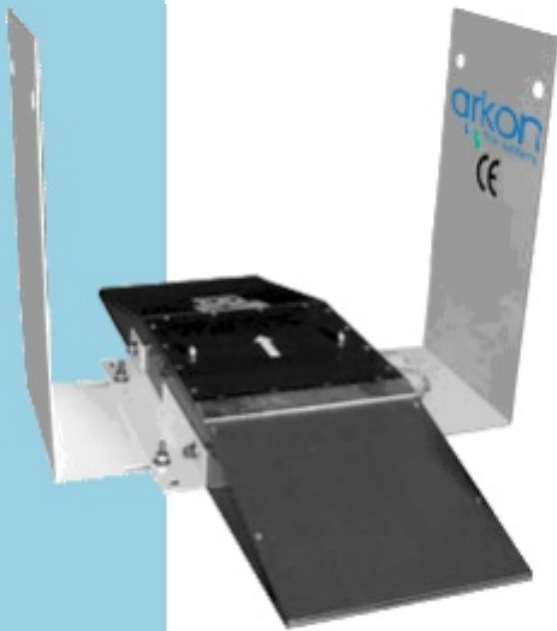


# Channel Mag CM2 - Magnetic Flowmeter For Open Channels



The ChannelMag is a bi-directional magnetic flowmeter system, suitable for use in existing channels of various shapes from widths or diameters 6" – 200 feet (150mm to 60m). It is suitable for raw sewage or storm water. The electrodes may be permanently coated with sewage grease, algae, and calcium carbonate or similar, without the need to clean.

ChannelMag sensors may be used singularly or in multiples, dependant on the width or diameter of the channel and the calibrated accuracy required.

A high-resolution ultrasonic transducer determines the level measurement, with compensation for change in air density. For media having frothy surfaces, or when the level sensor needs to be out of site, a hydrostatic level transducer is mounted integrally on the ChannelMag sensor. The hydrostatic level transducer is high resolution with compensation for barometric pressure.

A remote 4411e bi-directional transmitter calculates volumetric flow from the mean velocity and level sensor inputs. It displays rate and totals, and is programmable to show net forward totals from storm water back up. Transmission signals include two 4 – 20 mA outputs from separate terminals and a scaleable pulse frequency output, RS232 and RS484 and HART protocol communication as standard supply. See separate data sheets for 4411e and ChannelMags for rivers and non-full pipes from 20" (500mm) and larger.

CHANNELMAG FEATURE	BENEFIT
Patented Coil Excitation 1-5 A @ 40 Hz	Produces a high accuracy linear signal, unaffected by permanent coatings such as sewage grease, calcium carbonate, algae. No sensor cleaning necessary. High energy magnetic flux over virtually the complete cross section to generate a true weighted volumetric flow signal.
Suitable for existing channels up to 200 feet (60 m) wide	No restrictions, no gradients, no flumes, no expensive civil engineering involved.
Calibrated accuracy with NIST and international traceability	Suitable for custody transfer, with improved accuracy and rangeability over all other open channel techniques.
Solid state sensors, no moving parts	Virtually maintenance free.
Often installed under flow conditions	No bypass pumping necessary; huge cost savings.

## I. Channel-Mag — Method of Operation

The ChannelMag is suitable for open channels having diverse cross sectional shapes from 6" to 200 feet (150 mm to 60 m). They meet or exceed the requirements of ISO 9213 and are calibrated in a long open tank, believed to be the largest NIST traceable facility available. The ChannelMags are calibrated in accordance with ISO\* approved methods. Each ChannelMag system is normally supplied with a NIST traceable Calibration Certificate.

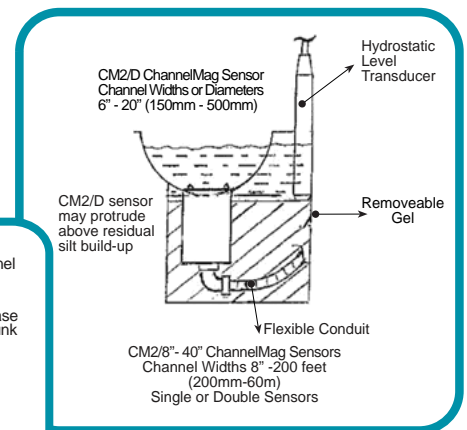
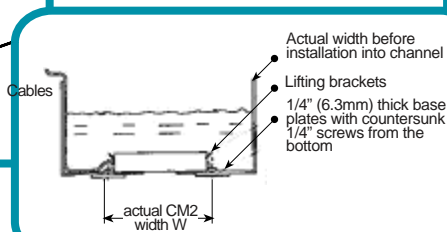
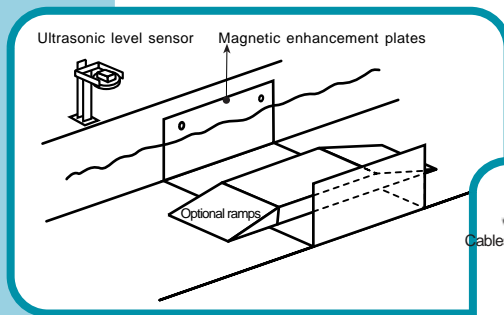
Magnetic enhancement plates are fixed to and calibrated with ChannelMag sensor types CM2/8" – 40". The enhancement plates are purposely made to the required shape of the channel, to widths or diameters from 10" to 15 feet (250 mm to 3 m). Their purpose is to determine the distribution pattern of magnetic flux on calibration in the test laboratory and to insure it is the same as the distribution on-site. In this way, the test calibration is the same as on-site. For channels less than 10" (250 mm) or wider than 15 feet (4500 mm), or when used with ChannelMag type CM2/D, the effectiveness of the enhancement plates is minimal, so they are not normally supplied.

ChannelMag CM2 sensors generate a powerful magnetic field over the whole or significant area of the channel. They operate using Faraday's Law, where a conductor moving in a magnetic field induces a voltage, the amplitude of which is proportional to the velocity of the conductor. The conductor is the media being measured. Large conical electrodes on the CM2 sensor measure the voltage signal, which is the mean velocity of the complete cross sectional flow and is unaffected by media viscosity or density.

Each ChannelMag CM2 sensor contains an exciter coil, powered by a remote 4411e transmitter. The 4411e is a microprocessor based patented Pulsed AC technology transmitter. The uniquely powerful and far-reaching magnetic field is created by energizing the coil with a magnetizing current up to 5 Amps at an exciter frequency of 40 Hz (for 60 Hz supply) or 33 Hz (for 50 Hz supply). This combination provides a signal to media noise ratio typically 50 times superior to traditional Pulsed DC technology. As such, the electrodes may be permanently coated with sewage grease, calcium carbonate and similar without loss of accuracy. Cleaning the ChannelMag is not necessary. The sensors may be installed such that the electrodes remain above non-moving silt deposits on the bed of the channel.

Volumetric flow is computed in the 4411e by multiplying level x mean velocity. The level signal from a diverse range of cross sectional shapes can be linearized in the 4411e. Level is measured normally by a high resolution ultrasonic level transducer. If the level sensor needs to be hidden from view, or if there is substantial froth on the media surface, then a high resolution pressure transducer is used under the ramps of the CM2 sensor.

\* Relevant ISO standards ISO 2537, ISO 3455 and ISO/TR 11974



## II. Channel-Mag — Equation

The basic equation performed by the 4411e transmitter is:

$$Q = KVH^n$$

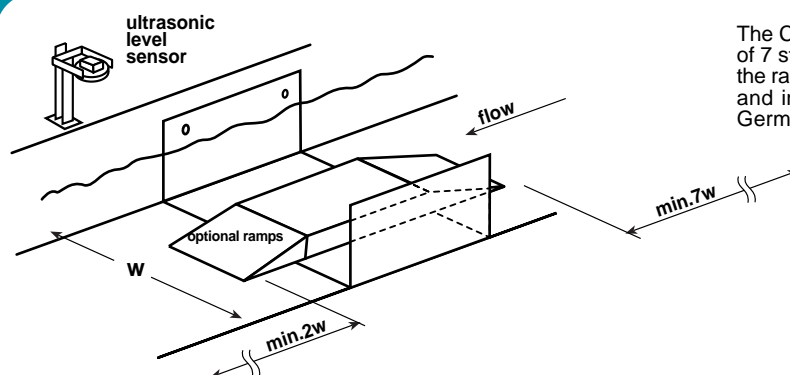
where

- Q = volumetric flow
- K = calibration constant
- V = mean velocity
- H = linearized level
- n = exponent depending on size and shape of channel

### III. Channel-Mag CM2 — Sensor Specification

High Calibrated Accuracy	± 2% of rate for mean velocities > 2 fps (0.6 m/s) ± 0.04 fps (0.012 m/s) for < 2 fps (0.6 m/s)
Relaxed Calibrated Accuracy	± 4% of rate for mean velocities > 2 fps (0.6 m/s) ± 0.08 fps (0.024 m/s) for < 2 fps (0.6 m/s)
<i>NOTE: ChannelMags are calibrated to meet or exceed the requirements of the UK Environmental Agency mCERTS, as well as ISO 2537, ISO 3455 and ISO/TR 11974.</i>	
Minimum Level	5.0" (125 mm) with ramps 2.0" (60 mm) without ramps
Adjustable Mean Velocity Range	0-2 fps (0-0.6 m/s) to 0-10 fps (0-3 m/s)
CM2 Body Material HDPE	with stainless steel fittings
Magnetic Enhancement Band Material	Ferritic steel with fusion bonded polyethylene protection
<i>NOTE: Not normally supplied for channels less than 8" (200mm) wide, nor when wider than 15 feet (4500mm).</i>	
Electrode Material	AISI 316 stainless steel (Hastelloy C optional)
Electrode Seals	Viton
CM2 Protection	Permanently submersible to NEMA 6 and IP 68 to 30 feet (10 m)
CM2 Junction Box	Supplied with all CM2 sensors
Cable Lengths From CM2 Junction Box	Standard 50 feet (15 m) from junction box, but without conduits. For distances > 100 feet (30 m) from junction box a pre-amp is installed in the junction box. Maximum distance 300 feet (100 m).
1 x CM2 Cables and Conduit Lengths to J-Box	From single CM2 sensor to junction box the following is supplied: CM2/D and 1 x CM2/8": 16 feet (5 m) with conduit to J-box CM2/24" and 40": 33 feet (10 m) with conduit to J-box
2 x CM2 Cables and Conduit Lengths to J-Box	Dual CM2 sensor cables and conduits have the same lengths, but are specified on ordering.
Cable Types For All CM2 Sensors	3 cables run from the CM2 sensors to the J-box. 1 for the electrodes, 1 for the reference coil(s) and 1 for the exciter coil(s). Each cable is 2 core, 18 SWG (0.75 mm <sup>2</sup> ) multi-strand shielded. UL listed to UL Standard 1424 and 13 and IEC approved.
<i>NOTE: The junction box is potted on site with re-enterable gel and is submersible to NEMA 6 and IP 68. It is made from fusion bonded polyethylene protected aluminum and is not intended for permanent submersion. The junction box is supplied with potting gel, ½" NPT conduit connectors and flexible plastic conduits. For ATEX Zone 2 explosive area or UL, CSA Ordinary Locations, approved cable connectors are supplied, but without conduits. ATEX requirements are that each connector is used for one cable only.</i>	
Maximum Media Temperature	140°F (60°C)
Maximum Level	33 feet (10 m)
CE Electromagnetic Compatibility	Interference emission and immunity to EN 61326

### IV. Straight Lengths of Channel



The ChannelMag CM2 accuracies are based on a minimum of 7 straight channel widths (7W) upstream (from the end of the ramps if supplied) and 2W downstream. The ChannelMag and installation conforms to the German DIN 19559 and German Waste Water Institute (ATV Arbeitsgruppe 1.2.5).

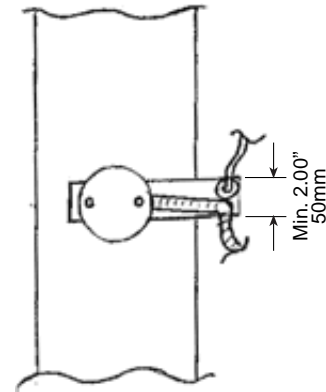
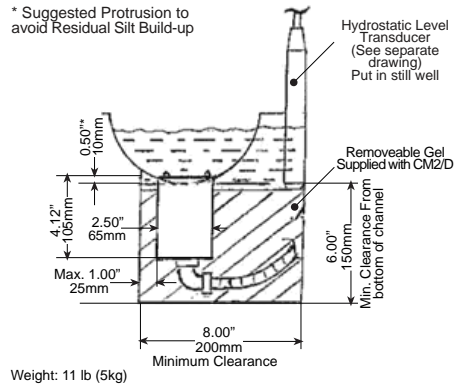
*NOTE: The level transducer must be installed at least 1 channel width before or after the ends of the ramps when the CM2 lies on the channel bed. This avoids level DROPS above the CM2 sensors caused by SUB-CRITICAL flows or level RISES caused by SUPER CRITICAL flows. These critical flows are circumvented if the CM2 sensor is let into a recess in the bed. As such, the upper surface of the CM2 may be up to 1" (25 mm) above the channel bed to avoid silt build-up. The level transducer may then be mounted directly above the CM2 sensor(s).*

## V.

### Channel Mag CM2/D 6"-20'

(Dimensions & Approximate weights)

Including junction box and standard length cables and conduit



## VI.

### Channel Mag CM2/8"- 40'

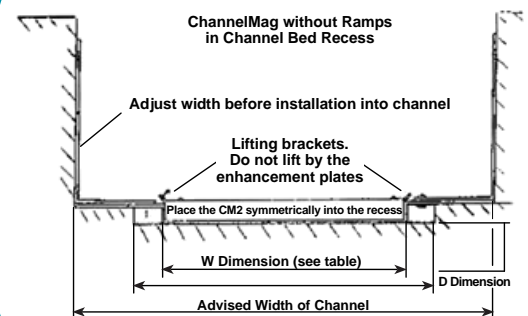
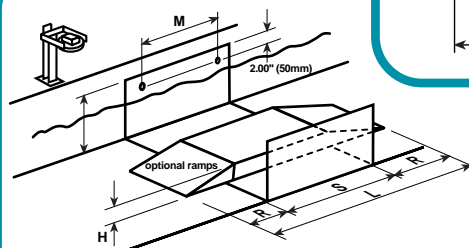
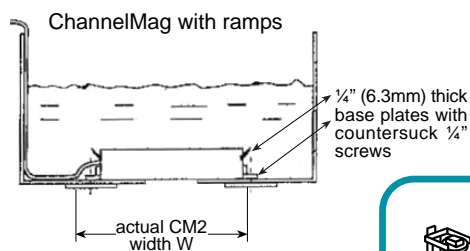
(Dimensions & Approximate weights)

Including junction box and standard length cables and conduit

nominal CM2 width		nominal CM2 width W		L		S		R		H		M		Weight each	
Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	lb	kg
8"	200	10.0"	254	40.0"	1016	8.0"	203	14.5"	370	2.5"	64	6.0"	152	55	25
24"	600	26.0"	660	60.0"	1520	24.0"	610	18.0"	460	3.12"	80	12.0"	305	186	85
40"	1000	42.0"	1065	80.0"	2030	40.0"	1020	20.0"	510	3.5"	89	24.0"	610	355	165

NOTE: The height "E" of the magnetic enhancement plates is custom made and normally extends 4" (100 mm) nominally above the maximum level. The width W is adjustable to fitt the channel width. M includes the mounting brackets.

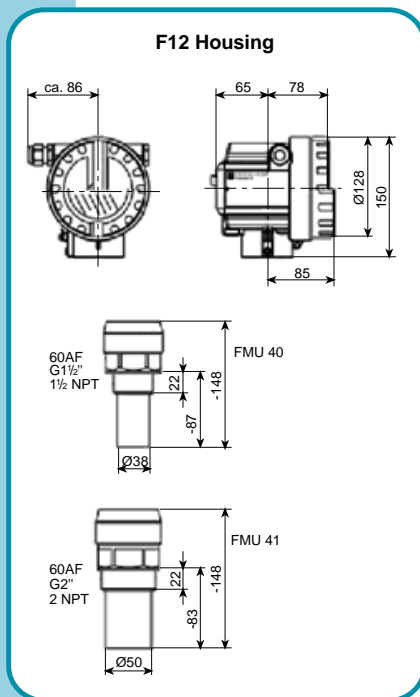
NOTE: A CM2/8" sensor is always supplied with ramps



## VII. Channel Mag types: (Channel widths, Diameters & Calibrated Accuracy)

Open Channel Width/Diameter		High Calibrated Accuracy CM2 Types Recommended	Relaxed Calibrated Accuracy CM2 Types Recommended
Inches	mm		
6" - 20"	150 - 500	Not Applicable	1 x CM2/D
10" - 30"	250 - 750	1 x CM2/8"	Not Applicable
31" - 50"	755 - 1250	2 x CM2/8"	1 x CM2/8"
51" - 70"	1255 - 1750	1 x CM2/24"	2 x CM2/8"
71" - 90"	1755 - 2250	1 x CM2/40"	2 x CM2/8"
91" - 120"	2255 - 3000	2 x CM2/24"	2 x CM2/8"
121" - 240"	3005 - 6000	2 x CM2/40"	2 x CM2/24"
River Flow *		Not Applicable	2 x CM2/8" Calibrated Point Velocity *

## VIII. FMU 40 & FMU 41 Ultrasonic Level Transducer Specification



As an alternative to the hydrostatic level transducer, an ultrasonic level transducer may be incorporated in a convenient man hole. This must be at least 1 diameter upstream or downstream of the end of the ramps of the CM2 ChannelMag sensor ramps. This avoids critical flow rise or fall errors.

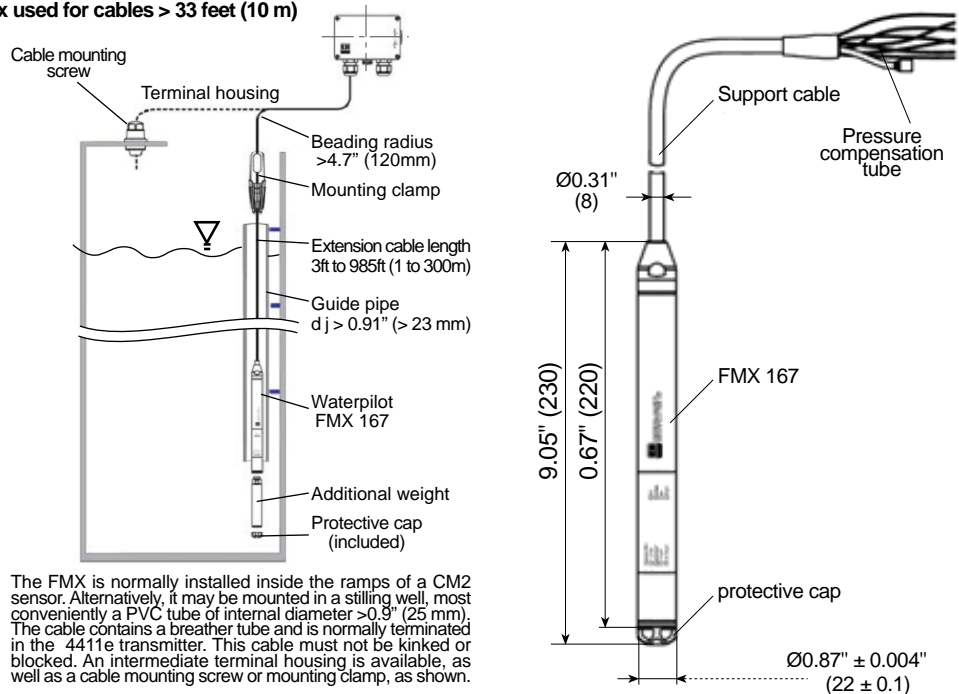
Basic Type	FMU 40
Range	0 - 200" (0 - 5000 mm)
Basic Type	FMU 41
Range	0 - 315" (0 - 8000 mm)
Accuracy	± 0.2% full scale
Minimum Dead Band	10" (250 mm)
Air Density Changes	Automatic temperature compensation
Connection	1½" NPT male for FMU 40 2" NPT male for FMU 41
2-Wire 4411e Signal	4 - 20mA, 2 wire system, 18VDC
HART Communication	Included
Protection	NEMA 6 and IP68 for 24 hours @ 6 feet w.c
Electromagnetic Compatibility	Interference emission to EN 61326
Indication	4 digit LCD
Ambient Temperature	-5 to +40 degrees F (-20 to +60 degrees C)
<i>Note: Outside these temperatures the LCD function is restricted. A protective cover is recommended if operating in strong sunlight.</i>	
Cable Entry	½" NPT
Materials of Construction	PVDF sensor with EPDM seal Aluminum enclosure, chromed and powder coated, sea water resistant.
Housing	F12 housing is standard
Explosive Atmospheres	FM and CSA Class 1 Div. 1 or 2 optional
Weight	FMU 40 approx. 5.5 lb (2.5 kg) FMU 41 approx. 6 lb (2.6 kg)

## IX. FMX 167 Hydrostatic Level Transducer Specification

A hydrostatic pressure transducer is standard supply for measuring level in partially filled pipes. It is also normally used when the level sensor needs to be hidden from view, or if there is substantial froth on the surface of the media. The hydrostatic level transducer is normally an integral part of the ChannelMag velocity sensor type CM2.

Basic Type	FMX167
Range	0 - 20" (0 - 500 mm) to 0 - 600 feet (0 - 180 m)
Accuracy	± 0.2% full scale or 0.072" (0.13 mm) eg. accuracy at 10" level = $0.072/20 \times 100 = 0.36\%$ accuracy at 36" level = $0.072/36 \times 100 = 0.2\%$
Barometric Pressure Change	Cable contains "breather" tube for compensation Mounted integrally on PM2 ChannelMag sensors Mounted at side of channel for widths < 8" (200 mm)
Cable Length	See ordering code. Normally same length as PM2 cables. Max. length 1000 feet (300 m)
2-wire 4411e Signal	4 - 20mA, 2 wire system, 18 VDC.
Electromagnetic Compatibility Protection	Interference emission to EN 61326 for CE requirements NEMA 6 and IP68 indefinitely to 700 feet (200 m) w.c
Ambient Temperature	Porous Gore-Tex Teflon filter protects internals 14 to 158 degrees F (-10 to 70 degrees C)
Materials of Construction Transducer housing:	316L stainless steel. Sensor diaphragm: aluminum trioxide ceramic Internal seal: standard Viton, optional EPDM Protective cap: high density polyethelene Cable: polyethelene with Gore-Tex Teflon filter
Explosive Atmospheres	See ordering code
Weight	Probe: 0.63 lb (0.3 kg) Cable: Add 0.13 lb/foot (0.05 kg/m)

### Junction Box used for cables > 33 feet (10 m)



## X. Channel Mag – System Connection Diagram

The diagram shows how a typical ChannelMag system is connected. The supply of a system is limited to items specifically quoted.

