grasp the state of measurement operation (measurement start/termination, etc.) and the occurrence of an abnormal event (out-of-tolerance, etc.) for all current measurement data.

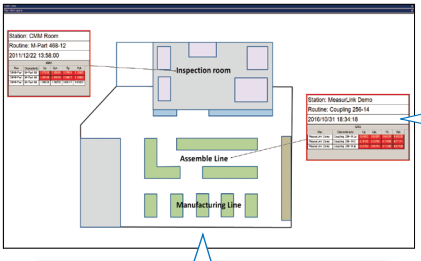


[Events possible to be logged]

- Measurement start/termination
- Recollection / change of measurement data
- Occurrence of outliers (Out-of-tolerance / out-of-control / run / trend, etc.)
- Out-of-recognition cause
- Change of process capability index (Acceptance to rejection / rejection to acceptance)

• Plant view

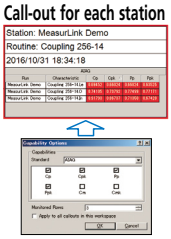
Displays a process capability index for each measuring instrument on the plant layout drawing. This allows the administrator to quickly identify the location where an abnormality has occurred.



Displays graphics files (bmp, jpg, gif, png) in the plant layout drawing in the background.

Call-out boxes with a leader can be arranged on an instrument-by-instrument (station-by-station) basis in conformity with the plant layout drawing in the background.

Call-out for each station



[Contents of call-out display]

- Station name (terminal name of each instrument)
- Inspection procedure (measuring procedure name for each part)
- Final revision date/time (data input time, etc.)
- Measured item information: Display of items for the specified number from top down
  (1) Inspection record file name *
  (2) Measured item name *
  (3) Process capability index *
  (Cp, Cpk, Pp, Ppk, etc.: two or more selectable)

* Measured items can be sorted (in ascending or descending order).

Mitutoyo

Measurement Data Management

Convenient data collection tool and quality control software

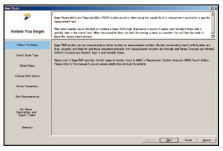
MeasurLink Evaluation / Analysis Software for Measurement System Analysis (MSA)
Gage R&R

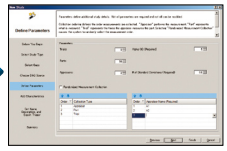
A

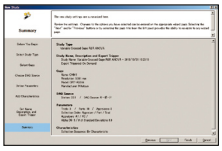
This is evaluation and analysis software conforming to Measurement System Analysis (MSA) required in ISO/TS 16949. Implementing MSA evaluation can be performed easily and quickly. ISO/TS 16949 requires that a proper measurement system be achieved by analyzing the accuracy of each instrument and variations in operator effects on repeatability using statistical methods.

• Automatic calculation of MSA evaluation results

This allows the operator to simply input an evaluation method/evaluation condition and measurement data with the Wizard function. The operator can implement MSA evaluation simply by selecting an "investigation type option", "gage option", "data input source option", "parameter option", etc. Measurement results, charts, and statistical calculation results are presented with the look and feel of Windows Explorer.


Investigation type options


Parameter options


Overview

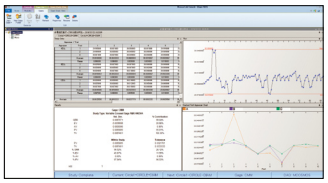
• Evaluation method compliant with MSA (fourth edition)

The software can implement evaluation using the following methods compliant with MSA (Measurement System Analysis).

1. Measurement value tolerance gage R&R variance analysis method
2. Measurement value tolerance gage R&R range&average method
3. Measurement value branching gage R&R variance analysis method
4. Measurement value branching gage R&R average&range method
5. Measurement value range method
6. Measurement value simplified method
7. Measurement value MSA4
8. Deviation
9. Linearity
10. Stability

• Analysis chart view

Various charts such as the control chart are effective for analysis/judgment on variations due to operator, the adequacy of gage accuracy, etc., and remedies for problems.



• Registration of gage-specific information

1. Registration of information on gages within the system

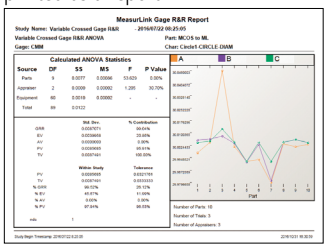
This allows registration of gage information on the following items and association with evaluated results.
Registration items: Gage name, maker, model, resolution, unit, measuring range, etc.

2. Information link between MeasurLink Gage Management and this software

This software can use gage information that has been registered in Gage Management directly as options.
Additionally, since R&R evaluation results are also linked with gage information, the schedule of gage R&R expiry dates can be managed by Gage Management.

• Output of results as a report

Evaluated results and charts can be printed as a report.

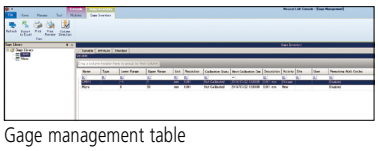


MeasurLink Gage Management Software
Gage Management

This software can plan and implement a reliable calibration schedule with a powerful retrieval function in addition to recording and controlling the status of gages. It enables simple recording of gage usage state (operation, storage, calibration, gage R&R, repair and out-of-service) to speedily understand the current location and state of all gages. Common gage information can be viewed from all networked terminals in which this network-compatible software has been installed. Gage information can be shared between software packages linked to MeasurLink Gage R&R.

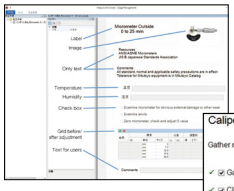
• Creation of a list of calibration-targeted gages from the gage administration table

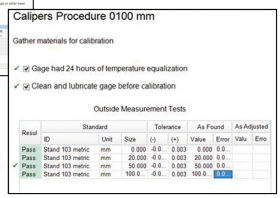
The target gages are retrieved from a variety of search items such as gage ID, gage type, model, maker, distributor, calibration date, current usage state and location to create the list.


Gage management table

• Registration and running a calibration procedure

Allows simple registration of the calibration procedure for each gage and implementation of the calibration.

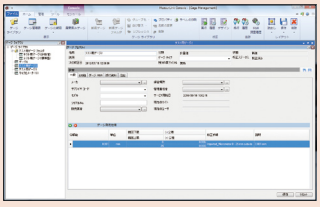

Registration of calibration procedure

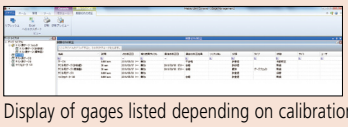


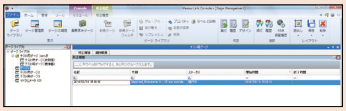
Calibration run

• Confirmation of detailed gage information

Allows confirmation of detailed information on individual gages. The software allows you to display a list of gages depending on "Calibration Overdue", "Next Month Due", etc., by setting a calibration date and confirm detailed information on the calibration history of gages.


Display of detailed gage information


Display of gages listed depending on calibration date


Display of calibration history

Main specifications of MeasureReport

- Document creation:
  Automatic creation of template sample style (Number of items x number of workpieces specified)
- GO/±NG Judgment:
  Tolerance judgment (marked in NG value)
  Workpiece judgment (OK or NG in judgment column)
- Statistical analysis: mean, maximum, minimum, range, standard deviation, Cp, Cpk, fraction defective, number of defectives, etc. 15 items in total.
- Capacity:
  (1) Measurement result file conversion
  (2) On-line data input
  Max. 200 items x Max. 2,000 workpieces
  (3) MeasurLink database import
  Max. 200 items x Max. 2,000 workpieces or
  Max. 2,000 items x Max. 200 workpieces
- File combined:
  A maximum of 10 measurement files can be specified and both measurement items and workpieces can be combined respectively.
- Printing and saving of inspection table:
  Automatic printing and saving in Excel format
- Comment output to the inspection table:
  30 items including part number and lot number can be input.
- Workpiece drawing output to the inspection table:
  Image files (bmp, jpg) can be displayed in arbitrary positions.
- Others:
  Decimal point digit justification, error display, automatic page break
- File conversion: Supported file formats

<CMM>
(1) MCOSMOS ASCII file (Geopak-3)
(2) MPK2700 statistic file (Binary format)
(3) MPK2700 ASCII file (Text format)

<Vision Measuring Systems>
(1) QUICK VISION QVPAK-QV Report
(2) QUICK SCOPE QSPAK measurement result file
(3) QUICK IMAGE QIPAK measurement result file

<Optical Instruments>
(1) Vision Unit QSPAK measurement result file

- MeasurLink can be exported up to Version 6.2.

Measure Report operation environment (recommended)

- OS: Windows 2000
  Windows XP
  WindowsVista (32-bit)
  Windows 7 (32-bit/64-bit)
  Windows 10 (64-bit)
- Microsoft Excel: 2000/2002/2003/2007/2010/2013/2016*

*Only 32-bit edition is available regardless of Windows version. It doesn't work on 64-bit Windows.

- CPU: Processor of 1 GHz or more
- Memory: 2GB or more
- Hard disk: 3GB or more free space
- Display: 1024 x 768 or larger
- Drive: CD-ROM or DVD drive (required for installation)

Data Conversion Program into Inspection Certificates in Excel Format MeasureReport

- Data from a measurement result file generated with a CMM, vision measuring machine or other machine can be output to an inspection table generated with Excel. Data from multiple measuring machines can be combined into a single inspection table (up to 200 measurement items).
- The computation function is available for tolerance judgment, workpiece judgment, statistical calculation and other types of processing at inspection-table generation time.

Create inspection table from measurement result file for each measuring machine (PC data processing)

CMM
MCOSMOS, MICROPAK2700
MICROPAK700

Measurement result file

Vision Measuring Systems
QVPAK, QSPAK
QIPAK

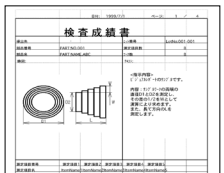
Measurement result file

Optical Instruments
Vision Unit
QSPAK

Measurement result file

Measurement result file conversion

Select and extract data, design value, tolerance value, etc., and output in specified Excel format.



Example of inspection table.

Excel inspection table creation macro program

- Measurement result file, data loaded from on-line communication, or data specified from database file of MeasurLink can be output to an Excel table.
- Original format can be created by simple editing with sample style as a template.
- Desired template style can be automatically created by specifying required number of items and workpieces.
- Tolerance judgment (*marked in NG data), workpiece judgment (OK or NG is indicated in judgment column), statistical analysis, page break are automatically processed.
- Data from several measuring machines can be combined in one inspection table.

Measurement Data Management

Convenient data collection tool and quality control software

Digimatic Gage / PC Data Input Device
USB Input Tool Direct

A

A data collection tool that offers simple and popular operability (HID connection) and optional software to input data to Microsoft Excel at a reasonable price. A more sophisticated way to improve operational efficiency.

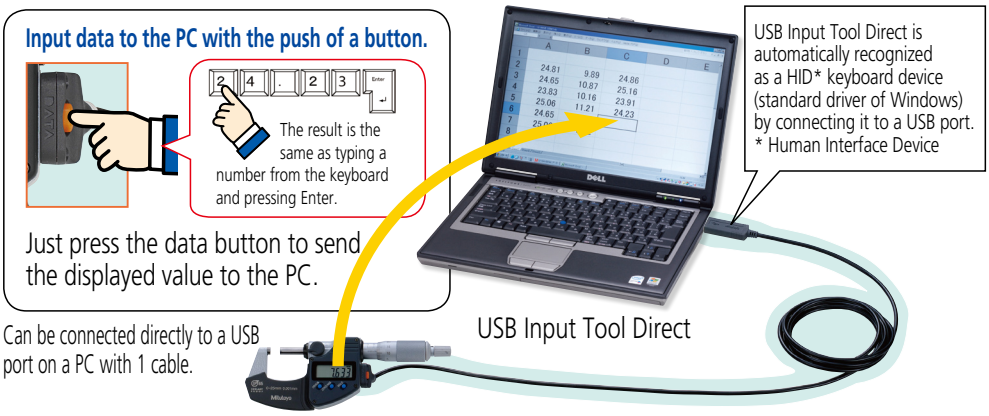
Use USB-ITN standalone as a dedicated interface for Digimatic indicators compatible with HID keyboard devices.

In common with the popular model IT-016U, this device is capable of entering measurement data to Microsoft Excel or a memo pad. Application example: using USB-ITN standalone to input data while selecting the data entry point flexibly during a measurement whose procedures cannot be determined in advance (such as the inspection of items or trial products with few measurements or without repeated procedures).

Using USB-ITN in combination with dedicated options

Refer to pages A-20 to A-22 for details.

If you need more than just the ability to load the measurement data to Excel, the optional software USB-ITPAK can create a data input procedure to an Excel sheet to improve the operational efficiency of repeated inspections. Application example: using USB-ITN in combination with USB-ITPAK V2.1 to improve the operational efficiency of daily inspections such as sampling tests or complete inspections of mass-produced product.




USB-ITN

Main specification

- Output compatibility: USB1.1 and USB2.0
- Supporting driver software: Switchable between 2 items below
  (1) When using standalone: HID keyboard device*
  (2) When using with USB-ITPAK V2.1: Virtual COM port (VCP)
- Communication speed: 12Mbps (Full Speed)
- Power supply: USB bus power
- Mass: 59 g
- USB2.0 certificate
- Conforms to EMC Directives.

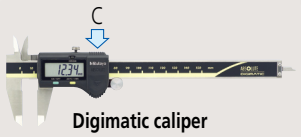
*Since this device is compatible with Windows standard driver software, dedicated driver software is not required.

System Configuration

Digimatic gages ← **Gage selector 3** (optional) ← **USB Input Tool Direct USB-ITN** → **PC**

Note: Only connectable with USB-ITN-D.

Foot Switch (optional) → **USB-FSW** (optional) → **USB-ITPAK V2.1** (optional)


Digimatic caliper

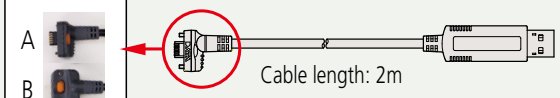

Digimatic micrometer


Digimatic indicator

Refer to pages A-25 and A-26 for details of Digimatic ports and connectors.

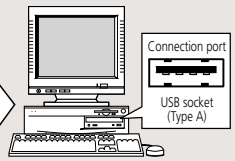
Connect the Digimatic connector to the gage

USB Input Tool Direct USB-ITN



Type	Order No.	Data switch
A	06AFM380A	✓
B	06AFM380B	✓
C	06AFM380C	✓
D	06AFM380D	–
E	06AFM380E	–
F	06AFM380F	–
G	06AFM380G	–

Connector is plugged into a USB port on a PC



System Environment

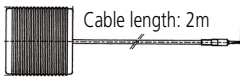
- **Hardware:**
  PC with USB socket (Type A)
- **Supporting OS:**
  Windows 2000 SP4
  Windows XP SP2 (or later)
  Windows Vista
  Windows 7
  Windows 8/8.1
  Windows10
- **Software:**
  Programs supporting keyboard input (Excel, Word, memo pad, etc.)
  Connection with USB-ITPAK is not available.

Data loading methods

- Data switch on the input tool (Type A/B/C only)
- Data switch on the measuring gage
- Command transmission from a PC*

* Only available when using **USB-ITPAK V2.1**
(1) Icon operation
(2) Function key operation
(3) Foot switch operation
One of the above operations

Foot Switch (optional)
937179T


Cable length: 2m

Option for USB-ITN
USB Foot Switch Adapter USB-FSW
06ADV384

Measurement Data Collection Software
USB-ITPAK V2.1 (optional)
06AFM386

Note:
- When using a foot switch in combination with **USB-ITN**, the optional **USB-FSW** and **USB-ITPAK V2.1** are required.
- When the measuring gage and USB-ITN have no data pushbuttons, the optional **USB-ITPAK V2.1** is required.

Refer to pages A-20 to A-22 for details of the options.

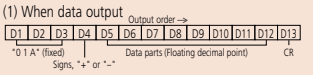
Specifications of IT-007R RS-232C Communication

- Output specification: RS-232C compliant

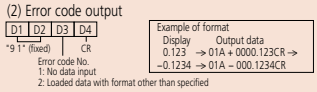
Communication method: Full duplex
Communication speed: 2400bps (fixed)
Bit configuration: Start bit 1
Data length 8
(Most significant bit, 0 (fixed))
Parity, None
Stop bit 1
Flow control: None
Home position: DCE (modem definition)

- Data format

(1) When data output



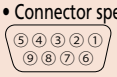
(2) Error code output



- Data request signal

Data can be output by transmitting a character from the PC.

- Connector specification and power supply from the PC



This product operates while accumulating the power supplied from the PC. A second or more input interval is required.

Pin No.	Symbol	in/out	Description of functions
1	(N.C.)	—	No connection
2	RXD	OUT	Data output from this product to the PC
3	TXD	IN	Data input from the PC to this product
4	DTR	IN	+12 V power supply from the PC*
5	GND	—	Ground
6	DSR	OUT	Not used
7	RTS	IN	+12 V power supply from the PC*
8	CTS	OUT	Not used
9	(N.C.)	—	No connection

* "4" and "6", "7" and "8" are connected with each other inside this product.
* When connecting to a sequencer, a power supply is required.
Input voltage: Supplied in the range 6 V - 16 V
Power supply terminal: Supplied to pins 4 and 7

Measurement Data Input Unit
Input Tool SERIES IT-016U / IT-007R

USB Keyboard Signal Conversion Type IT-016U

The IT-016U, a popular USB input tool that enables easy data recording. Allows you to perform inspection work more efficiently.

IT-016U

The IT-016U is equipped with a connector socket for a push-button or switch-foot operation.
Functional improvements include:

- A bigger, easy-to-press data switch. Size increased from ø4 mm to ø18 mm.
  Durability of the push button increased from 1 million to 10 million operations.
- May be used with optional software USB-ITPAK V2.1
  Enables efficient routine inspection work, for example, in mass production.

RS-232C Communication Conversion Type IT-007R

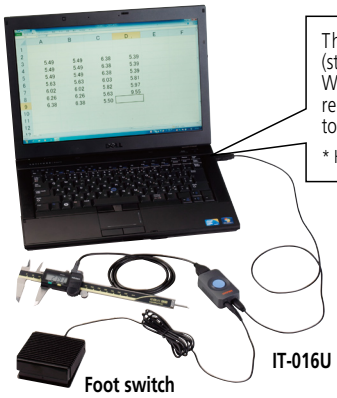
Input tool for RS-232C communication best suited for communication control of the software!

IT-007 R

Control is available by transmitting data request commands via RS-232C.
For example, production engineers can create communication programs to load the measurement data by transmitting a command from the PC.
This product is a compact and low-cost RS-232C communication interface, which is convenient when it is installed in a machine tool or dedicated device to feed back measurement data.

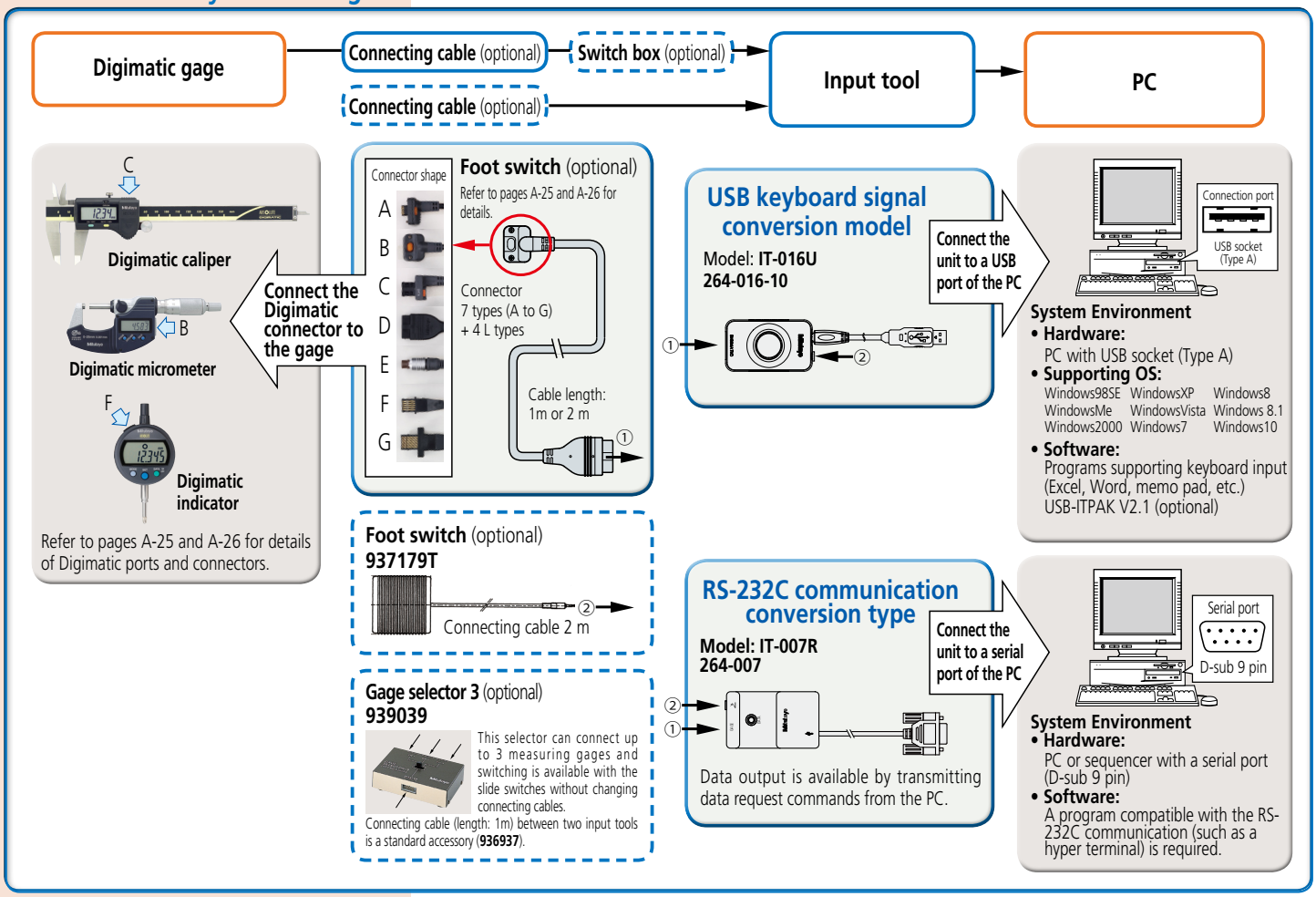
Main Specifications of IT-016U

Supported driver software: Changeable between two types
Output specification: USB2.0 or USB1.0
(1) Stand-alone: HID keyboard device*
(2) Using USB-ITPAK V2.1: Virtual COM port (VCP)
Communication speed: 12Mbps (Full Speed)
Power supply: USB bus power
USB2.0 certificate
Conforms to EMC Directives
* This product is compatible with the standard driver software for Windows. No dedicated driver software is required.



The HID keyboard device (standard driver software for Windows) is automatically recognized when connected to a USB port.
* HID (Human Interface Device)

IT-016U/IT-007R System Configuration



Measurement Data Management

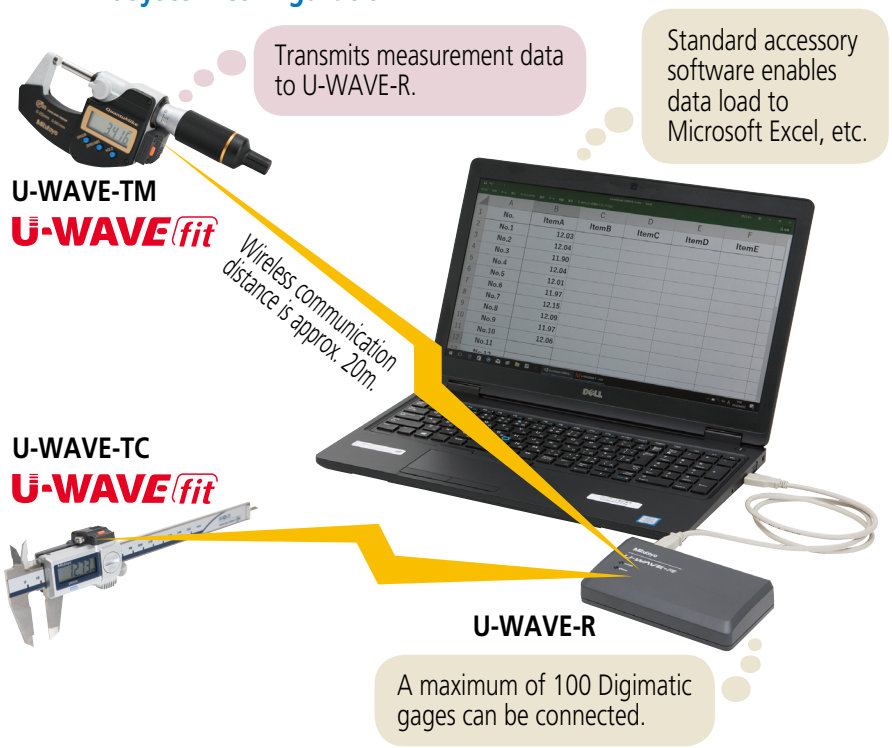
Convenient data collection tool and quality control software

Measurement data wireless communication system U-WAVE-TC / TM (U-WAVE fit)

A

- Data from tools with Digimatic output function can be sent to a PC via wireless communication.
- With functions and performance inherited from U-WAVE-T, the compact and thinner design provides better fitting to an instrument and improved operability, which enables further improvement of efficiency.
- The data interface function of the U-WAVE-R standard accessory software enables data input to commonly available software (Microsoft Excel, Notepad, etc.) by keyboard input.
- USB-ITPAK V2.1 supports U-WAVE!
  Loading multiple measurement data into separate Excel sheets, or simultaneous measurement using the special event drive is now available without the need for macro programming yourself. (Automatic loading in a certain interval is available with a timer function.)

U-WAVE fit system configuration



1 U-WAVE-R

Receives data from U-WAVE-TC / TM and loads to a PC via USB.

Model	U-WAVE-R
Order No.	**02AZD810D**
Power supply	USB bus power system
Number of U-WAVE-R units that can be connected to one PC	Up to 15
Number of U-WAVE-T units that can be connected	Up to 100
External dimensions	140×80×31.6 mm
Mass	130 g

U-WAVE-R main unit

USB2.0 cable (1m) attached

U-WAVEPAK

U-WAVEPAK software (standard accessory)

System Environment: Compatible OS

Windows 2000 Professional (SP4 or later)*
Windows XP Home Edition (SP2 or later)*
Windows XP Professional (SP2 or later)*
Windows Vista*, Windows 7*, Windows 8/ 8.1*
Windows 10*

* Revision history (U-WAVEPAK)
  Ver1.010 or later is compatible with 32/64-bit OS.
  Ver1.020 or later is compatible with Windows 8.
  Ver1.021 or later is compatible with Windows 8.1.
  Ver1.022 or later is compatible with Windows 10.

Main specifications

- Setup of dedicated driver software (USB and virtual COM port)
- Initial setting of ID number and frequency selection (required only once for the first time)
- Load data to Microsoft Excel or Notepad through the data interface function
- Note: Cannot be connected to a device other than a PC (such as DP-1VA LOGGER, PDA, or controller).

U-WAVE fit (U-WAVE-TC / TM) System Communication Specifications

• Wireless communication

Wireless specifications	IEEE802.15.4 base
Wireless communication distance	Approx. 20 m (line of sight)
Wireless communication speed	250 kbps
Transmission output	2.5 mW (4 dBm) or less
Modulation method	DS-SS (Direct Sequence - Spread Spectrum) Resistant to interfering signals and noise
Communication frequency	2.4 GHz band (ISM band: Universal frequency)
Used band	15 channels (2.405 to 2.475 GHz at intervals of 5 MHz) The noise search function avoids interference with other communication devices.

Use of U-WAVE is allowed in the following countries:

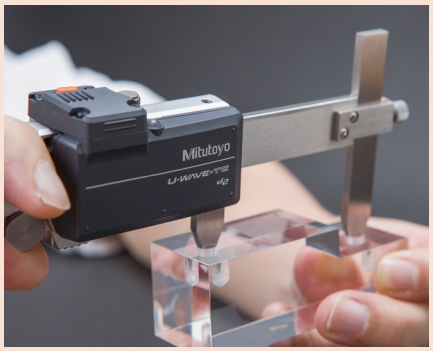
This product is a radio equipment classified in the 2.4 GHz Wide-band Low Power Data Communication System.
To use this product, conformity to the radio law of each country is required.
For use in countries other than those below, please contact your dealer or nearest Mitutoyo sales office.
To use in countries other than the country where you purchased the product, please contact your dealer or nearest Mitutoyo sales office.

Applicable models	**264-620/1/2/3**
Asia	Japan, China, Vietnam
North America	US, Canada
Europe	28 EU member nations (UK, France, Germany, Italy, Netherlands, Belgium, Luxembourg, Spain, Portugal, Austria, Sweden, Finland, Denmark, Bulgaria, Cyprus, Czech Republic,, Slovakia, Estonia, Greece, Hungary, Ireland, Latvia, Lithuania, Malta, Poland, Romania, Slovenia, Croatia) 4 EFTA member nations (Norway, Switzerland, Iceland, Liechtenstein) and Turkey

As of August, 2018

Refer to the U-WAVE Catalog (No. E12000) for more details.

Applications



Measurement data wireless communication system U-WAVE-TC / TM (U-WAVE fit)

Type of transmission unit

264-622

264-621

SPECIFICATIONS

Transmits measurement data to U-WAVE-R. Select IP67 or buzzer model according to your application.

Connectable measuring instruments	Micrometer		Caliper	
Order No.	**264-622**	**264-623**	**264-620**	**264-621**
Model	**U-WAVE-TM** (IP67 type)	**U-WAVE-TM** (Buzzer type)	**U-WAVE-TC** (IP67 type)	**U-WAVE-TC** (Buzzer type)
Protection Rating	IP67	N/A	IP67	N/A
Data reception indication	LEDs	Buzzer and LEDs	LEDs	Buzzer and LEDs
Power supply	Lithium battery CR2032×1			
Battery life	Approx. 400,000 times continuous data transmission			
External dimensions	41.9×12.9×38.8 mm		56×11.45×30.4 mm	
Mass	18 g			

Note: IP67 model is water/dust-proofed suitable for the factory floor.

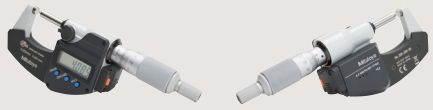
02AZF310

02AZF300

Fixed to transmission unit and inserted into output connector of digimatic gage

Order No.	**02AZF310**	**02AZF300**
Protection level	IP67	N/A
Mass	6 g	
Connectable transmission unit	U-WAVE-TM/TC (IP67 type)	U-WAVE-TC (Buzzer type)

Compatibility of measuring tool and unit

Digimatic gage		Assembled appearance (Front / Back)	Connecting unit	Transmission unit
Micrometer	Standard		 **02AZF310**	**U-WAVE-TM (Buzzer type) 264-623**  U-WAVE fit
	Water/dust-proof type			**U-WAVE-TM (IP67 type) 264-622**  U-WAVE fit
Caliper	Standard		 **02AZF300**	**U-WAVE-TC (Buzzer type) 264-621**  U-WAVE fit
	Water/dust-proof type		 **02AZF310**	**U-WAVE-TC (IP67 type) 264-620**  U-WAVE fit

Measurement Data Management

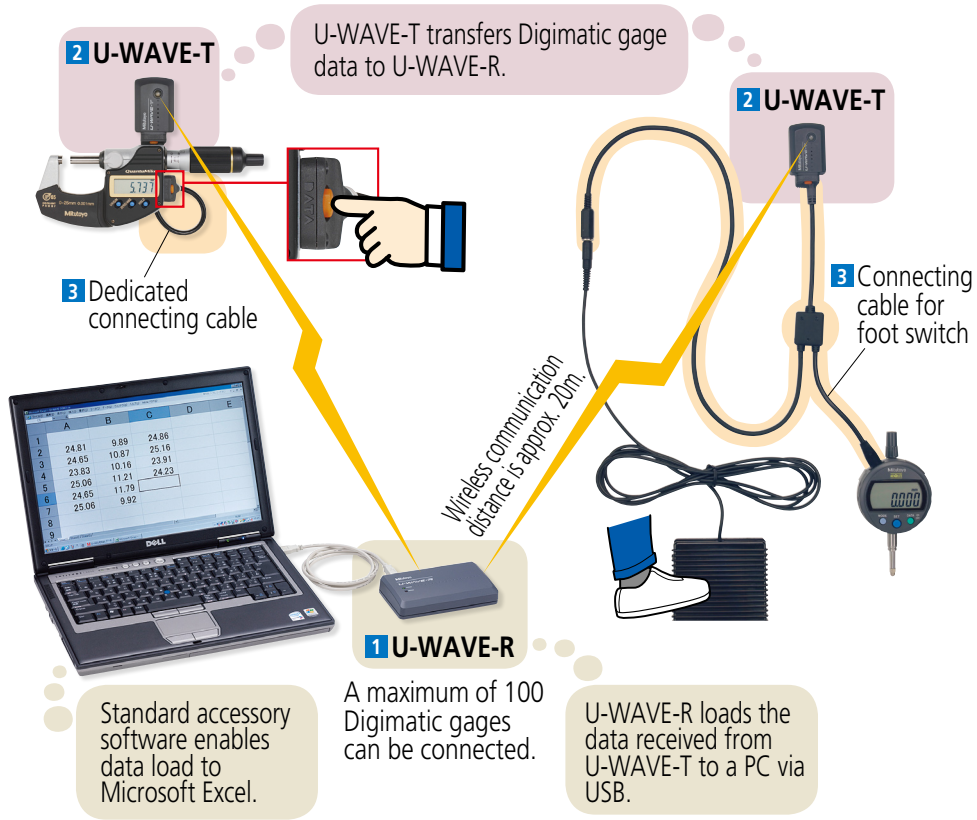
Convenient data collection tool and quality control software

Measurement data wireless communication system U-WAVE

A

- Data from Digimatic gages can be loaded to a PC easily.
- Wireless communication eliminates cabling, improving measuring operability.
- The Data Interface Function of the U-WAVE-R standard accessory software enables data input to commonly available software by keyboard input (Microsoft Excel, Notepad, etc.).
- USB-ITPAK V2.1 supports U-WAVE
  Loading multiple measurement data into separate Excel sheets, or simultaneous measurement using the special event drive is now available without the need for macro programming. (Automatic loading in a certain interval is available with the timer function.)

U-WAVE system configuration



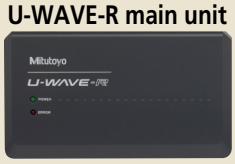
Data from Digimatic gages can be loaded to a PC easily by using items 1 to 3 below.

1 U-WAVE-R

Receives data from U-WAVE-T and loads to a PC via USB.

Model	U-WAVE-R
Order No.	**02AZD810D**
Power supply	USB bus power system
Number of U-WAVE-R units that can be connected to one PC	Up to 15
Number of U-WAVE-T units that can be connected	Up to 100
External dimensions	140×80×31.6 mm
Mass	130 g

U-WAVE-R main unit



USB2.0 cable (1m) attached

U-WAVEPAK

U-WAVEPAK software (standard accessory)

System Environment: Compatible OS
Windows 2000 Professional (SP4 or later)*
Windows XP Home Edition (SP2 or later)*
Windows XP Professional (SP2 or later)*
Windows Vista*, Windows 7*, Windows 8/ 8.1*
Windows 10*

* Revision history (U-WAVEPAK)
  Ver1.010 or later is compatible with 32/64-bit OS.
  Ver1.020 or later is compatible with Windows 8.
  Ver1.021 or later is compatible with Windows 8.1.
  Ver1.022 or later is compatible with Windows 10.

Main specifications
- Setup of dedicated driver software (USB and virtual COM port)
- Initial setting of ID number and frequency selection (required only once for first time)
- Load data to Microsoft Excel or Notepad through data interface function
- Note: Cannot be connected to a device other than a PC (such as DP-1VA LOGGER, PDA, or controller).

U-WAVE-T System Communication Specifications

• Wireless communication

Wireless specifications	IEEE802.15.4 base
Wireless communication distance	Approx. 20 m (within visible range)
Wireless communication speed	250 kbps
Transmission output	1 mW (0dBm) or less
Modulation method	DS-SS (Direct Sequence - Spread Spectrum) Resistant to interfering signals and noise
Communication frequency	2.4GHz band (ISM band: Universal frequency)
Used band	15 channels (2.405 to 2.475GHz at intervals of 5MHz) The noise search function avoids interference with other communication devices.

Use of U-WAVE is allowed in the following countries:
This product is a radio equipment classified in the 2.4 GHz Wide-band Low Power Data Communication System. To use this product, conformity to the radio law of each country is required.
For use in countries other than those below, please contact your dealer or nearest Mitutoyo sales office.
To use in countries other than the country where you purchased the product, please contact your dealer or nearest Mitutoyo sales office.

Applicable models	**02AZD810D**, **02AZD880G**, **02AZD730G**
Asia	Japan, China, Vietnam, Taiwan, Indonesia, Thailand, Malaysia, Philippines, India, Singapore
North America	US, Canada
Central and South America	Mexico, Costa Rica, Argentina
Europe	28 EU member nations (UK, France, Germany, Italy, Netherlands, Belgium, Luxembourg, Spain, Portugal, Austria, Sweden, Finland, Denmark, Bulgaria, Cyprus, Czech, Slovakia, Estonia, Greece, Hungary, Ireland, Latvia, Lithuania, Malta, Poland, Romania, Croatia) 4 EFTA member nations (Norway, Switzerland, Iceland, Liechtenstein) Turkey, Russia

Applicable models	**02AZD810E**, **02AZD880H**, **02AZD730H**
Central and South America	Brazil

Applicable models	**02AZD810F**, **02AZD880J**, **02AZD730J**
Asia	South Korea

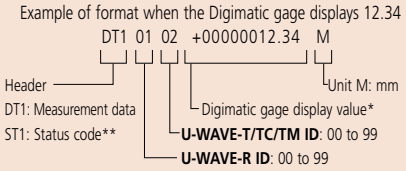
As of August, 2018

Refer to the U-WAVE Catalog (No. E12000) for more details.

Measurement data wireless communication system U-WAVE

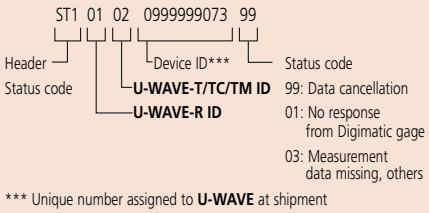
• Data format

Example of format when the Digimatic gage displays 12.34



* Data interface function is switchable to "Measurement value only"
e.g.) +00000012.34

** Example of status code format



*** Unique number assigned to **U-WAVE** at shipment

Notes on identification of measurement data and multiple systems operation

Following the above format, the U-WAVE data format starts with a 4-digit code where the first two digits represent receiver channels and the last two are transmitter channels. The large number of transmitter/receiver combinations possible with this scheme ensures that the receivers in a factory measurement system only accept data from the intended transmitters, even when several receivers are all within communication range of different transmitters using the same channel.
Different frequency bands (up to 15 available) may also be used to further ensure that there are no communication problems between adjacent U-WAVE-R units.

2 U-WAVE-T

Transmits measurement data to U-WAVE-R. Select IP67 or buzzer model, according to your application. U-WAVE-R can be connected to Digimatic gages by dedicated cable for U-WAVE-T (option).

Model	**U-WAVE-T** (IP67 type)	**U-WAVE-T** (Buzzer type)
Order No.	**02AZD730G**	**02AZD880G**
Protection Rating	IP67	None
Data reception indication	LEDs	Buzzer and LEDs
Power supply	Lithium battery CR2032×1	
Battery life	Approx. 400,000 transmissions	
Dimensions	44×29.6×18.5 mm	
Mass	23 g	

Buzzer type
Receipt of data can be checked by buzzer and LED (common specification)

IP67 type
Highly resistant to dust and water ingress

3 U-WAVE-T dedicated connection cable

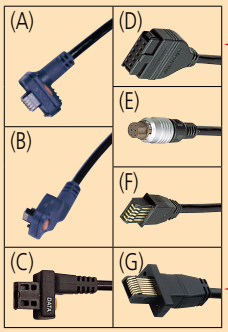
A dedicated cable connects a Digimatic gage to U-WAVE-T. Check the connector (A to G; refer to pages A-21 and A-22 for details) compatible with the Digimatic gage to be used and select either standard type (figure 1) or foot switch type (figure 2) according to your application.

Type	Standard connecting cable Part Nos.	Connecting cable for foot switch Part Nos.
(A) Water-proof model with output button	**02AZD790A**	**02AZE140A**
(B) Water-proof model with output button	**02AZD790B**	**02AZE140B**
(C) With data-out button	**02AZD790C**	**02AZE140C**
(D) 10-pin plain type	**02AZD790D**	**02AZE140D**
(E) 6-pin round type	**02AZD790E**	**02AZE140E**
(F) Plain type straight	**02AZD790F**	**02AZE140F**
(G) Plain type straight water-proof model	**02AZD790G**	**02AZE140G**

Standard accessory
Clip for cable fixing

Application example of the clip

7 types of connector



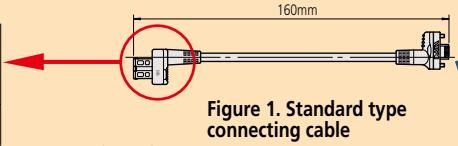
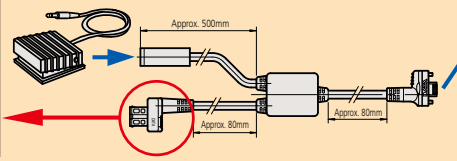
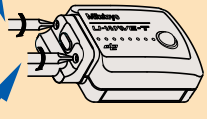


Figure 1. Standard type connecting cable

Foot switch (option)
937179T





Connector attached to U-WAVE-T by 2 screws

Figure 2. Connecting cable for foot switch

Mitutoyo

Measurement Data Management

Convenient data collection tool and quality control software

Measurement Data Management
U-WAVE

A

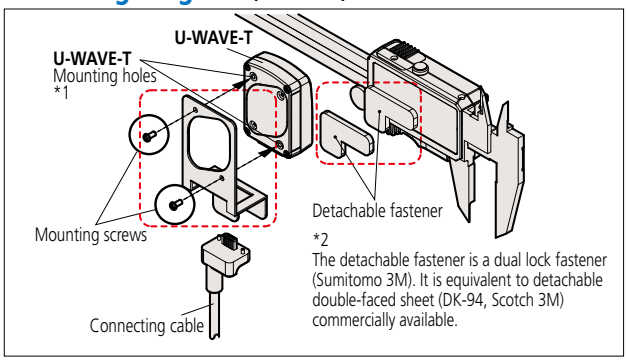
Optional Accessories for U-WAVE-T

U-WAVE-T mounting plate

Since the standard cable clip is not sufficient to support the U-WAVE-T on a Digimatic gage, a mounting plate is provided. The mounting plate can be fixed to the gage by the easily detachable hook-and-eye type fasteners provided. Batteries can be replaced without needing to detach the U-WAVE-T from the gage.

U-WAVE-T mounting plate
Order No.02AZE200
Standard accessories
- Detachable fasteners: 1 set
- Mounting screw 2 pcs.

Mounting diagram (02AZE200)

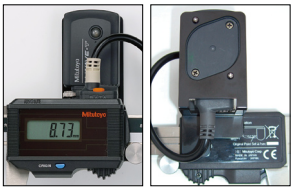


*2 The detachable fastener is a dual lock fastener (Sumitomo 3M). It is equivalent to detachable double-faced sheet (DK-94, Scotch 3M) commercially available.

*1 To avoid damaging the threaded holes in the plastic body of the U-WAVE-T unit, the mounting screws should be tightened only just sufficiently to grip. Repeated removal of these screws should also be avoided for the same reason.
*2 In order to avoid loss of adhesion, do not allow oil or coolant to come into contact with the bonding surfaces of the detachable fasteners.

Application examples of the mounting plate

Super Caliper CD67-S15PM



Front view Rear view

QuantuMike MDE-25MX

Front view Rear view

Digimatic Indicator ID-C112XB

Front view Rear view

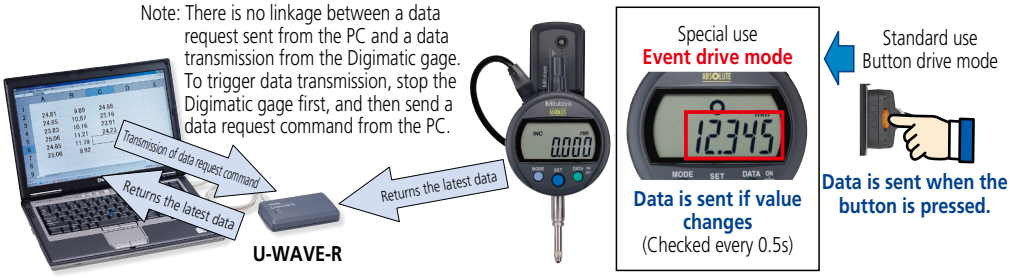
Application example of the 'Event drive' mode

Data request support from PC. Special order U-WAVEPAK (Event drive)

For standard type U-WAVE, the currently displayed data can be sent by pressing the data switch.
This is called "button drive mode".
In the "event drive mode", the measurement value is checked every 0.5 seconds and measurement data is automatically sent if there is a change. At this time, the data switch is disabled. The sent data is written in the U-WAVE-R memory, and only the latest data is kept, it is not output to the PC. The data is loaded to the PC from the U-WAVE-R memory when the data request command is sent. The mode switching between "button drive" and "event drive" is enabled by the special order U-WAVEPAK (Event drive).
In the event drive mode, pressing the data switch on the Digimatic gage is not necessary. PC operation enables loading data from multiple gages at once.

To perform simultaneous measurement using USB-ITPAK V2.1, a special order U-WAVEPAK (Event drive) is required.

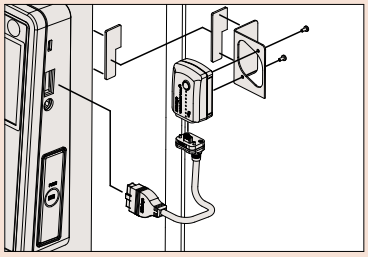
Note: There is no linkage between a data request sent from the PC and a data transmission from the Digimatic gage. To trigger data transmission, stop the Digimatic gage first, and then send a data request command from the PC.



When using the event drive please note:
- The battery life is shorter than in normal mode.
  The battery lasts approximately 20 days with continuous use.
  Switching to the button mode when the battery is not in use extends the battery life.
- When using several Digimatic gages (U-WAVE-T), communication errors may occur because of radio interference in simultaneous measuring. Therefore, it is required to add U-WAVE-R and set different frequencies (15ch) to avoid radio wave interference.

U-WAVE-T mounting plate for QM-Height
Order No.02AZE990
Standard accessories
- Detachable fasteners: 1 set
- Mounting screw: 4 pcs

Mounting diagram for QM-Height (02AZE990)



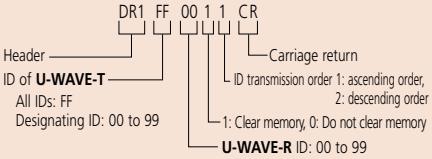
Special order U-WAVEPAK (Event drive)

This is a special order product. For the latest pricing, please contact your dealer or the nearest Mitutoyo Service Center.
Product configuration: Program on CD

For **U-WAVE-R**, **U-WAVE-T** and **U-WAVE-TC / TM**, please purchase the standard model. Install this special order **U-WAVEPAK** (Event drive) and gain the ability to perform setups without using the standard accessory **U-WAVEPAK**.

A program to send a data request command is separately required to load data to a PC.
Event drive supporting software:
- **USB-ITPAK V2.1** (timer input enabled)
- **MeasureReport** (function key operation)

Example of data request command - All Data Output:



Order No.

Model No.	**USB-ITPAK V2.1**
Order No.	**06AFM386**

Upgrade pricing from V1.0 is not available. Please purchase V2.0.

USB-ITPAK V2.1 USB dongle

A USB dongle must be connected to the PC running the software.

Operating environment

Compatible OS *1	Windows 2000 SP4 Windows XP SP2 or later Windows Vista Windows7 Windows8 Windows8.1 Windows10
Supported Excel versions *2	Excel 2002 Excel 2003 Excel 2007 Excel 2010 Excel 2013 Excel 2016
Hard disk	Free space of more than 10MB
CD-ROM drive	For program installation
USB port *3	2 ports or more
Monitor resolution	800×600, 256 colors or more

*1: 32-bit, 64-bit OS supported
*2: Operation with Excel for MAC OS is not guaranteed.
*3: A commercially available hub can be used.
(USB certified product is recommended)

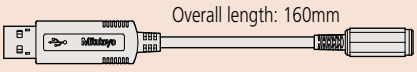
Language support

- Operation language (15 languages)
  Japanese, English, German, French, Spanish, Italian, Czech, Swedish, Turkish, Polish, Hungarian, Russian, Korean, Chinese (traditional/simplified)
- Operation manual (PDF file)
  Japanese, English, German

Order No.

Model No.	**USB-FSW**
Order No.	**06ADV384**

Foot Switch Adapter USB-FSW



Common optional software IT-016U/USB-ITN and U-WAVE

Upgraded USB-ITPAK now supports U-WAVE, a wireless communication system.
Both wired connection (IT-016U/USB-ITN) and wireless system (U-WAVE) are supported.

New functions of USB-ITPAK V2.1

- Supports the U-WAVE wireless communication system
- Timer input function
- Measurement date/time display
- Others: Compatible with Windows 8, 64-bit OS, and Russian included in the operating language selection

USB-ITPAK V2.1 creates a procedure to input data from gages equipped with Digimatic output to Excel sheets via USB-ITN or U-WAVE. This optional software facilitates the daily inspection work for mass-produced products.

The combined use with USB-ITPAK V2.1 will improve the operational efficiency of repetition inspection work. Best suited for keeping track of inspection data of mass-produced products.

- Automatically calls Excel sheet.
- Cursor moves can be specified.
- Input range can be specified per Digimatic gage, which reduces improper input.
- The last data input can be canceled by a single operation (foot switch, function key etc.)
- Data input or cancellation can be performed at once in multiple-point simultaneous measurement.

Main features of USB-ITPAK V2.1

- **Setting of Microsoft Excel input:**
  Designation of where to input (workbook, worksheet, cell range), cursor move (right, down), and others.
- **Selection of measuring method (3 modes available)**
  (1) Sequential measurement (2) Simultaneous measurement (3) Individual measurement (refer to page A-21 for details).
- **Control item and instruction at data input** (Note 1: Not available during individual measurement, Note 2: Not available during simultaneous measurement in the event drive mode)

Control item	Mouse operation	Function key	Foot switch + USB-FSW	Data switch when using U-WAVE	Data switch other than U-WAVE
Data output request	✓ (Note 1)	✓ (Note 1)	✓	✓ (Note 2)	✓
Data cancel	✓ (Note 1)	✓ (Note 1)	✓	✓ Press and hold (Note 2)	–
Data skip	✓ (Note 1)	✓ (Note 1)	✓	–	–
Character input (example: OK or NG etc.)	–	–	✓ Pre-registered character strings	–	–

- **Number of connectable gages** (Note 3: The actual number can be less depending on the system configuration.)

Available devices	Maximum number of connection (total of (1), (2), and (3))	Others
(1) **IT-016U/USB-ITN**	For Windows 2000/XP Up to 100 units (Note3) For Windows Vista/7/8/8.1/10 Up to 20 units (Note3) (For **U-WAVE-R**, plus 100 per unit in terms of available gages.)	• Maximum registration (total of (1), (2), and (3)) 400 units
(2) **USB-FSW**		
(3) **U-WAVE-R** (Up to 100 gages can be per one unit of **U-WAVE**. **U-WAVE-T** ID: 00 to 99)		• Control/identification of connecting gage VCP (Virtual COM port) Switch from HID to VCP for (1) and (2). The VCP driver software is supplied with **USB-ITPAK**.

- **Data loading time:** when using **USB-ITN**, 0.2s to 0.3s per gage unit
  U-WAVE event drive mode: 0.5s data refresh interval
- **Timer input function** (only in simultaneous measurement)
  Input interval (time): 0.1s (Note 4) to 24 hours at maximum
  (Note 4: If a shorter time is set, a priority is given to the longer time compared with the actual communication time.)
- **Measurement date/time display function** (available in sequential and simultaneous measurements)
  The display format is subject to the setting of the Excel sheet.

USB Foot Switch Adapter USB-FSW

This USB adapter for connecting a PC is required when using the Foot Switch (**937179T**) in **USB-ITN**.
A dedicated VCP driver* for this adapter is included in **USB-ITPAK**.

Main specification

- With **USB-ITPAK**, application of the foot switch can be set.
- Data control: "Data request","Data cancel", "Data skip"
- Character string input (e.g. GO/NG, etc.)

*USB-FSW is used for installation of the VCP driver.

Measurement Data Management

Convenient data collection tool and quality control software

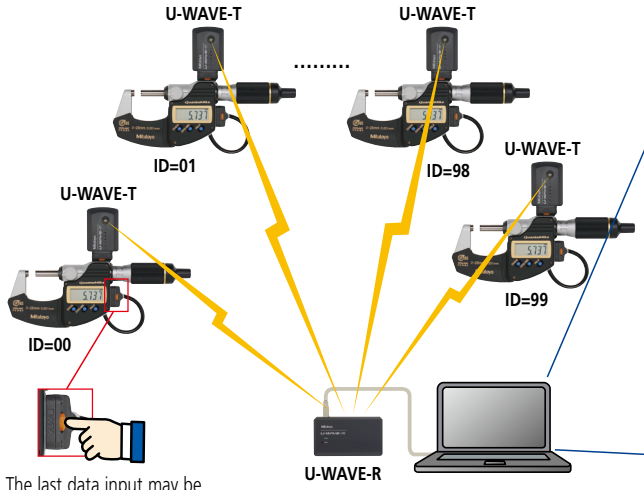
Measurement Data Management
USB-ITPAK V2.1 USB-ITPAK V2.1 (IT-016U/USB-ITN/U-WAVE/DP-1VA LOGGER connectable)

A

More applications can be handled due to new features (Wireless (**U-WAVE**) support, Timer input, Measurement date/time display)

Example of measurement using the U-WAVE wireless communication system — data sorting of individual measurements

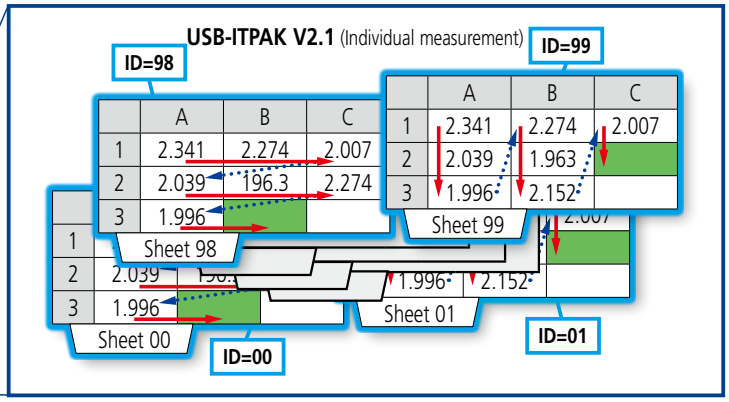
Data from multiple Digimatic gages sent to separate Excel sheets



The last data input may be canceled by pressing and holding the data switch

Up to 100 gages can be handled by one **U-WAVE-R** unit

Loading data from multiple Digimatic gages (**U-WAVE-T**) into separate Excel sheets is now available without the need for macro programming.

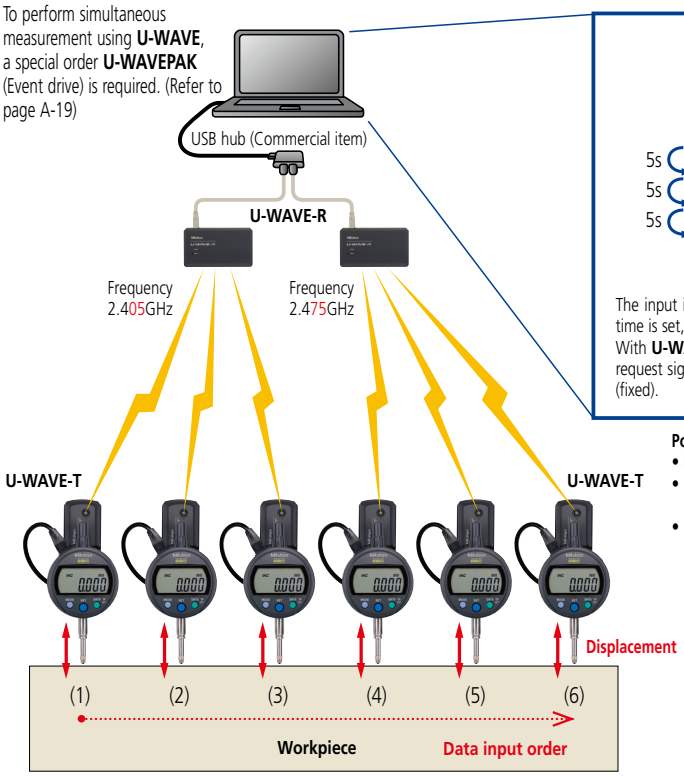


Entry point can be specified per gage (by **U-WAVE-T** ID).
- Specifying an Excel file: Excel Book (full path) + sheet name
- Specifying data input cells (example: A1:C3)
- Specifying cursor move (right or down)

Example of measurement using the U-WAVE wireless communication system — timer input + measurement date/time display during simultaneous measurement

Automatically obtains displacement data in a certain input interval

To perform simultaneous measurement using **U-WAVE**, a special order **U-WAVEPAK** (Event drive) is required. (Refer to page A-19)



If using **USB-ITPAK V2.1** supporting **U-WAVE** event drive, arbitrary timer input is allowed without the need for macro programming.

USB-ITPAK V2.1 simultaneous measurement + timer input (example: 5s interval)

	A	B	C	D	E	F	G
1	Displacement (1)	Displacement (2)	Displacement (3)	Displacement (4)	Displacement (5)	Displacement (6)	Measurement date/time
2	0.281	0.162	0.121	0.051	0.011	–0.001	2013/4/1 7 30 00
3	0.279	0.152	0.133	0.064	0.018	–0.003	2013/4/1 7 30 05
4	0.265	0.149	0.142	0.089	0.021	–0.007	2013/4/1 7 30 10
5							
6							

5s 5s 5s

The input interval can be arbitrarily set by 0.1s intervals up to 24 hours. If a smaller value than the data loading time is set, the actual measurement time will be the input interval.
With **U-WAVE**, an error (no data) may occur if less than 0.5s is set for the input interval. This is because the data request signal is issued before the data comes in, based on the event drive data refresh interval that is set to 0.5s (fixed).

Points to note when performing simultaneous measurement using U-WAVE and USB-ITPAK V2.1
- Besides **U-WAVE**, a special order **U-WAVEPAK** (Event drive) is required.
- The battery life of **U-WAVE-T** becomes shorter in the event mode, reducing to approximately 20 days for continuous measurement.
- When using several Digimatic gages, communication errors may occur because simultaneous transmission from all gages may cause radio interference.
  With **U-WAVE**, radio wave interference can be mostly avoided if data is transmitted after making sure there is no other radio communication.
  CSMA/CA method: this avoids radio interference and enables successful simultaneous data transmission of three U-WAVE-T units per **U-WAVE-R**.
  To perform simultaneous measurement with more than three units of U-WAVE-T, add U-WAVE-R and set different frequencies (15 ch) to avoid radio interference.

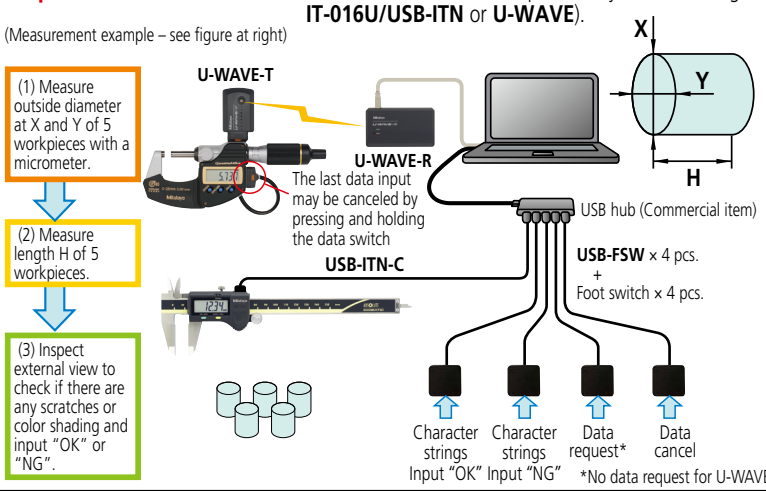
Create Microsoft Excel input procedures with USB-ITPAK V2.1 to handle data from U-WAVE or the USB Input Tool Direct

Measurement applications of USB-ITPAK V2.1 (Three examples of how USB-ITPAK V2.1 can be deployed are shown below)

Sequential measurement

Measurement values are input one by one according to a procedure previously defined by using one or more Digimatic gages (via **IT-016U/USB-ITN** or **U-WAVE**).

(Measurement example – see figure at right)



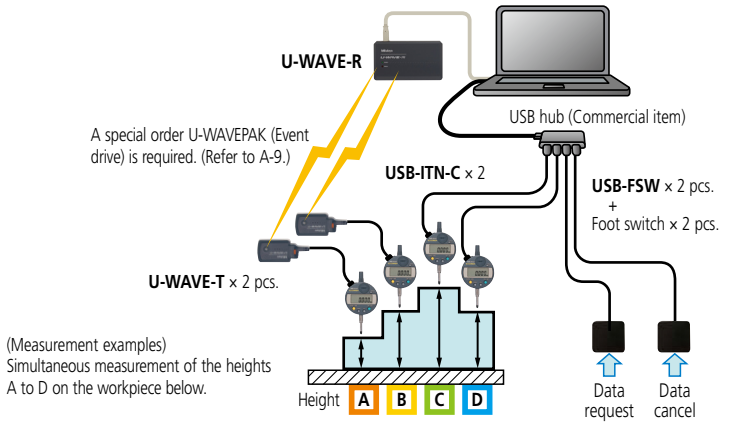
When a measuring procedure is executed, a window (as below) is displayed. "Data request*", "Data cancel*", "Data skip*", "Aborting", "Complete" can be specified.
* These operations can be allocated to the function key or foot switch (via USB-FSW).

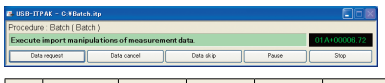
	A	B	C	D	E	F
1	Setting	1	2	3	4	5
2	Dimension X	10.025	10.033	9.964	10.031	10.046
3	Dimension Y	9.982	10.017	10.008	9.996	10.027
4	Dimension H	29.97	30.02	30.07	29.96	30.04
5	External Appearance	OK	OK	NG		

Cell movement direction after inputting data (down and right)
Carriage return (Low, column)
Microsoft Excel sheet previously specified
Input range of micrometer (B2 to F3)
Input range of caliper (B4 to F4)
Input range of visual judgment (B5 to F5)
Cell that will receive next input is highlighted in green

Simultaneous measurement

Measurement values are input simultaneously from several Digimatic gages (via **IT-016U/USB-ITN**, **U-WAVE**)





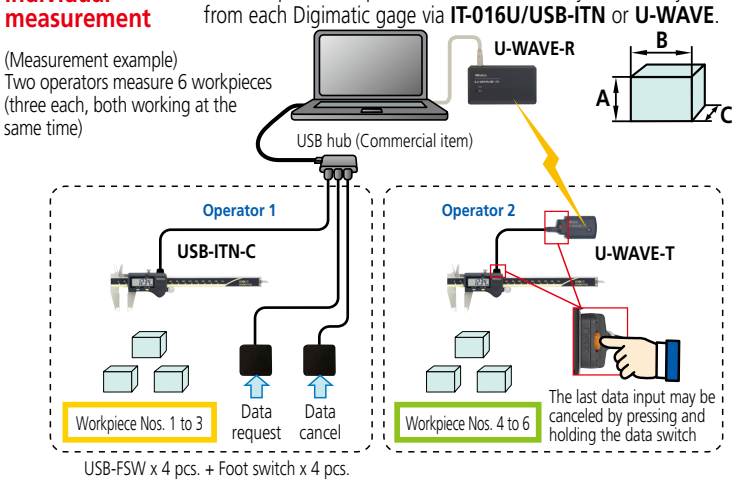
	A	B	C	D	E
1		Height A	Height B	Height C	Height D
2	1	5.02	8.03	9.96	6.03
3	2	4.98	8.02	10.01	5.99
4	3	4.97	8.04	10.07	5.96
5	4				
6	5				

First measurement (finished)
Second measurement (finished)
Third measurement (finished)
Fourth measurement (Wait for next input)

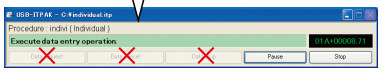
Individual measurement

Several operators input measurement data asynchronously according to individually defined procedures (where to input, move direction, etc.) from each Digimatic gage via **IT-016U/USB-ITN** or **U-WAVE**.

(Measurement example)
Two operators measure 6 workpieces (three each, both working at the same time)



Since several individual operators perform measurement simultaneously, an operation key and a function key in the window below cannot be used at the same time. The only effective input device in this case is the foot switch (via USB-FSW).



	A	B	C	D	E	F	G
1	Setting	1	2	3	4	5	6
2	Dimension A	10.02	10.03	9.96	10.15	10.23	10.04
3	Dimension B	9.98	10.01	10.07	9.99	9.78	
4	Dimension C	10.15	10.14		9.96	10.27	

Operator 1 Cell that will receive next input
Operator 2 Cell that will receive next input

Notes on using USB-ITPAK V2.1:
Do not merge the cells in the specified range as a measurement data input.
During measurement, the Microsoft Excel worksheet cannot be modified in any way apart from entering data. If you need to modify the sheet, it is necessary to abort or finish the measurement.

Mitutoyo

Measurement Data Management

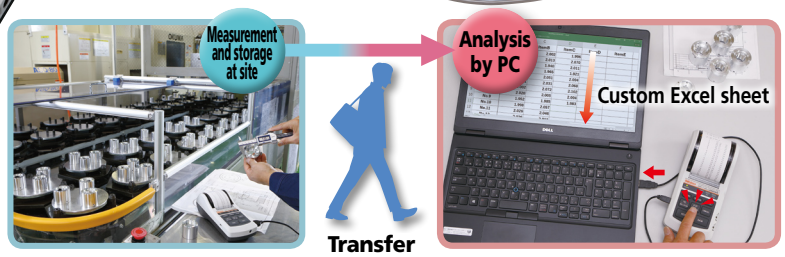
Convenient data collection tool and quality control software

Mini-Printer Equipped with Data Logging Function
SERIES 264 — Digimatic Mini-Processor DP-1VA LOGGER

A

- In addition to the conventional (DP-1VR) printing and statistical calculation functions, data logger and USB output functions are added and enhanced!
- This is a palm-sized printer used to print measurement data from Digimatic gages or to perform statistical analysis.
- The versatile DP-1VA LOGGER printer not only prints measurement data, but performs a variety of statistical analyses, draws histograms and D-charts and also performs complex operations on X-bar R control charts.
- The data logger function allows storage of up to 1,000 pieces of data in memory, and batch transfer of stored data to an Excel-format inspection certificate, etc., by connecting to a PC with a USB cable (optional).

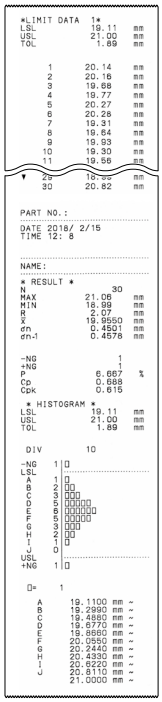
264-505
DP-1VA LOGGER



Example of printout

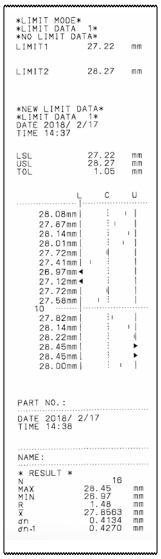
MODE1

Various statistical calculations are executed using all input data. If the tolerance limits have been set, GO/±NG judgment and histogram creation are also enabled.



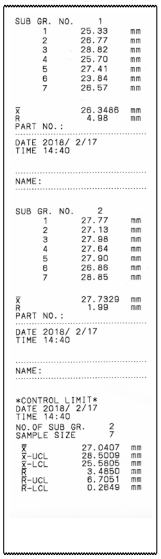
MODE2

In addition to the MODE1 function, measurements within the tolerance limits are printed out as a D chart*. This chart allows you to identify the trend of variations in measurement data.
* D chart stands for Displacement chart.



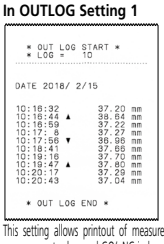
MODE3

Only input of data automatically enables calculation processing of complex control limit values as well as calculation for creating an Xbar-R control chart.



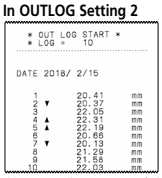
Example of batch printing log data

In OUTLOG Setting 1



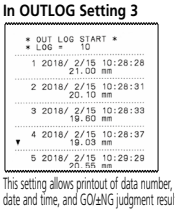
This setting allows printout of measurement time, measurement value, and GO/±NG judgment result.

In OUTLOG Setting 2



This setting allows printout of data number, measurement value, and GO/±NG judgment result.

In OUTLOG Setting 3



This setting allows printout of data number, measurement date and time, and GO/±NG judgment result.

Statistical calculation data

MODE0

GO/±NG judgment

MODE1, 2

N :Number of pieces of data
MAX :Maximum value
MIN :Minimum value
R :Range
$\bar{X}$:Mean value
σn :Standard deviation of a population (N)
σn-1 :Sample standard deviation (N-1)
–NG :For the number of pieces of data smaller than the lower limit
+NG :For the number of pieces of data larger than the upper limit
P :Percentage of rejects
Cp :Maximum process capability potential
Cpk :Actual process capability achieved

MODE3

N :Number of pieces of data
MAX :Maximum value
MIN :Minimum value
n :Number of subgroups (up to 10)
$\bar{X}$:Mean value in a subgroup
R :Range of a subgroup
$\bar{\bar{X}}$:Mean value
$\bar{X}$-UCL :Upper control limit
$\bar{X}$-LCL :Lower control limit
$\bar{\bar{R}}$:Center (R control)
R-UCL :Upper control limit (R control)
R-LCL :Lower control limit (R control)

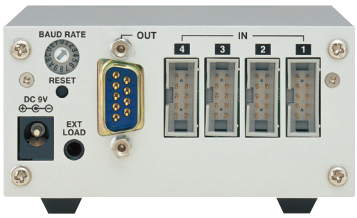
Specifications

- **Order No.: 264-505**
- Model: DP-1VA LOGGER
- Data input: Digimatic input, RS-232C input (specific to Mitutoyo KA counter)
- Data processing capacity:
  Mode 0: 100,000 pieces of data
  Modes 1,2: 9,999 pieces of data
  Mode 3: Sample size
  10 9,999 subgroups = 99,990 pieces of data
- GO/±NG judgment (five sets can be defined)
- Output: (1) USB output (2) RS-232C data output at TTL levels (3) GO/±NG judgment result output (–NG, GO, +NG)
- Input timer: Input intervals
  0.25s, 1s, 5s, 30s, 1min, 30min, 60min
- Printing method: Thermal line printer
- Printing speed: 0.8s per line (6.5mm/s) (using AC adapter)
- Printing line: 10,000 lines of normal characters per roll
  7,000 lines of large characters per roll
- Printing paper: High durability thermo-sensitive paper
  Width 58mm x length 48m
  Note: Printed characters do not fade if a printout is stored in a cool dark place, but if it is to be used for official documents, or stored more than 5 years, it is recommended to make a more durable copy.
- Power supply: 2 power methods
  (1) AC adapter 100-240V 50/60Hz AC adapter (6V, 2A) as a standard accessory.
  (2) 4pcs. of LR6/AA size (alkaline or Ni-Mh)
  Note: Manganese dioxide batteries are not usable.
- Battery life: About 10,000 lines (if data is printed once every 5 seconds using 1,600mA NiMH batteries at 20oC)
  Note: This is a typical value and is not guaranteed.
- External dimensions: 94 (W) x 201 (D) x 75.2 (H) mm
- Mass: 390g (main unit)
- Optional Accessories:
  1. USB cable (A-microB) : **06AFZ050** (1 m)
  2. RS-232C output cable: **09EAA084** (1 m, D-SUB 9 pin)
  3. GO/±NG judgment cable: **965516**
     (2 m, 10 pin terminal/separate)
  4. Foot switch: **937179T** (2 m)
- Consumable items:
  Printing paper (10 rolls) : .**09EAA082**

Refer to the DP-1VA LOGGER leaflet (E12041) for more details.

Digimatic/RS-232C Interface Unit Multiplexer MUX-10F

- Multiplexer MUX 10F is a measurement data transfer device that converts incoming Digimatic output measurement data to RS-232C and outputs it to an external device such as a PC.
  Up to four measuring instruments with Digimatic output can be connected.



264-002
MUX-10F

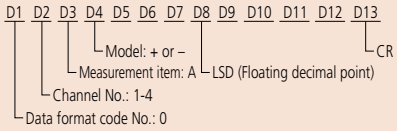
Specifications

- **Order No.: 264-002**
- Model: MUX-10F
- Data input port: 4 channels for Digimatic gages
- Output: (RS-232C)
- Data output Via RS-232C interface:
  Data transmission method: Half-duplex
  Data transmission code: ASCII/JIS
  Data length: 8 bits
  Parity check: None
  Stop bit: 1
  Data transmission speed: 300/600/1200/2400/9600/19200bps
- Connector specification:

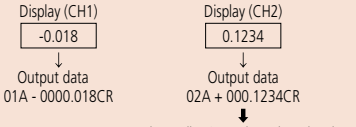
Pin No.	Signal	Function	in/out
1	CD		out
2	RD	Received data	out
3	TD	Communication data	in
4			
5	GND	Ground	
6	DR		out
7			
8	CS		out
9			

* For connection with a PC, use a commercially available RS-232C straight cable.

- Data format
  (1) When data output

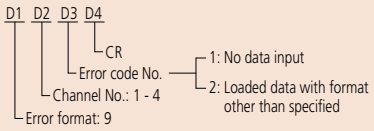


(2) Example of format



The smallest input channel number data is output first in the output stream, with the others following in ascending order.

(3) Error code output



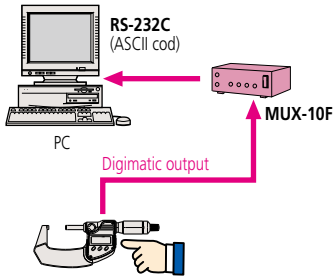
- Power supply: AC adapter (9 V, 500 mA)
  External dimensions: 91.4 (W) x 92.5 (D) x 50.4 (H) mm

Note: Communication software is not included.

Usage Example

Data input using the data button on the Digimatic gage

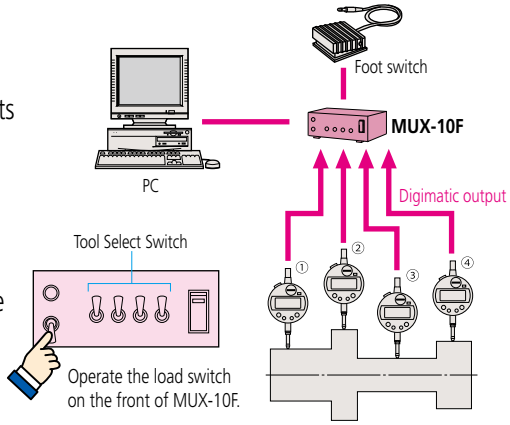
- If the Digimatic gage has a data button, data is sent to the MUX-10 from the gage, converted to RS-232C and sent out.



Press the data button on the measuring gage.

Data input using the load switch

- If the Digimatic gage does not have a data button, or when simultaneous measurements are performed, the MUX-10 load switch is used to poll data from the measuring gage(s) selected by the tool selection switch(es), converted to RS-232C, and sent out.
- If multiple measuring gages are selected by the tool selection switch, data is input in the order of channels 1 through 4.
- Optional foot switch (937179T) is available for quick data entry.

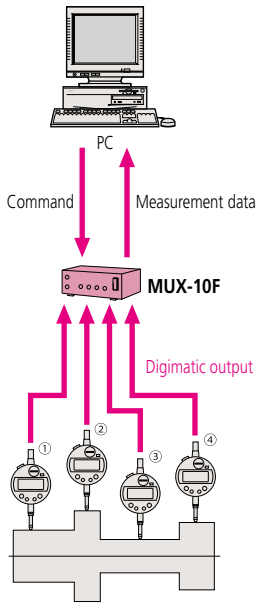


Data input using the external commands

- Data from a specified measuring gage connected to MUX-10F can be polled (ch 1- 4) by inputting a command from the PC.

Commands (ASCII)	Transfer channels
1 (ASCII code31) CR	1
2 (ASCII code32) CR	2
3 (ASCII code33) CR	3
4 (ASCII code34) CR	4
*A (ASCII code41) CR	1, 2, 3, 4
*B (ASCII code42) CR	1, 2, 4
*C (ASCII code43) CR	1, 3, 4
*D (ASCII code44) CR	2, 3, 4
E (ASCII code45) CR	1, 2, 3
F (ASCII code46) CR	1, 2
G (ASCII code47) CR	1, 3
H (ASCII code48) CR	1, 4
I (ASCII code49) CR	2, 3
J (ASCII code50) CR	2, 4
K (ASCII code51) CR	3, 4

* Command will operate the same as previous MUX-10 when 4-channel mode is turned off.



Measurement Data Management

Convenient data collection tool and quality control software

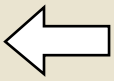
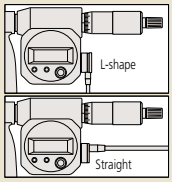
Digimatic Data Cable Selector (including USB Input Tool Direct)

USB Input Tool Direct USB-ITN 	Connector type	(A) Water-proof type with output button	(B) Water-proof type with output button	(C) Straight type with output button	(CR) L type with output switch (cable outlet is right)
	Model No. Order No.	**USB-ITN-A 06AFM380A**	**USB-ITN-B 06AFM380B**	**USB-ITN-C 06AFM380C**	No applicable models USB-ITN-C is available Refer to the following figure.

IT-016U/IT-007R/DP-1VA LOGGER/MUX-10F/ EC Counter 	Connector type	(A) Water-proof type with output button	(B) Water-proof type with output button	(C) Straight type with output button	(CR) L type with output switch (cable outlet is right))
	Order No. 1 m	**05CZA624**	**05CZA662**	**959149**	**04AZB512**
	Order No. 2 m	**05CZA625**	**05CZA663**	**959150**	**04AZB513**

U-WAVE-T 	Connector type	(A) Water-proof type with output button	(B) Water-proof type with output button	(C) Straight type with output button	(CR) L type with output switch (cable outlet is right)
	Standard	**02AZD790A**	**02AZD790B**	**02AZD790C**	No applicable models Type C connectors are available, but take care of the cable when using thimbles Refer to the following figure.
	For foot switch	**02AZE140A**	**02AZE140B**	**02AZE140C**	

Select a cable (A to G) whose gage connector fits the Digimatic port on your gage (check the red dotted frame in the above pictures).

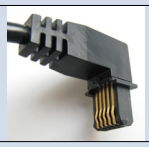
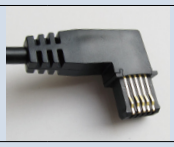
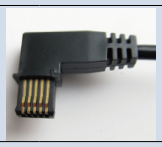
Gage connectors on data cable The connector dimensions are given on page A-27.	Connector type	Ⓐ Water-proof type with output button	Ⓑ Water-proof type with output button	Ⓒ Straight type with output button	Ⓒ L type with output switch (cable outlet is right)
	Picture of gage connector				
	Data switch	Available	Available	Available	Available
Digimatic ports on gage Please note that some high-precision Digimatic gages are capable of displaying the measurement result to more than 6 digits. However, according to the Digimatic output specification, the result may be output in 6 digits only. Digimatic gages whose display may exceed 6 digits • Laser Scan Micrometers • Litematic • Linear gage counter (EH) • High-Accuracy Digimatic Micrometer (293-100/293-130)	Picture of Digimatic port				
	Applicable models	• Digimatic caliper **500-776/500-777**, etc. **500-712-20/500-713-20**, etc. **500-712** etc. **550-301-10/550-331-10**, etc. **551-301-10/551-331-10**, etc. **552-302-10/552-303-10**, etc. **552-150-10/552-151-10**, etc. **552-155-10/552-156-10**, etc. **552-181-10/552-182-10**, etc. • Digimatic special application caliper **573-601/573-602**, etc. • Digimatic depth gage **571-251-10/571-252-10**, etc. • Digimatic scale unit **572-600, 572-601**, etc.	• Digimatic micrometer **293-100/293-130** **293-140-30/293-141-30**, etc. **293-230-30** etc. **340-251-30/340-252-30** • Dedicated micrometers for Digimatic **422-230-30/422-231-30**, etc. **406-250-30/406-251-30**, etc. **343-250-30/343-251-30**, etc. **369-250-30/369-251-30**, etc. **345-250-30/345-251-30**, etc. **314-251-30/314-252-30**, etc. • Digimatic micrometer head **350-251-30/350-261-30**, etc. • Digimatic holtest **468-161/468-162**, etc. • Digimatic depth gage **329-250-30/329-251-30**, etc.	• Digimatic caliper **500-150-30/500-151-30**, etc. **500-500-10/500-501-10**, etc. **500-443** etc. • Digimatic special application caliper **573-118-10/573-119-10**. etc. **573-116-10/573-117-10**, etc. **573-191-30/573-291-30** **573-181-30/573-182-30**, etc. • Digimatic depth gage **571-201-30/571-202-30**, etc. • Digimatic micrometer head **164-163/164-164** • Digimatic scale unit **572-203-10/572-213-10** **572-300-10/572-301-10**, etc. • Digital height master **515-374/515-376**, etc	• Digimatic micrometer **293-582/293-583**, etc. **389-514/389-714**  Type C straight connectors are available, but may interfere with thimble operation.

(D) Flat 10-pin type	(E) Round 6-pin type	(F) Flat straight type	(FB) Flat L-shape (cable outlet is back)	(FR) Flat L-shape (cable outlet is right)	(FL) Flat L-shape (cable outlet is left)	(G) Flat straight waterproof type
USB-ITN-D 06AFM380D	**USB-ITN-E 06AFM380E**	**USB-ITN-F 06AFM380F**	No applicable models USB-ITN-F is available			**USB-ITN-G 06AFM380G**

(D) Flat 10-pin type	(E) Round 6-pin type	(F) Flat straight type	(FB) Flat L-shape (cable outlet is back)	(FR) Flat L-shape (cable outlet is right)	(FL) Flat L-shape (cable outlet is left)	(G) Flat straight waterproof type
936937	**937387**	**905338**	**905689**	**905691**	**905693**	**21EAA194**
965014	**965013**	**905409**	**905690**	**905692**	**905694**	**21EAA190**

(D) Flat 10-pin type	(E) Round 6-pin type	(F) Flat straight type	(FB) Flat L-shape (cable outlet is back)	(FR) Flat L-shape (cable outlet is right)	(FL) Flat L-shape (cable outlet is left)	(G) Flat straight waterproof type
02AZD790D	**02AZD790E**	**02AZD790F**	No applicable models Use **02AZD790F** or **02AZE140F**.			**02AZD790G**
02AZE140D	**02AZE140E**	**02AZE140F**				**02AZE140G**

(Note 1) ID-F, EB, EC-101D, ID-U, ID-SS, ID-SX are required to use with the USB-ITN.
(Note 2) USB-ITN, IT-016U, and U-WAVE cannot be used with EF/EH, VL-50-B/50S-B, and SJ-500/SV-2100.

(D) Flat 10-pin type	(E) Round 6-pin type	(F) Flat straight type	(FB) Flat L-shape (cable outlet is back)	(FR) Flat L-shape (cable outlet is right)	(FL) Flat L-shape (cable outlet is left)	(G) Flat straight waterproof type
						
N/A	N/A	N/A	N/A	N/A	N/A	N/A
						
• Digimatic indicator **ID-H** **ID-F** (Note1) • High-precision height gage **QM-Height** • Mu-checker **Digital Mu-checker** (using a foot switch) • Laser scan micrometer **LSM-9506** • Linear gage counter **EF/EH** (Note 2) **EB** (Note 1), **EC-101D** (Note 1) • Litematic **VL-50-B/50S-B** (Note 2) • Contour measuring system **SJ-210/310/410** SJ-500/SV-2100 (Note 2) • Hardness testing machines **HM-210/220**	• Digimatic micrometer **293-666/293-667**, etc. **227-201** etc. **369-411/369-412**, etc.. • Hardness testing machines **HM-100** **HM-200** **HV-100** **HR-300/400/500** **HH-411**	• Digimatic indicator **ID-CX**, **ID-C (Peak-Value Hold Type)** (Note1), **ID-C (Calculation type)**, **ID-C (Bore Gage Type)**, **ID-U** (Note2), **ID-SS** (Note1), **ID-SX** (Note1) • Digimatic height gage **192-663-10/192-613-10/570-322/570-227**, etc. (Flat L-shape, cable outlet is right) • ABS boremetic **568-361/568-362**, etc. • Digimatic bore gage **511-501/511-502**, etc. • Scale unit **572-460/572-560/ 572-480-10/572-580-10**, etc. • Hardness testing machines **HH-300** • Digimatic depth gage **Digimatic type** (**ID-CX**)				• Digimatic indicator **ID-N** **ID-B**

Measurement Data Management

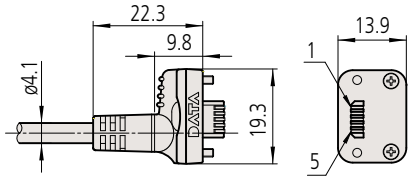
Convenient data collection tool and quality control software

Digimatic data cable specifications (Dimensions)

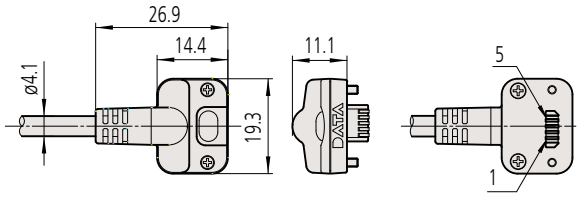
Gage connector dimensions

A

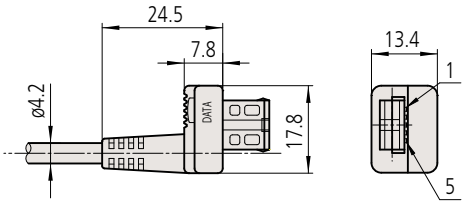
(A) (1) **06AFM380A** (2) **05CZA624** (1 m) **05CZA625** (2 m) (3) **02AZD790A** (Standard) **02AZE140A** (FSW)



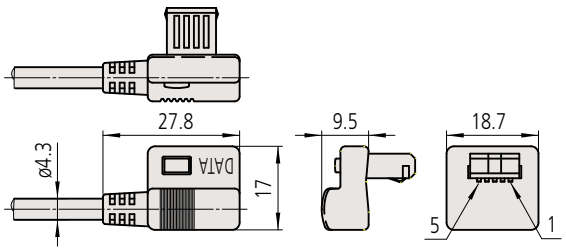
(B) (1) **06AFM380B** (2) **05CZA662** (1 m) **05CZA663** (2 m) (3) **02AZD790B** (Standard) **02AZE140B** (FSW)



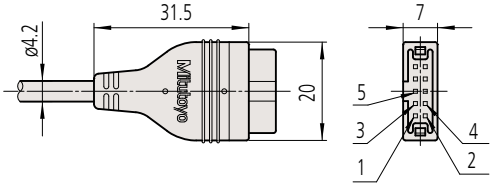
(C) (1) **06AFM380C** (2) **959149** (1 m) **959150** (2 m) (3) **02AZD790C** (Standard) **02AZE140C** (FSW)



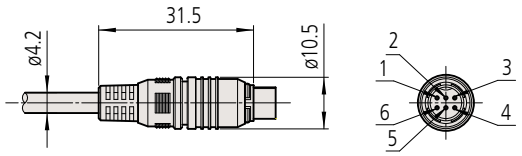
(CR) (1) No applicable models (2) **04AZB512** (1 m) **04AZB513** (2 m) (3) No applicable models



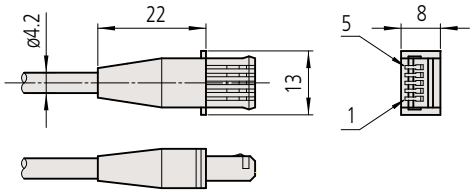
(D) (1) **06AFM380D** (2) **936937** (1 m) **965014** (2 m) (3) **02AZD790D** (Standard) **02AZE140D** (FSW)



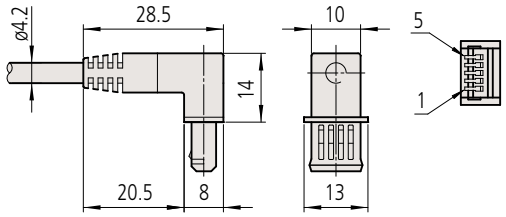
(E) (1) **06AFM380E** (2) **937387** (1 m) **965013** (2 m) (3) **02AZD790E** (Standard) **02AZE140E** (FSW)



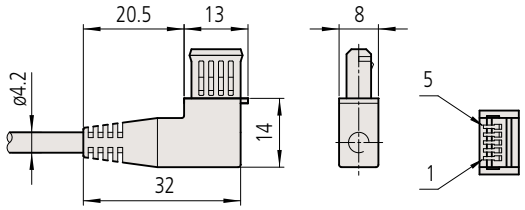
(F) (1) **06AFM380F** (2) **905338** (1 m) **905409** (2 m) (3) **02AZD790F** (Standard) **02AZE140F** (FSW)



(FB) (1) No applicable models (2) **905689** (1 m) **905690** (2 m) (3) No applicable models

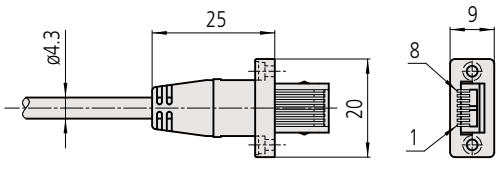


(FR) (1) No applicable models (2) **905691** (1 m) **905692** (2 m) (3) No applicable models



(FL) and (FR) is symmetrical and the same size.

(G) (1) **06AFM380G** (2) **21EAA194** (1 m) **21EAA190** (2 m) (3) **02AZD790G** (Standard) **02AZE140G** (FSW)



Quality control (QC)

A system for economically producing products or services of a quality that meets customer requirements.

Process quality control

Activities to reduce variation in product output by a process and keep this variation low. Process improvement and standardization as well as technology accumulation are promoted through these activities.

Statistical process control (SPC)

Process quality control through statistical methods.

Population

A group of all items that have characteristics to be considered for improving and controlling processes and quality of product. A group which is treated based on samples is usually the population represented by the samples.

Lot

Collection of product produced under the same conditions.

Sample

An item of product (or items) taken out of the population to investigate its characteristics.

Sample size

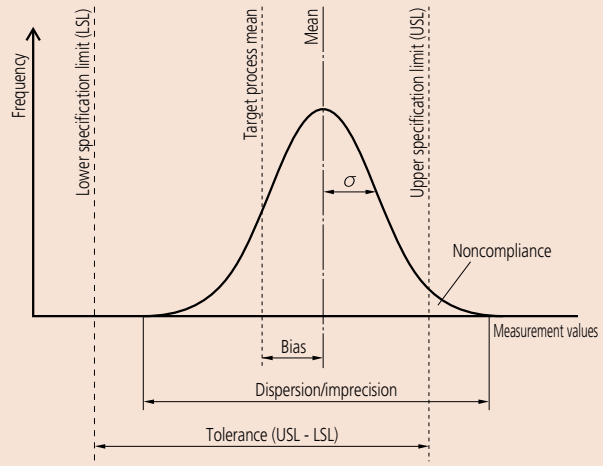
Number of product items in the sample.

Bias

Value calculated by subtracting the true value from the mean of measurement values when multiple measurements are performed.

Dispersion

Variation in the values of a target characteristic in relation to the mean value. Standard deviation is usually used to represent the dispersion of values around the mean.



Histogram

A diagram that divides the range between the maximum and the minimum measurement values into several divisions and shows the number of values (appearance frequency) in each division in the form of a bar graph. This makes it easier to understand the rough average or the approximate extent of dispersion. A bell-shaped symmetric distribution is called the normal distribution and is much used in theoretical examples on account of its easily calculable characteristics. However, caution should be observed because many real processes do not conform to the normal distribution, and error will result if it is assumed that they do.

Process capability

Process-specific performance demonstrated when the process is sufficiently standardized, any causes of malfunctions are eliminated, and the process is in a state of statistical control. The process capability is represented by mean $\pm 3\sigma$ or 6σ when the quality characteristic output from the process shows normal distribution. σ (sigma) indicates standard deviation.

Process capability index (PCI or Cp)

A measure of how well the process can operate within the tolerance limits of the target characteristic. It should always be significantly greater than one. The index value is calculated by dividing the tolerance of a target characteristic by the process capability (6σ). The value calculated by dividing the difference between the mean ($\overline{X}$) and the standard value by 3σ may be used to represent this index in cases of a unilateral tolerance. The process capability index assumes that a characteristic follows the normal distribution.

Notes: If a characteristic follows the normal distribution, 99.74% data is within the range $\pm 3\sigma$ from the mean.

Bilateral tolerance

$$Cp = \frac{USL-LSL}{6\sigma}$$

USL: Upper specification limit
LSL: Lower specification limit

Unilateral tolerance ... If only the upper limit is stipulated

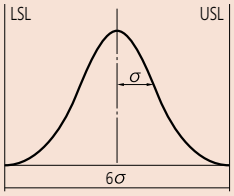
$$Cp = \frac{USL-\overline{X}}{3\sigma}$$

Unilateral tolerance ... If only the lower limit is stipulated

$$Cp = \frac{\overline{X}-LSL}{3\sigma}$$

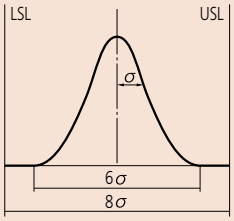
Specific examples of a process capability index (Cp) (bilateral tolerance)

Cp = 1



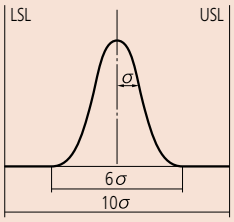
The process capability is barely achieved as the 6 sigma process limits are coincident with the tolerance limits.

Cp = 1.33



The process capability is the minimum value that can be generally accepted as it is no closer than 1 sigma to the tolerance limits.

Cp = 1.67



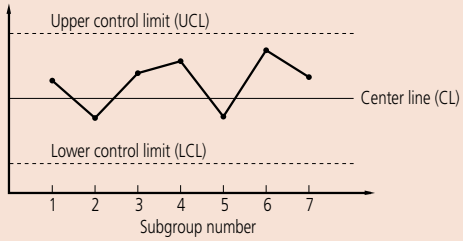
The process capability is sufficient as it is no closer than 2 sigma to the tolerance limits.

Note that Cp only represents the relationship between the tolerance limits and the process dispersion and does not consider the position of the process mean.

Notes: A process capability index that takes the difference between the process mean from the target process mean into consideration is generally called Cpk, which is the upper tolerance (USL minus the mean) divided by 3σ (half of process capability) or the lower tolerance (the mean value minus LSL) divided by 3σ, whichever is smaller.

Control chart

Used to control the process by separating the process variation into that due to chance causes and that due to a malfunction. The control chart consists of one center line (CL) and the control limit lines rationally determined above and below it (UCL and LCL). It can be said that the process is in a state of statistical control if all points are within the upper and lower control limit lines without notable trends when the characteristic values that represent the process output are plotted. The control chart is a useful tool for controlling process output, and therefore quality.



Chance causes

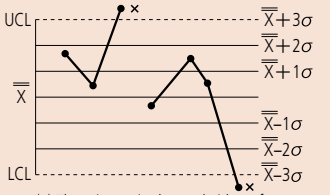
These causes of variation are of relatively low importance. Chance causes are technologically or economically impossible to eliminate even if they can be identified.

$\bar{X}$-R control chart

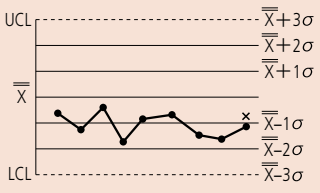
A control chart used for process control that provides the most information on the process. The $\bar{X}$-R control chart consists of the $\bar{X}$ control chart that uses the mean of each subgroup for control to monitor abnormal bias of the process mean and the R control chart that uses the range for control to monitor abnormal variation. Usually, both charts are used together.

How to read the control chart

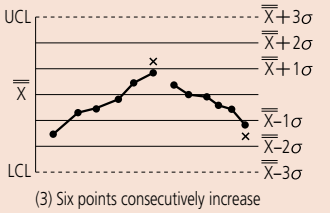
Typical trends of successive point position in the control chart that are considered undesirable are shown below. These trends are taken to mean that a 'special cause' is affecting the process output and that action from the process operator is required to remedy the situation. These determination rules only provide a guideline. Take the process-specific variation into consideration when actually making determination rules. Assuming that the upper and the lower control limits are 3σ away from the center line, divide the control chart into six regions at intervals of 1σ to apply the following rules. These rules are applicable to the X control chart and the $\bar{X}$ control chart. Note that these 'trend rules for action' were formulated assuming a normal distribution. Rules can be formulated to suit any other distribution.



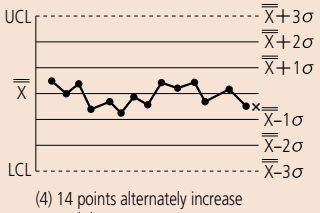
(1) There is a point beyond either of the control limit lines (±3σ).



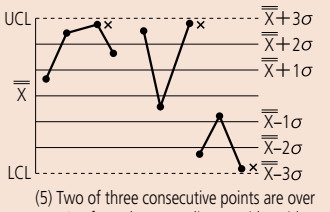
(2) Nine consecutive points are to one side of the center line.



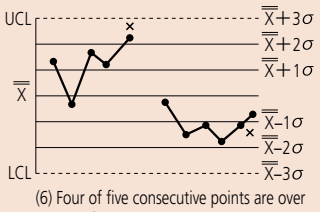
(3) Six points consecutively increase or decrease.



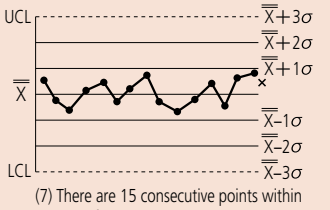
(4) 14 points alternately increase and decrease.



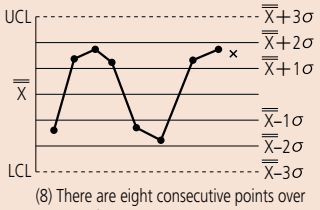
(5) Two of three consecutive points are over ±2σ from the center line on either side.



(6) Four of five consecutive points are over ±1σ from the center line on either side.



(7) There are 15 consecutive points within ±1σ from the center line.



(8) There are eight consecutive points over ±1σ from the center line.

Note: This part of 'Quick Guide to Precision Measuring Instruments' (A-25 to A-26) has been written by Mitutoyo based on its own interpretation of the JIS Quality Control Handbook published by the Japanese Standards Association.

References

- JIS Quality Control Handbook (Japanese Standards Association)

Z 8101: 1981
Z 8101-1: 1999
Z 8101-2: 1999
Z 9020: 1999
Z 9021: 1998

Mitutoyo