CATALOG DE-119B

Davis Controls
LIMITED

Endress + Hauser

- Point Level Switches
- Continuous Level Transmitters
- Solids Level Controls
- Liquid Level Controls
- Flow Controls
- Conveyor Blockage Detectors
- Open Channel Flow Measurement
- Printers

See page 2

Davis Controls
LIMITED

TORONTO
P.O. Box 160
Islington, Ontario M9A 4X2
(416) 233-3211, 239-2383
Telex 06-967684
(Answerback: Davistrol Tor)

ONTARIO
Call toll free from area codes
416, 519, 613 or 705
1-800-268-2468

MANITOBA, NW ONT.
Call toll free from area codes
204 and 807
1-800-268-2766

ATLANTIC
Call toll free from area codes
902, 506 and 709
1-800-268-2766

VANCOUVER
10451 Shellbridge Way
Suite 150
Richmond, B.C. V6X 2W8
(604) 278-4052
Telex 04-357844 (Info-Serv VCR)

EDMONTON
9816 44th Avenue
Edmonton, Alberta T6E 5E5
(403) 436-9836
Telex 037-41588

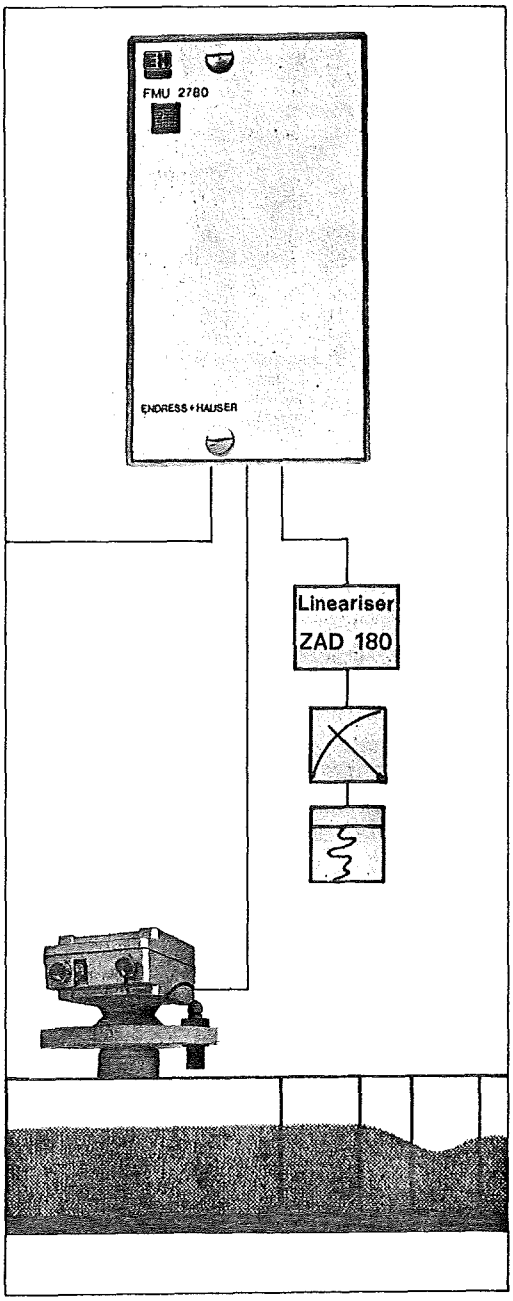
ALBERTA
Call toll free from
area code 403
1-800-232-1959

SASKATOON
2241 Hanselman Ave.,
Suite 200
Saskatoon, Saskatchewan
S7L 6A7
(306) 664-4944
Telex 07-42432

MONTREAL
Les Equipements de Contrôle Davis Ltée
10500 Côte de Liesse, Suite 122
Lachine, Québec H8T 1A4
(514) 631-3552
Telex 05-822665

Printed in Canada **DE-119B 15M/4-84**

NIVOSONIC FMU 2780



Ultrasonic Echo Gauge

Continuous level measuring instrument

Non-contact measurement

For all types of liquids

Accuracy of measurement is not affected by the properties of the liquids

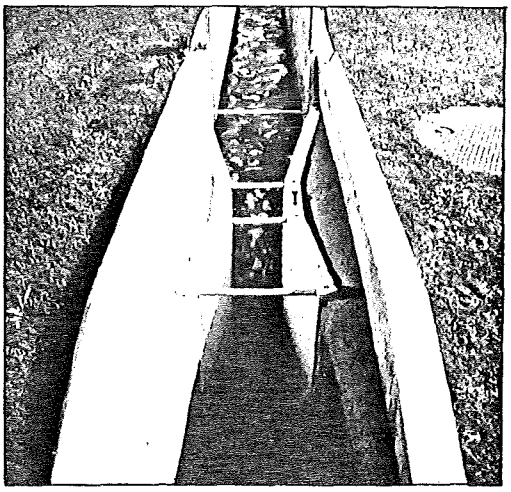
For very short and long measuring spans

Easy calibration by incremental switches and potentiometers directly scaled in "distance"

Considerable separation between ultrasonic-sensor and FMU 2780 possible

Built-in temperature compensation

Not sensitive to weather conditions or dirt



Technical data

FMU 2780

Housing:	Plug-in, grey Duroplast Base plate with removable terminal block
Dimensions:	see figure 1
Protection:	IP 40
Max ambient temperature:	— 40 °C to + 60 °C when installed singly
	120 V + 10% —15%, 50/60 Hz Can be adapted to 110, 220, 240 V
Versions:	24 V ac, 24 V dc
Power consumption:	approx. 3 VA
Weight:	approx. 1.4 kg
Operating frequency:	approx: 46 kHz
Measuring ranges	
- with DU 213:	Level 0...0.09 m to 0...1.1 m for indication 0 ... 100% (depending on application conditions)
- with DU 212:	Level 0...0.14 m to 0...5 m for indication 0 ... 100% (depending on application conditions)
Accuracy	
- with DU 213:	for operating temperature of sensor between —40 °C ... +40°C: ± 1.5% of F (measuring span), but not better than ±2 mm, with E/F=6 and M=45 cm
	for operating temperature of sensor between +40°C ... +60°C: ± 2.5% of F (measuring span), but not better than ± 4 mm, with E/F=6 and M=45 cm
- with DU 212:	for operating temperature of sensor between —20°C ...+60°C: ± 1.5% of F (measuring span) but not better than ± 1.5 cm, with E/F < 2 and M = 70 cm

N.B.: Accuracy increases as E/F-ratio decreases: see item "Accuracy" of Technical Specifications of DU 213.

Voltage output:	0...5 V dc, R_L min 1 kOhm
Current ouput:	0...20 mA, R_L max 350 Ohm or 4...20 mA, R_L max 350 Ohm
Response time for level change 0 to 100%:	can be selected between 10 and 60 s
Blocking distance:	"DU 213" corresponds to approx. 45 cm from flange; "DU 212" corresponds to approx. 70 cm from flange; MAX corresponds to about 1,1 m
Sensor cable:	2 core screened cable Max 20 Ohm per core Max 50 nF between core and screen

Dimensions and Drilling Template

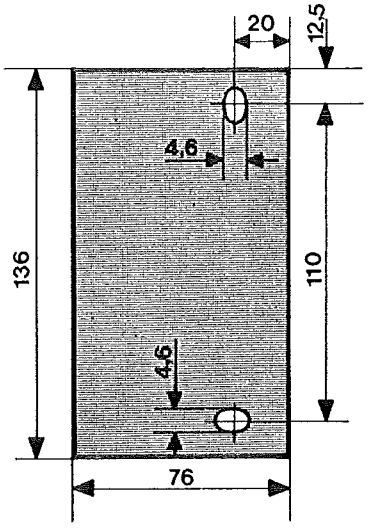


Fig. 1 **Depth of housing 170 mm**

Application

The ultrasonic ECHO unit NIVOSONIC FMU 2780 is used for continuous non-contact level measurement in tanks containing liquids when connected to SENSOR DU 212, and also for non-contact flow measurement in open channels when connected to SENSOR DU 213.

The characteristic of the liquid surface (wave formation) does not affect measurement. The sound waves penetrate light foam up to 2 cm thick. Where the foam is thick and dense, the NIVOSONIC FMU 2780 detects the surface of the foam.

Measuring system

This comprises the NIVOSONIC FMU 2780 and the ultrasonic sensor DU 213 or DU 212.

As optional extras we can supply adapter pipes and sensor clamps. Indicating meter, electronic limit controllers, linearisers for flow measurement, etc. can be connected to the current and voltage output of the NIVOSONIC FMU 2780.

Operating principle

A sensor emits ultrasonic pulses at a frequency of approx. 46 kHz. The inaudible sound waves are reflected by the liquid surface and are received by the sensor. The round-trip time (i.e. the time elapsed between transmitting and receiving the echo) is measured electronically in the FMU 2780 and appears as an output signal proportional to level.

If the sensor does not receive an echo, a safety circuit of the FMU 2780 is initiated which causes the output signal to drive up scale over 100%, or down below 0%, according to choice.

The built-in temperature probe in the ultrasonic sensor automatically compensates round-trip time errors which are caused by the temperature coefficient of the speed of sound in air.

For open channel flow measurement, the level proportional signal is modified by a lineariser programmed with the Q/h characteristic of the channel.

Installation

Sensor:

See Technichal Information sheet for ultrasonic sensor DU 213/DU 212.

Electronic module:

The NIVOSONIC FMU 2780 is a plug-in unit (Monosyst). For installation and cabling only the base plate with the terminal block is needed. The electronics module is then merely plugged in and secured with two retaining screws.

See figure 1 for dimensions and drilling template.
When fitted individually or at least 10 mm apart, max ambient temperature in the switch cabinet during operation is 60 °C.

Connection

See figure 2 for electrical connections of NIVOSONIC FMU 2780. Note voltage on label.

By re-soldering a bridge on the printed circuit board the instrument can be adapted for another voltage. Change voltage on label.

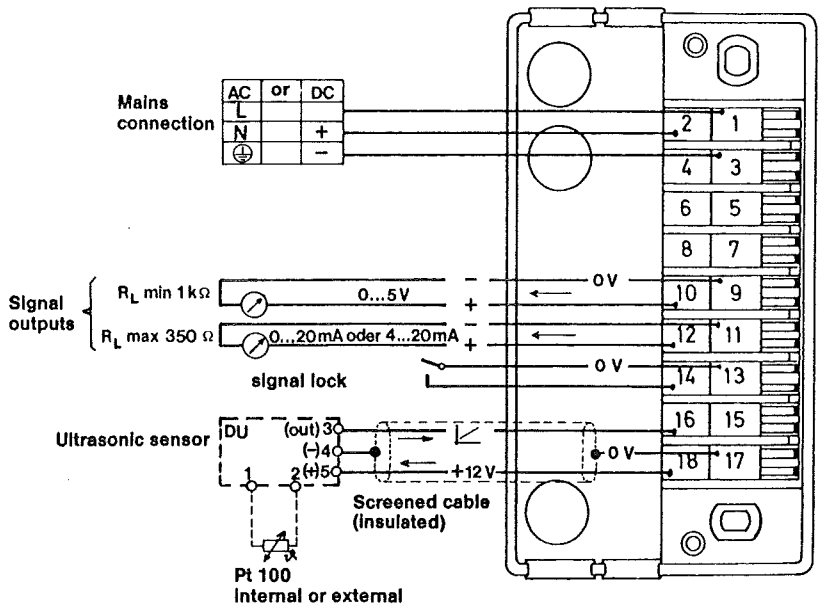


Fig. 2

Technical Data

DU 213/DU 212

Housing:	Protective system IP 55
Dimensions:	see figures 3 and 4
Max ambient temperature:	— 40 °C to + 60 °C
Supply:	from FMU 2780
Accuracy:	see FMU 2780 and below
Minimum blocking distance	
DU 213:	45 cm
DU 212:	70 cm
Measuring ranges:	see FMU 2780
Sensor cable:	2-core screened cable, max 20 Ohm per core, max 50 nF between core and screen.
Temperature compensation gauge	
DU 213:	external feeler
DU 212:	built-in

Mounting

General remark: E/F-value should be kept as small as possible to achieve the highest possible accuracy: it is therefore useful not to mount the sensor higher than necessary above the 100%-level, but also not lower than the minimum allowed blocking distance.

For standard applications the mounting heights (distance between the underside of the sensor flange and the 100%-level) are:

- DU 213: 45 cm
- DU 212: 70 cm.

For non-standard applications (presence of strong ripples, foam or agitators in vessels) the mounting distance must be increased to allow the use of a larger blocking distance than standard.

When an extension tube is used to lift the sensor above the roof of the vessel (this applies mainly for DU 212), the free end of the pipe must be cut at 45 °C (to avoid spurious echos) and the blocking distance must not be shorter than the pipe length plus 15 cm.

Avoid the measurement in guide-tubes because of the high working frequency (46 kHz): small droplets of liquid or solid deposits left by the process liquid will cause spurious reflections.

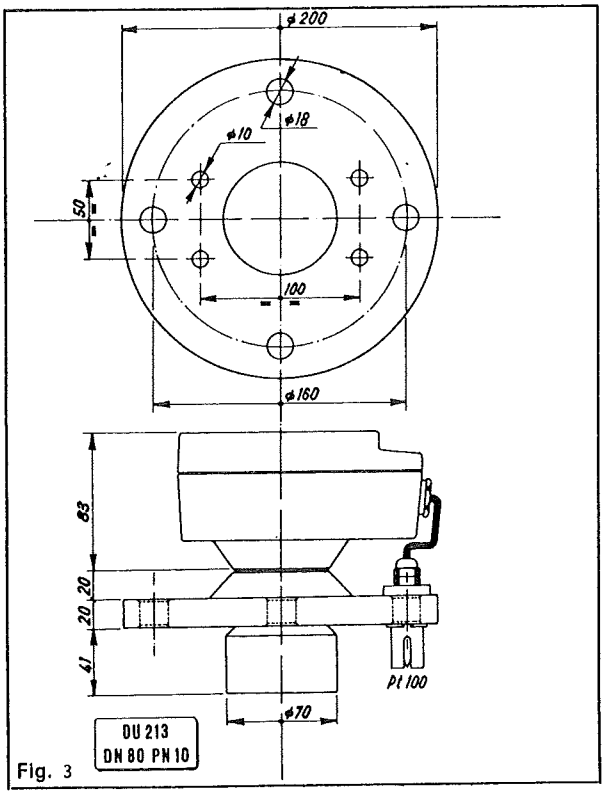


Fig. 3

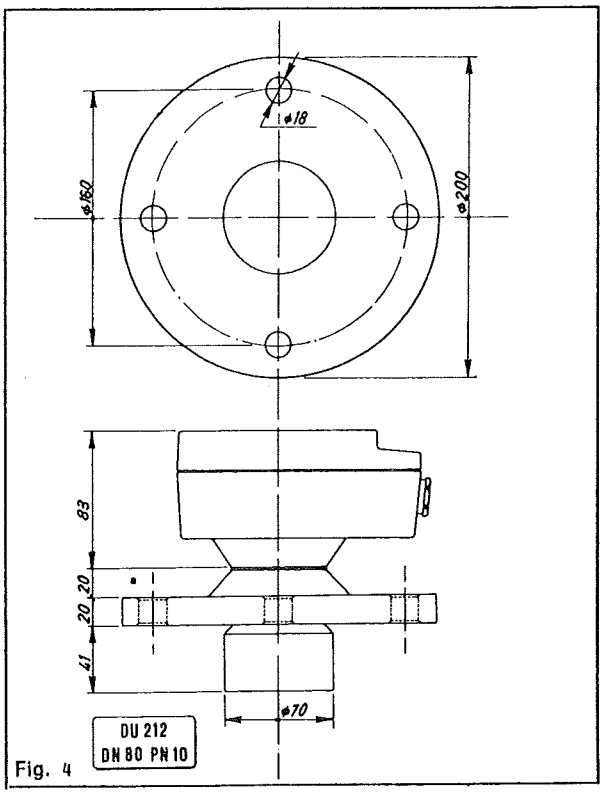
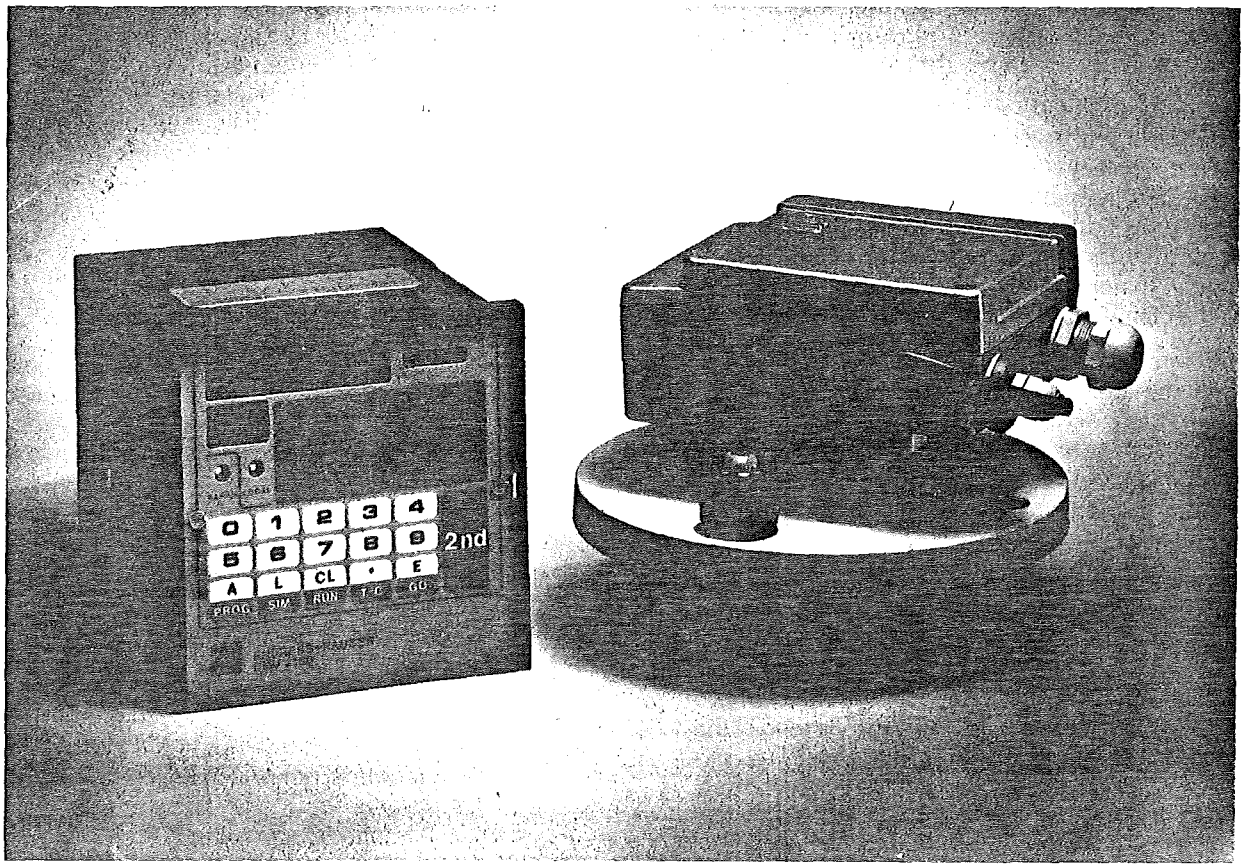


Fig. 4



SYSTEM FEATURES

- Digital readout
- Keyboard programmable
- Field-programmable high & low flow alarms
- Field-programmable high & low level alarms
- Calculates flow mathematically
- Diagnostic general failure alarm
- Transducer can be mounted more than 1000 feet from microprocessor module
- Accuracy—better than 1.5% of flow or ±0.1" of head
- Sampler output
- Counting outputs to drive other devices
- Two flow thresholds to split flow totalization into 3 totalizer outputs, providing increased accuracy in flow reading

DMU 2160

The DMU 2160 open channel flow measurement system is a state-of-the-art micro-processor based flow computer combined with a reliable, non-contact ultrasonic transducer. This system can measure the flow, level and ambient air temperature of virtually any open channel, flume or weir. This modern system for continuous flow measurement offers higher accuracy and ultra-reliability never before achievable in a non-contact system.

The DMU 2160 flow computer is programmable via a pressure sensitive, sealed membrane keyboard. The keyboard allows the user to program the unit's performance and input the parameters that are used to mathematically calculate the flow. Flow calculation is done mathematically to improve accuracy instead of using stored characteristic curves which can induce errors.

The open channel's flow characteristics are programmed into the computer program sequence to be used in making the calculations. In instances where the channel's actual flow function differs significantly from the theoretical, the DMU 2160's simulation mode can be used to "custom fit" a flow function to the application. This allows the user to improve the system accuracy.

The unit's programming features allow the user to configure the control outputs such as alarms, external pulse outputs and other various parameters pertaining to the data acquistion. Two large L.E.D. displays on the unit allow viewing of the measured values and alarm conditions. The six-digit display indicates the flow in the open channel in engineering units that are programmed by the user. Level of the stream in the open channel and the ambient air temperature can also be temporarily displayed by keyboard selection. During the programming process the six-digit display indicates the values inserted into the program. The two-digit display indicates the function being displayed while the unit is in the run mode. In the program mode the two-digit display indicates the program step being viewed.

To prevent tampering, or the program being changed by accident, the unit features a "sentry" protection technique that requires that several keys be pushed in sequence to unlock the keyboard and accept a program change. The user-entered program parameters are stored in an EAROM where they are protected from power outage. The EAROM memory can hold the program for five years after the power is removed from the unit.

The DMU 2160 electronics module is a DIN size, NEMA 1 case with panel mounting hardware. An optional NEMA 4X enclosure (weatherproof and corrosion-resistant, 16" x 14" x 7⅝") is available to house the DMU 2160 case. The basic unit includes as standard a six-digit, non-resettable electromechanical counter to indicate totalized flow. The counter rate is user-programmable to any desired engineering units. Other standard features are:

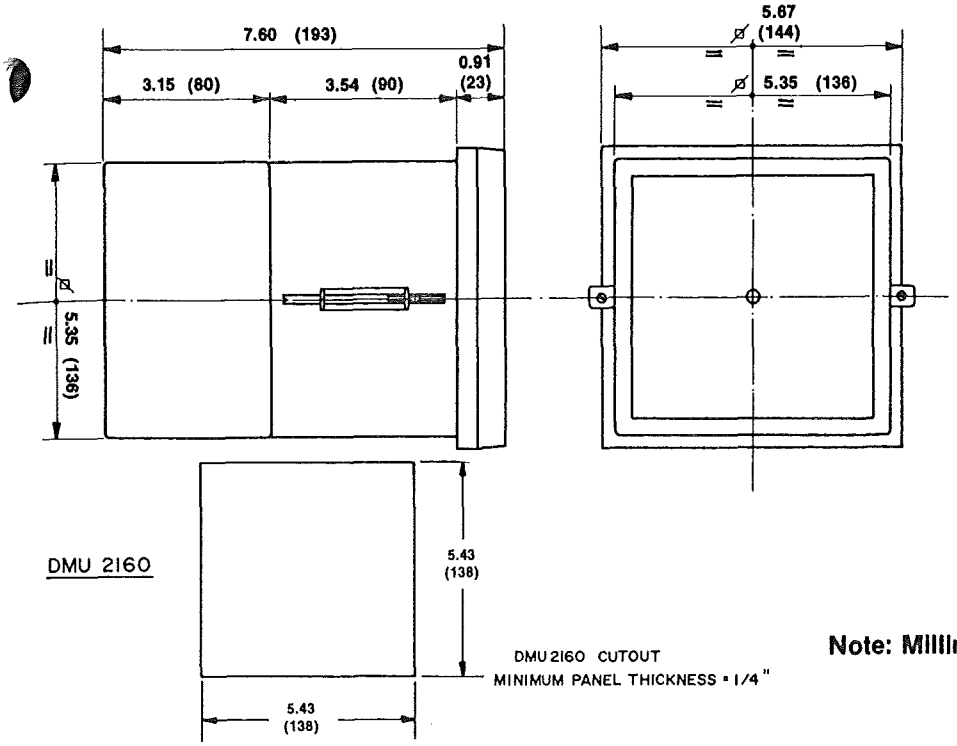
1. Two analog signal outputs for instantaneous flow rate output to a recording device or computer. The current output signal is switch selectable for 0 to 20 mA DC, 4 to 20 mA DC. The voltage output is always 0 to 10 VDC.
2. Relay output for totalizing. This relay output provides a contact pulse capable of driving an external counter or other control device. The output count rate is the same as that programmed for the built-in flow totalizer.
3. General alarm output and L.E.D. light to indicate failure of the DMU 2160 unit. Auto diagnostics are possible by keyboard entry of inquiries to the unit.

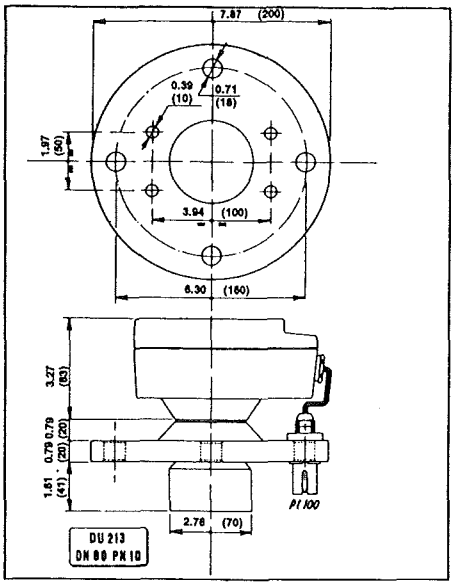
The DMU 2160 also offers two basic option packages that allow the addition of other control outputs. The "A" option package offers the addition of three more relays that are programmable to output a variety of functions. The "B" option package offers two more counting output relays (in addition to the "A" option relays) that allow the user to split the flow totalizing process into three distinct programmable flow levels. The purpose of this "splitter" is to be able to totalize the flow rate into three different counters. Open channel flow measurement accuracy decreases as the liquid level in the channel goes down. The flow splitter outputs the totalized flow to three optional counters so it may be determined how much flow occurred within the user-predetermined flow ranges and how accurate the total flow reading is.

Table I indicates the output options available on the DMU 2160 and how each relay can be programmed to output various functions.

The standard DU 213/Q ultrasonic transducer is connected to the DMU 2160 by a two wire, unshielded cable. The transducer can be mounted up to 1000 feet away from the DMU 2160. Therefore the DMU 2160 can be panel mounted into a control room for more frequent observation. The signal from the transducer to the DMU 2160 is accomplished with a transmission technique that has a high noise immunity. The transducer is compensated for temperature by a 100-ohm platinum RTD sensor mounted on the transducer flange. Two optional transducers are available. (See Table II for transducer options.) The DU 213/QR has remote electronics and RTD temperature compensator on a 3-meter (9.8 feet) cable. This unit is used when excessive vibration is expected. The DU 213/QS has the electronics and temperature compensator on a 10-meter (32.8 feet) cable. This unit is designed so that the transducer can be submersed by flooding without being damaged with the electronics located outside the area likely to be flooded.

DIMENSIONS AND MOUNTING: DMU 2160 AND DU 213/Q





DU 213/Q

Note: Millimeter dimensions shown in parentheses.

TABLE I DMU 2160 OPTIONS
OUTPUT RELAY/ASSIGNMENT TABLE

RELAYS	STANDARD	OPTION "A"	OPTION "B"
GENERAL ALARM	System or Sensor Failure	System or Sensor Failure	System or Sensor Failure
TOTALIZER	Scaled Pulse[2]	Scaled Pulse[2]	Scaled Pulse[2]
R 1	X	Low Level or Low Flow Alarm[1]	Low Level or Low Flow Alarm[1]
R 2	X	High Flow Alarm or Scaled Pulse[1,3]	High Flow Alarm or Scaled Pulse[1,3]
R 3	X	High Level Alarm or Scaled Pulse[1,3]	High Level Alarm or Scaled Pulse[1,3]
COUNT 1	X	X	Scaled Pulse and Flow Splitter[2]
COUNT 0	X	X	Scaled Pulse or Flow Splitter[2]

"X" indicates "Not Present."

NOTE:

1. Each output relay is only assignable to one output function. Selection of setpoints is made during user-programming and relay function is assigned by switch selection on the rear panel of the electronics.
2. Primary scaled pulse weight (Engineering Units) applies to the internal counter, "Totalizer" relay, and both flow splitter options.
3. "R2" and "R3" pulse weights (Engineering Units) may be scaled independently of each other or any other counting outputs.

TABLE II
TRANSDUCER TYPES

Transducer	Description
DU 213/Q	Transducer can be mounted up to 1000' from DMU 2160 which can be panel mounted in control room. Temperature compensation mounted on transducer flange.
DU 213/QR	Transducer has remote electronics and temperature compensation located on a 10' cable. Used when excessive vibration exists.
DU 213/QS	Transducer has remote electronics and temperature compensation located on a 33' cable. Used if transducer may be submersed.

SPECIFICATIONS: DMU 2160: Electronic Microprocessor-Based, Ultrasonic Controller and Flow Computer.

Accuracy: ± 0.08 inches level

Accuracy, System: ±1.5% (typical, consult technical manual)

Enclosure: NEMA 1, Panel Mounting. Optional NEMA 4X (to house the DMU 2160 case)

Power Supply: 110 VAC 50/60 Hz standard
Optional: 220 VAC or 24VAC 50/60 Hz, or 24VDC

Power Consumption: 13.5 VA

Measuring Range: 0" to 4", to 0" to 118"

Operating Temperature For Rated Accuracy: 15°F to 105°F (-10°C to +40C)

Normal Working Temperature: 15°F to 125°F (-10°C to +50°C)

Storage Temperature: 15°F to 140°F (-10°C to +60°C)

Outputs (Standard):

Flow Rate: 0 to 10 VDC, min. impedance 1 K ohm and, switch select another output; either
0 to 20 mADC, max. loop impedance 600 ohms
or
4 to 20 mADC, max. loop impedance 600 ohms

(current isolation standard on NEMA 4 X package)

Fault Alarm: General alarm to indicate unit malfunction. SPDT relay, 4 amp, 250 VAC.

Totalizing Relay: SPST relay, 4 amp, 250VAC. Unit supplies voltage-free contact to output flow rate to external device. Count rate is set by the user-program to correspond to engineering units required by the customer.

Outputs (Optional):

Relay 1(OPT. A): Low Level or Low Flow Alarm, SPDT contacts rated at 4 amp, 250VAC.

Relay 2(OPT. A): High Flow Alarm, SPDT contacts rated at 4 amps, 250 VAC; or auxiliary scaled pulse (contact closure) proportional to flow, independently programmable for pulse-to-volume ratio.

Relay 3(OPT. A): High Level Alarm, SPDT contacts rated at 4 amps, 250 VAC; or auxiliary scaled pulse (contact closure) proportional to flow, independently programmable for pulse-to-volume ratio.

Count F1(OPT. B): Scaled pulse (contact closure), SPST, for partial flow totalization between selectable flow rates.

Count F0(OPT. B): Scaled pulse (contact closure), SPST, for partial flow totalization between selectable flow rates.

Readout:

* 6-Digit LED display 0.5" high to indicate flow, level, temperature or system programming.

* 2-Digit LED display 0.5" high to indicate display mode or program step.

* 6-Digit, non-resettable, electromechanical counter to indicate total flow. Programmable for units of volume.

* LED Indicator for Fault Alarm

Recommended Cable: Two-wire unshielded to the ultrasonic transducer. Maximum 1000 feet with #18 wire.

Flow Characteristics: Programmable to any primary flow element including open pipes.

Memory Storage Life: 5 years after power is removed from the unit.

SPECIFICATIONS: DU 213/Q: Ultrasonic Transducer

Beam Angle: 7 degrees included angle

Connection Cable: 2-conductor, unshielded wire, #18 wire for up to 1000 feet.

Data Transmission: Timed pulse technique.

Enclosure: NEMA 4

Minimum Blocking Distance: 18"

Mounting: 3-inch flange, or adapted to 2-inch horizontal pipe mounting.

Operating Frequency: 46.6 KHz at 5 impulses per second

Operating Temperature: -5°F to +140°F (-20°C to +60°C)

Temperature Compensation: Integral 100-ohm platinum RTD Compensator.

Note: All programming inputs are done in millimeters.