

# High Accuracy

## MT220 Series of Digital Manometers

– For Truly Efficient Field Calibration –

# MT220



- High accuracy:  $\pm 0.01\%$  of reading, with a maximum allowable input of 500 kPa (130 kPa-range model)
  - Measurement with DCV and DCA
  - 24 V DC output
  - Percent reading
  - Error reading
  - Measurement data memory
  - D/A conversion output, comparator output, and external trigger input (optional)
  - GP-IB or RS-232 interfaces
  - 12 V DC power supply
  - Battery operation (optional)

The de facto standard of field calibrators for pressure and differential pressure transmitters

# The de Facto Standard of Field Calibrators for Pressure and Differential Pressure Transmitters

## High-Performance, High-Efficiency Field Calibration

In electric power, gas, nuclear power, oil refinery, petrochemical and pharmaceutical plants, numerous sensors are used to measure such variables as pressure, temperature and flow rate, and to automate the process. These sensors must be calibrated periodically to maintain product quality. However, because there are typically so many pressure/differential pressure transmitters out in the field, the transmitters are usually calibrated in-situ. This calibration accounts for much of plant maintenance work. Efficiency is therefore crucial to maintain uptime of equipment and facilities.

The MT220 is a precision digital manometer for use with pressure/differential pressure transmitters and is designed to maximize the efficiency of field calibration work.

## Functions Tailored to Your Calibration Work

Calibration involves inputting the same pressure level to both a calibrator and a transmitter and comparing the transmitter output with a value measured by the calibrator. The MT220 comes with all the functions you need for such calibration work in the plant or field. Practical functions include measuring transmitter output (1-5 V or 4-20 mA), outputting 24 V DC for driving the transmitter, and indicating the transmitter output error as a percent value. The MT220 even has a pressure range pre-adjusted to that of transmitters.

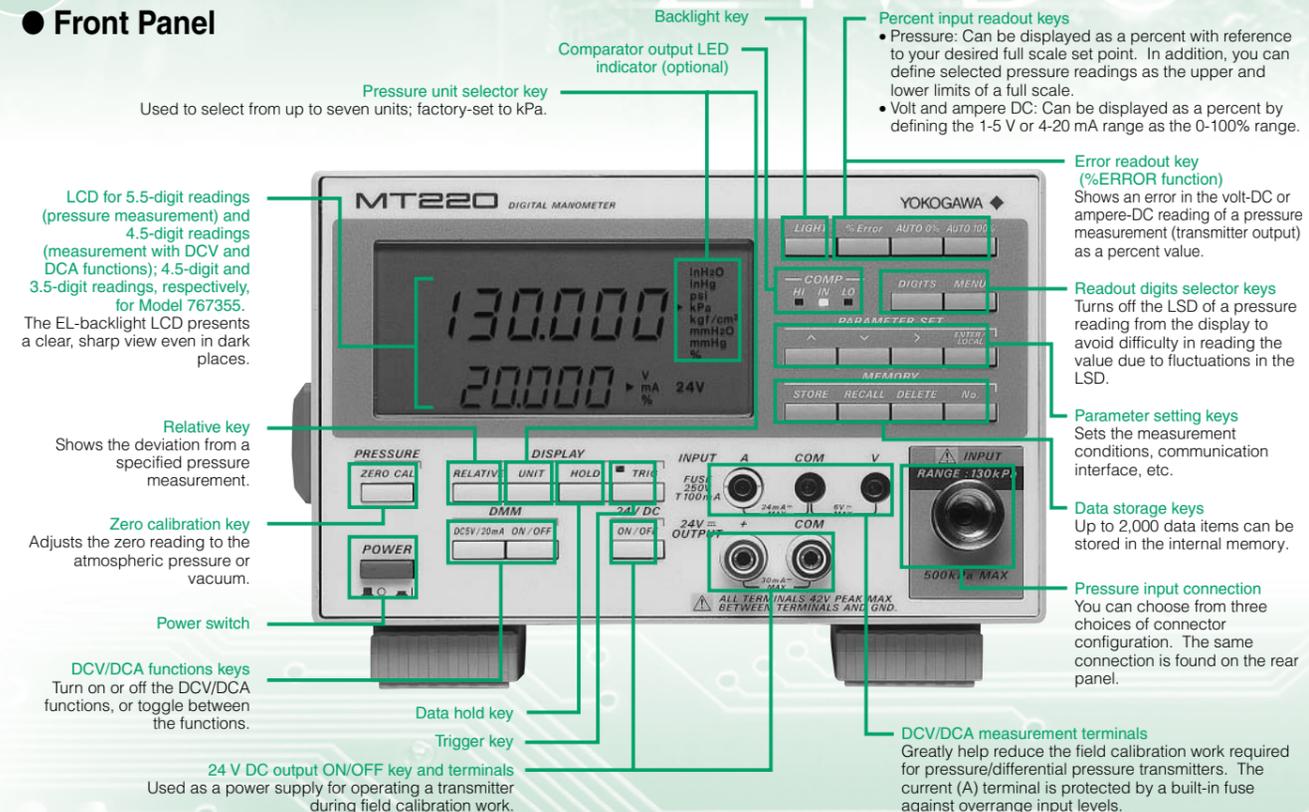
## Assured Compatibility with Earlier Models

The specifications of the MT220 are based on the earlier series of MT120 manometers to ensure compatibility; both series also share the same communications commands.

## Other Major Functions

Many other functions help you implement your specific applications successfully.

### ● Front Panel



## Full Support for Higher Accuracy of Pressure/Differential Pressure Transmitters

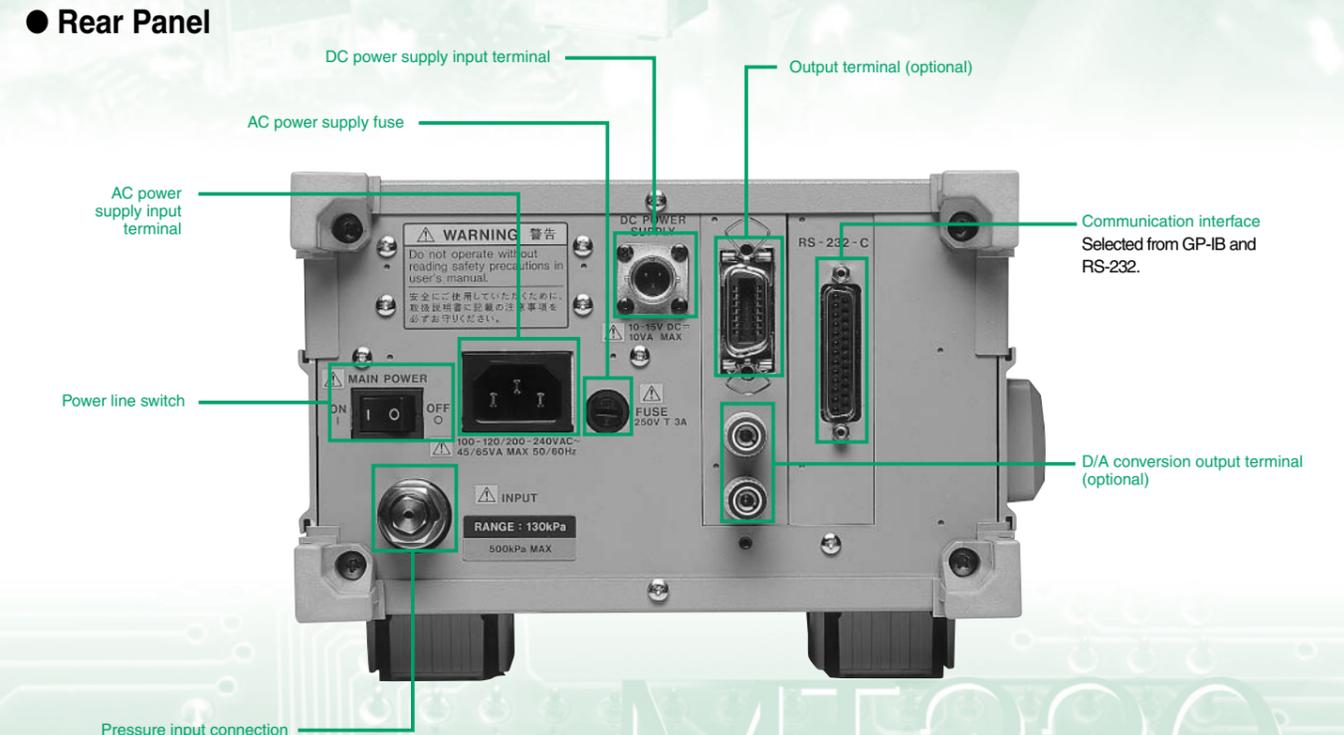
The accuracy of pressure/differential pressure transmitters has continued to improve, from  $\pm 0.25\%$  to  $\pm 0.1\%$ , and now to  $\pm 0.075\%$ . That means the accuracy and stability of the manometers used to calibrate these transmitters must keep pace.

The MT220 employs Yokogawa's original silicon resonant sensor—a high precision pressure sensing device. We've also set up an advanced calibration environment, including a tightly-controlled traceability system. As a result, our calibrators feature basic accuracy as high as  $\pm 0.01\%$ , and excellent stability. With the MT220, you can verify the performance of even the most accurate of pressure/differential pressure transmitters, i.e.  $\pm 0.075\%$ .

## Years of Experience in Precision Pressure Measuring Instruments

Yokogawa, a leading company with a proven track record in the field of industrial instruments and instrumentation, also has decades of experience in pressure measurement. We've been developing digital manometers for more than 20 years and have won a great many loyal customers. Our wide range of pressure measuring instruments offer unrivalled functionality and performance.

### ● Rear Panel

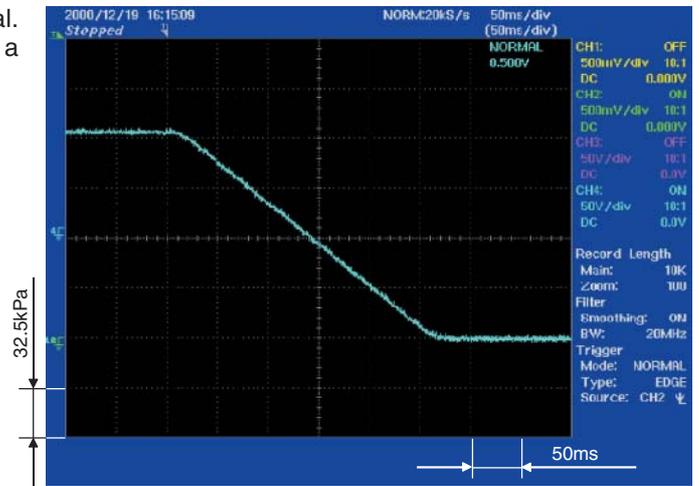


# High-Performance Products Built on Sound Technology

## Automation of Pressure Measurement

### D/A Conversion Output (Optional)

Outputs a D/A-converted signal through the external terminal. This feature lets you easily send measurement data to a measuring system or a recorder.



Example of D/A Conversion Output Waveform

### Comparator Output and External Trigger Input (Optional)

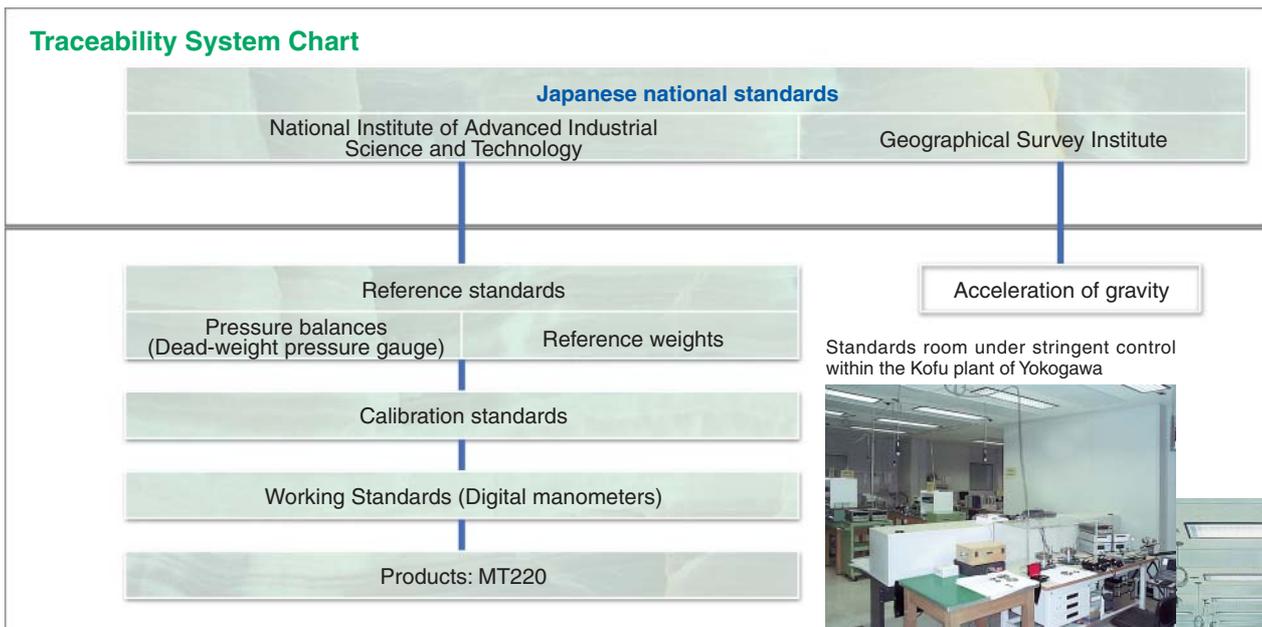
The comparator output provides the result of comparing an input level with preset upper and lower limits through the external terminal. You can also apply a start-of-measurement trigger using the rising edge of an external trigger signal supplied through the external trigger input. These features help automate your production/inspection lines of pressure-related products.

### GP-IB (or RS-232) Interface—Choose When Ordering

This feature lets you read measured values into your PC or set measurement conditions from the PC. Communication is still possible even when the MT210/210F series are operated on batteries or the DC power source.

## Yokogawa Traceability System for Ensuring Top Reliability of Pressure measurement by customers

The company is committed to controlling and maintaining the accuracy of standards installed in the standards room of its Kofu plant.



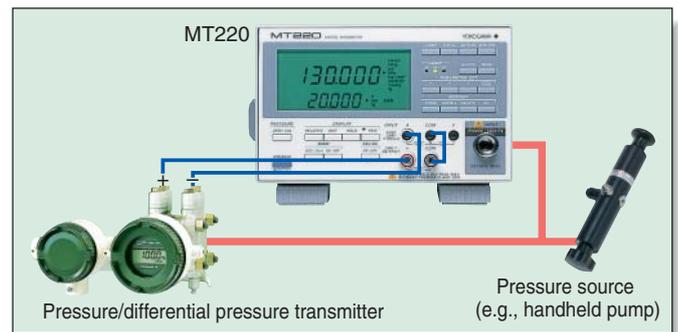
# A Proven Track Record of Field Applications

## Field Calibration of Pressure/Differential Pressure Transmitters



Example of Calibration Work

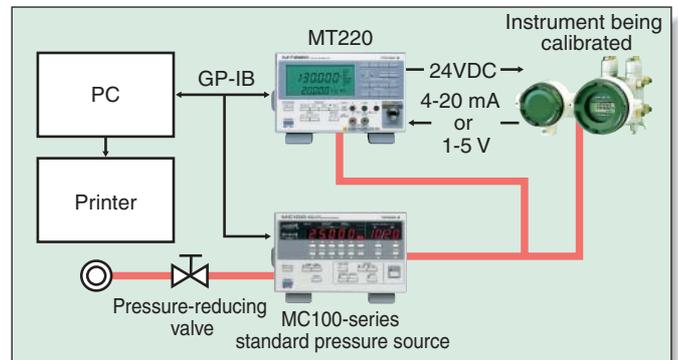
The MT220 can measure pressure with outstanding accuracy, high resolution, minimal tempco, and excellent stability. It offers a wealth of functions for field calibration, including transmitter output measurement (DCV/DCA functions), 24-V DC output, percent error readout, measurement data memory, and Ni-Cd battery operation. The D/A conversion output makes it simple to output data to a recorder or other equipment. And of course, data output through a GP-IB or RS-232 interface is also possible—including data output during operation on a 12 V DC power supply or Ni-Cd batteries.



Hook-up Example

## Calibration System Configuration Using a Combination of MT220 and Standard Pressure Source

Calibrating transmitters, pressure sensors and manometers is easy. Simply combine the MT220 with a standard pressure source (e.g., MC100 series) or a handheld pump (e.g., Model BA-11). You can also automate your calibration system by integrating your PC and relevant equipment with the system, making it ideal for a calibration laboratory, for example.



Hook-up Example



Example of System Configuration

## Major Users of Yokogawa Digital Manometers (for Reference Only)

National standards institutions in Japan and abroad; institutions related to nuclear power generation; national and public research institutions; electric-power companies; automakers and their affiliates; electric home appliances manufacturers; precision instruments manufacturers; semiconductor and electronic components manufacturers; pharmaceutical manufacturers; heavy electrical machinery builders; oil refinery companies and chemical and petrochemical companies; and engineering companies.

# Technical Data

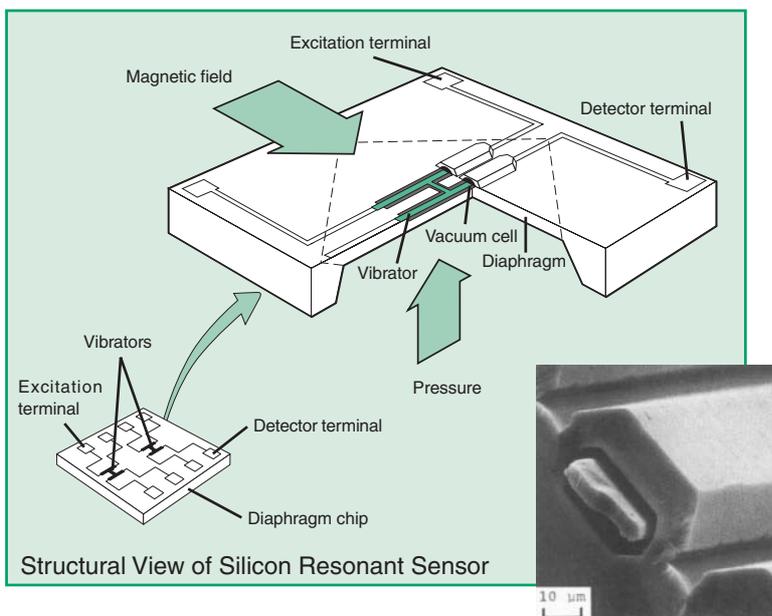
## ■ Pressure-Measurement Specifications

Model	767351	767353	767355	767356	767357
Pressure type	Gauge				Absolute
Measurement range (with guaranteed accuracy)	Positive pressure: 0 to 10 kPa Negative pressure: -10 to 0 kPa	Positive pressure: 0 to 130 kPa Negative pressure: -80 to 0 kPa	Positive pressure: 0 to 700 kPa Negative pressure: -80 to 0 kPa	Positive pressure: 0 to 3000 kPa Negative pressure: -80 to 0 kPa	0 to 130 kPa abs
Readout range	-12.0000 to 12.0000 kPa	Up to 156.000 kPa	Up to 840.000 kPa	Up to 3600.00 kPa	Up to 156.000 kPa abs
Accuracy <sup>*6,7</sup> (Six months after calibration) (Tested at 23 ±3°C, after zero calibration)	Positive pressure: ±(0.01% of reading +0.015% of full scale) Negative pressure: ±(0.2% of reading +0.1% of full scale)	Positive pressure: ±(0.01% of reading+3 digits) for 20 to 130 kPa ±5digits for 0 to 20 kPa Negative pressure: ±(0.2% of reading +0.1% of full scale)	Positive pressure: ±(0.01% of reading +0.005% of full scale) Negative pressure: ±(0.2% of reading +0.1% of full scale)	Positive pressure: ±(0.01% of reading +0.005% of full scale) Negative pressure: ±(0.2% of reading +0.1% of full scale)	±(0.01% of reading+0.005% of full scale)
Measurement accuracy one year after calibration (add each value to the accuracy six months after calibration) (Tested at 23 ±3°C, after zero calibration)	±(0.01% of full scale)		±(0.005% of full scale)		
Readout update interval <sup>*1</sup>	250 ms				
Response time <sup>*2</sup>	2.5 s max.				
Resolution	0.0001 kPa	0.001 kPa	0.01 kPa	0.01 kPa	0.001 kPa
Allowable input	2.7 kPa abs to 500 kPa gaug	2.7 kPa abs to 500 kPa gauge	2.7 kPa abs to 3000 kPa gauge	2.7 kPa abs to 4500 kPa gauge	1 Pa abs to 500 kPa abs
Internal volume	Approx. 10 cm <sup>3</sup>				
Temperature effect	Zero point: ±0.0015% of full scale/°C Span: ±0.001% of full scale/°C		Zero point: ±0.001% of full scale/°C Span: ±0.001% of full scale/°C		
Effect of attitude • 90° tilt, forward or backward • 30° tilt, right or left	Zero point: ±0.1% of full scale Span: ±2.5% of full scale	Zero point: ±0.01% of full scale Span: ±0.2% of full scale	Zero point: ±0.01% of full scale Span: ±0.05% of full scale	Zero point: ±0.01% of full scale Span: ±0.01% of full scale	Zero point: ±0.01% of full scale Span: ±0.2% of full scale
Leak rate	10 <sup>-5</sup> cm <sup>3</sup> /s				
Weight (main unit)	Approx. 8.5 kg	Approx. 7.0 kg	Approx. 8.5 kg	Approx. 7.0 kg	Approx. 7.0 kg
Applicable fluids	Gases and liquids (non-flammable, non-explosive, non-toxic and non-corrosive fluids)				
Fluid temperature	5 to 50°C				
Liquid viscosity	5 × 10 <sup>-3</sup> m <sup>2</sup> /s max.				
Pressure sensor	Silicon resonant sensor				
Pressure sensing element	Diaphragm				
Readout unit	kPa only, or selection from a group consisting of kPa, kgf/cm <sup>2</sup> , mmHg and mmH <sub>2</sub> O or a group consisting of kPa, psi, inHg, inH <sub>2</sub> O, kgf/cm <sup>2</sup> , mmHg and mmH <sub>2</sub> O; specify when ordering <sup>*)</sup>				
Pressure input connector	Rc1/4 or NPT1/4 female-threaded or VCO1/4 male-threaded <sup>**</sup> (specify when ordering), located on both front and rear panels; however, simultaneous input to connections on both sides is prohibited)				
Material of measurement section	Diaphragm: Hastelloy C276; flange of measurement chamber: stainless steel (JIS SUS316), Internal piping: stainless steel (JIS SUS316); O-ring: fluororubber; input connector: stainless steel (JIS SUS316)				

## ■ Reference Information

### Yokogawa's Original Silicon Resonant Sensor (Winner of the Ohkochi Grand Technology Prize and the Chairman's Award of the Japan Federation of Economic Organizations (Keidanren))

Thanks to Yokogawa's award-winning sensor, the MT220 boasts a basic accuracy as high as ±0.01%, and high resolution. The silicon resonant sensor is also practically immune to external effects such as temperature variations.



## ■ Pressure Unit Conversion Table

Pa	bar	kgf/cm <sup>2</sup>	atm	mmH <sub>2</sub> O or mmAq	mmHg or Torr
1	1 × 10 <sup>-5</sup>	1.019 72 × 10 <sup>-5</sup>	9.869 23 × 10 <sup>-6</sup>	1.019 72 × 10 <sup>-1</sup>	7.500 62 × 10 <sup>-3</sup>
1 × 10 <sup>5</sup>	1	1.019 72	9.869 23 × 10 <sup>-1</sup>	1.019 72 × 10 <sup>4</sup>	7.500 62 × 10 <sup>2</sup>
9.806 65 × 10 <sup>4</sup>	9.806 65 × 10 <sup>-1</sup>	1	9.678 41 × 10 <sup>-1</sup>	1 × 10 <sup>4</sup>	7.355 59 × 10 <sup>2</sup>
1.013 25 × 10 <sup>5</sup>	1.013 25	1.033 23	1	1.033 23 × 10 <sup>4</sup>	7.600 00 × 10 <sup>2</sup>
9.806 65	9.806 65 × 10 <sup>-5</sup>	1 × 10 <sup>-4</sup>	9.678 41 × 10 <sup>-5</sup>	1	7.355 59 × 10 <sup>-2</sup>
1.333 22 × 10 <sup>2</sup>	1.333 22 × 10 <sup>-3</sup>	1.359 51 × 10 <sup>-3</sup>	1.315 79 × 10 <sup>-3</sup>	1.359 51 × 10	1

## DCV/DCA Function Specifications

	Voltage	Current
Measurement range (with guaranteed accuracy)	0 to $\pm 5.25$ V	0 to $\pm 21$ mA
Accuracy (Tested at $23 \pm 3^\circ\text{C}$ )	$\pm(0.01\%$ of reading + 2 digits) 30 days after calibration	
	$\pm(0.03\%$ of reading + 2 digits) 90 days after calibration	
	$\pm(0.05\%$ of reading + 3 digits) 6 months after calibration	
	$\pm(0.07\%$ of reading + 3 digits) 1 year after calibration	
Readout range	0 to $\pm 6.0000$ V	0 to $\pm 24.000$ mA
Maximum allowable input	30VDC	100mA
Readout unit	V	mA
Input impedance	Approx. 10 M $\Omega$	Approx. 20 M $\Omega$
CMRR	120 dB min. (50/60 Hz; $R_s = 1$ k $\Omega$ )	—
NMRR	60 dB min. (50/60 Hz)	—
Temperature effect	$\pm(0.01\%$ of reading + 2 digits) / $10^\circ\text{C}$	

Note: The maximum allowable potential difference between any measuring terminal and the grounding terminal is 42 V<sub>peak</sub>.

## 24 V DC Output Specifications

Output voltage	24 $\pm 1$ V DC (fixed)
Output current	30 mA max. (with limiter)

Note: The maximum allowable potential difference between any measuring terminal and the grounding terminal is 42 V<sub>peak</sub>.

## Data Memory Specifications

Memory capacity	2000 data items
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## Specifications of Communication Interfaces (choose one)

GP-IB interface	
Electrical and mechanical specifications	Conforms to IEEE Standard 488-1978
Functional specifications	SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0
RS-232 interface	
Transmission method	Start-stop synchronization
Transfer rate	1200, 2400, 4800, 9600 bits/s

## Specifications of "/DA" Option

### D/A Conversion Output

Output voltage	Switchable between 0 to $\pm 2$ V and 0 to $\pm 5$ V to reflect the readout of pressure measurement Example of corresponding output voltages when measured with a 130-kPa gauge-pressure model set to the $\pm 2$ V range: 0 kPa = 0 V 65 kPa = 1 V 130 kPa = 2 V 156 kPa = 2.4 V -80 kPa = -1.230 V
Output resolution	16 bits, where full scale is approximately $\pm 125\%$ of range
Output accuracy (Tested at $23 \pm 3^\circ\text{C}$ , after zero calibration, using the D/A conversion output terminal)	Add $\pm 0.05\%$ of full scale to accuracy in the Pressure-measurement Specifications section.
Temperature effect	$\pm(0.005\%$ of full scale)/ $^\circ\text{C}$
Output update interval	Approx. 2 ms
Response time	Same as the response time specified in the Pressure-measurement Specifications section.
Output resistance	0.1 $\Omega$ max.
Load resistance	1 k $\Omega$ min.

### Comparator Output

Output signal	HIGH, IN, LOW, BUSY
Operation	HIGH = 1, if measured value > upper limit IN = 1, if upper limit $\geq$ measured value $\geq$ lower limit LOW = 1, if measured value < lower limit BUSY = 1, if there is a transition in the output signal An LED lamp on the display corresponding to HIGH, LOW or IN comes on.
Signal level	TTL

### External Trigger

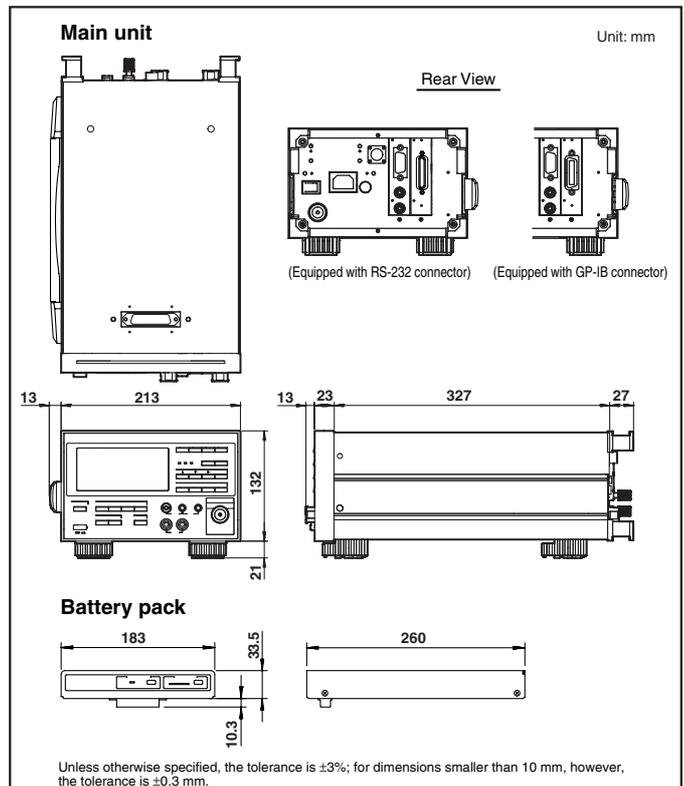
Input level	TTL
Operation	A start-of-measurement trigger is applied at a falling edge when the high-state level of an external signal is input with the HOLD function enabled. At the moment of triggering, the LED lamp on the front panel comes on.

## Common Specifications

Display	LCD (with backlight); number of readout digits: 5.5 or 4.5 <sup>*5</sup> digits for pressure measurement and 4.5 digits for measurement with DCV/DCA functions
Warm-up time	Approx. 5 minutes
Operating temperature/humidity ranges	5 to 40 $^\circ\text{C}$ /20 to 80% RH (no condensation)
Altitude of operation	2000 m max.
Storage temperature range	-20 $^\circ\text{C}$ to 60 $^\circ\text{C}$
Power Supply	Three-way power (AC or DC supply, or optional Ni-Cd batteries)
AC power rating Allowable supply voltage range Allowable supply frequency range	100 to 120/200 to 240 V AC, at 50/60 Hz 90 to 132 V/180 to 264 V AC 47 to 63 Hz
DC power rating	10 to 15 V DC
Battery pack (optional)	Ni-Cd batteries: Last approximately 6 hours in continuous operation mode when fully charged (tested with the backlight, DCV/DCA functions and 24-V DC output turned on). Battery charger: Built into the MT220 main unit Recharge time: Approx. 12 hours
Power consumption	When in pressure measurement mode: 25 VA max. for 100-V power line; 40 VA max. for 200-V power line When in recharge mode: 45 VA max. for 100-V power line; 65 VA max. for 200-V power line When in DC-powered operation: 10 VA max.
Insulation resistance	20 M $\Omega$ min. at 500 V DC, between AC power supply and casing
Withstanding voltage	1500 V AC (50/60 Hz) for 1 minute, between AC power supply and casing
External dimensions	Main unit: Approx. 132 mm $\times$ 213 mm $\times$ 350 mm, excluding protrusions Battery pack (optional): Approx. 33 mm $\times$ 182 mm $\times$ 260 mm, excluding protrusions
Weight	Main unit: See the Pressure-measurement Specifications section. Battery pack: Approx. 2.7 kg
Accessories	Connector for DC power supply (1), rubber pads for rear foot (2), labels for indicating measurement object, test lead (1), power cord (1), and user's manual (1)

- \*1 The interval of outputting data via communication is the same as the readout update interval.  
\*2 Conditions of response time measurement:  
• The response time is defined as the interval from the start of change to the time the readout settles to within  $\pm 1\%$  of its final value.  
• The manometer under test is made open to the atmospheric pressure when it is at its full-scale value, where the input section is under no load. In the case of absolute-pressure models, the manometer under test is made open to the atmospheric pressure at a scale value of 0.  
• Measurement is performed using the D/A conversion output.  
\*3 All models are factory-set to kPa.  
\*4 VCO is a registered trademark of Swagelok Company. A conversion connector is attached.  
\*5 4.5/3.5 digits for Model 767355.  
\*6 Yokogawa's pressure standards accuracy is excluded.  
\*7 Long term stability of zero point is excluded.

## External Dimensions



## Models and Suffix Codes

### Main Units

Product	Model	Suffix Code	Remarks
MT220 series of digital manometers	767351	—	10 kPa-range, gauge-pressure model
	767353	—	130 kPa-range, gauge-pressure model
	767355	—	700 kPa-range, gauge-pressure model
	767356	—	3000 kPa-range, gauge-pressure model
	767357	—	130 kPa-range, absolute-pressure model
Pressure unit	-U1		kPa
	-U2		kPa, switchable to kgf/cm <sup>2</sup> , mmHg or mmH <sub>2</sub> O
	-U3		kPa, switchable to psi, inHg, inH <sub>2</sub> O, kgf/cm <sup>2</sup> , mmHg or mmH <sub>2</sub> O
Communication interface	-C1		GP-IB
	-C2		RS-232
Pressure I/O connection	-P1		Rc 1/4
	-P2		NPT1/4 female-threaded
	-P3		VCO 1/4 male-threaded*
Power cord	-D		UL/CSA standard
	-F		VDE standard
	-H		GB standard
	-R		AS standard
	-Q		BS standard
Option	/DA		D/A conversion output, comparator output and external trigger input

\* VCO is a registered trademark of Swagelok Company.

### Optional Accessories

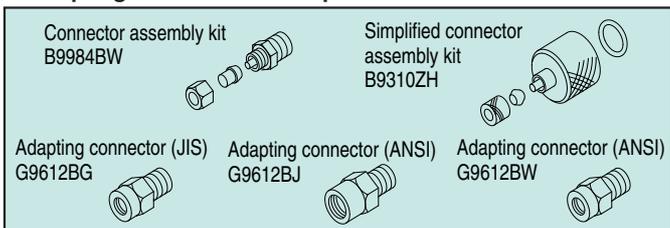
Product	Model	Suffix Code	Remarks
Battery pack	269913	—	Ni-Cd batteries for MT210/220 series
Ni-Cd batteries	269914	—	A kit of three Ni-Cd batteries for the 269913 battery pack
Carrying case	B9320ND	—	For use with MT210/220 series
Connector assembly kit	B9984BY	—	For use with $\phi 4 \times \phi 6$ PVC tubing (for "-P1" option)
Connector assembly kit	B9984BW	—	For use with $\phi 4 \times \phi 6$ PVC tubing (for "-P2" option)
Simplified connector assembly kit	B9310ZH	—	For use with $\phi 4 \times \phi 6$ PVC tubing
Adapting connector	G9612BG	—	JIS; R1/4-to-Rc1/8
Adapting connector	G9612BJ	—	ANSI; R1/4-to-NPT1/4 female thread
Adapting connector	G9612BW	—	ANSI; R1/4-to-NPT1/8 female thread

### Carrying Case

Picture of B9320ND carrying case



### Adapting Connectors for Input Section



## Related Products

### MT210/210F Digital Manometers

- High accuracy:  $\pm 0.01\%$  of reading
- Maximum allowable input: 500 kPa (130 kPa-range model)
- A wide range of pressures, from low differential pressure of 1 kPa to high gauge pressure of 3000 kPa
- Selection from three measurement modes: normal speed, medium speed and high speed (MT210F series)
- D/A conversion output, comparator output, and external trigger input (optional)
- GP-IB and RS-232 interfaces
- 12-V DC power supply
- Battery operation (optional)



### MT10 Mini-manometer

- Highly reliable design based on silicon resonant sensor
- Compact
- High accuracy:  $\pm(0.04\%$  of reading +  $0.03\%$  of full scale) for 130 kPa-range model
- Three choices of pressure range: 130, 700 and 3000 kPa
- Simple operation
- Data hold function
- RS-232 interface



### MC100 Pressure Standard

- High accuracy:  $\pm(0.05\%$  of full scale)
- Excellent stability of operation based on silicon resonant sensor
- Two choices of pressure ranges: 25 and 200 kPa
- Output divider function for generating fractions of a pressure setpoint, to a maximum resolution of 1/20
- Output autostep function
- Output sweep function
- Offset monitor function



### CA71 Handy Calibrators

- Source and measure operations at the same time. DC Voltage, DC Current, Resistance, Thermocouple (TC), Resistance Temperature Detector (RTD), Frequency, Pulse).
- AC voltages, including supply voltage, can be measured.
- Includes a wide array of additional functions.
- Easy operation.
- Compact size and Lightweight.



#### NOTICE

- Before operating the product, read the instruction manual thoroughly for proper and safe operation.
- If this product is for use with a system requiring safeguards that directly involve personnel safety, please contact the Yokogawa sales offices.

# YOKOGAWA

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