

FH8400 User's Manual



FAURE HERMAN
Mastering the Flow

IDEX
LIQUID CONTROLS GROUP

Faure Herman

Route de Bonnétable
BP 20154
72406 La Ferté Bernard Cedex
FRANCE

Tél : +33 (0)2 43 60 28 60

Fax : +33 (0)2 43 60 28 70

E-mail : fhprojects@idexcorp.com

Faure Herman Meter

Houston TX. 77086 (U.S.A.)

Phone : + 1 713 623 0808

Fax : + 1 713 623 2332

E-mail : FHH-Sales@idexcorp.com

Attention!

This manual contains important instructions and important warnings. It is essential to read and apply it before commencing installation, connection, and commissioning work.

Failure to observe these instructions and warnings may damage the flowmeter and endanger persons.

Qualification and training of the personnel

The flowmeter must be installed and maintained by personnel trained and qualified for this work.

Hazards arising from failure to observe the instructions and warnings

Failure to observe these instructions and warnings may:

- Endanger personnel as a result of mechanical, electrical, or chemical problems,
- Damage the flowmeter,
- Pollute the environment by releasing hazardous substances.

Safety at work

The safety instructions appearing in this manual must be observed, as must all accident prevention and occupational safety regulations in force in the country of installation.

Safety instructions

Disconnect the power supply and depressurize the flowmeter before servicing (prevention of electrical hazards and hazards created by pressurized equipment).

Conditions of operation

The reliability of the flowmeter is guaranteed only if it is installed and used as described in this manual. The extreme conditions of use indicated on the data plate must not be exceeded.

Reconditioning, repair, modifications

Reconditioning, repair, or modification are allowed only after Faure Herman has been consulted. The use of parts and accessories approved by Faure Herman avoids compromising safety. If any other parts are used, Faure Herman cannot be held liable for the consequences.

Transport, handling, and storage

The flowmeter must be handled with care so as to avoid damage.

Transport and handling must be performed using resources appropriate to the weight and bulk of the flowmeter.

When the flowmeter has lifting rings, they must be used. The flowmeter must in no case be handled or secured by the electrical boxes.

The use of end caps serves to protect the flanges during transport and handling.

Unpacking

The flowmeter must be checked and inspected in order to make sure that it has not been damaged and that nothing is missing. Protections and devices (such as screws) placed to immobilize moving parts must be withdrawn before installation.

Storage

If the flowmeter is not installed as soon as it is received, it must be suitably stored in a dry place, protected from the elements and from large temperature swings. For prolonged storage, arrangements to protect from damp may be necessary.

Return

Before any return, contact Faure Herman. If the flowmeter has been used with hazardous, corrosive, or toxic substances, the operator must make sure that it has been correctly rinsed, cleaned, and decontaminated before being returned to Faure Herman.



FAURE HERMAN

Mastering the Flow

www.faureherman.com

General contents

Note: The detailed contents are inserted on the end of manual

General contents	5
ATEX recommendations	7
Chapter 1: General overview	15
Chapter 2: Commissioning procedure	25
Chapter 3: Using the FH8400 remote control device	37
Chapter 4: Spare parts and Maintenance	49
Chapter 5 : Modbus transmission tables	63
Appendix I	89
Appendix II	91
Appendix III	93
Appendix IV	97



Detailed contents

103

Personal notes

109

ATEX recommendations

FR

Recommandations ATEX

Cet équipement est certifié ATEX et conforme aux exigences essentielles en ce qui concerne la sécurité et la santé pour la conception et la construction d'appareils destinés à être utilisés en atmosphères explosibles (Directive 94/9/CE).

Pour une utilisation en toute sécurité, assurez-vous que l'équipement est utilisé conformément aux indications définies dans le certificat ATEX et la plaque d'identification, et respectez les manuels d'utilisation, d'installation et de maintenance de l'équipement et des sous ensembles qui le composent.

L'installation, l'utilisation et la maintenance doivent être réalisées par un personnel formé et spécialisé comprenant l'une des langues du manuel.

S'il vous manque un manuel ou pour toute information, contactez le service Après-vente de FAURE HERMAN :

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

EN

ATEX recommendations

This equipment is ATEX certified and complies with the essential Health and Safety requirements relating to the design and construction of equipment intended for use in potentially explosive atmospheres (94/9/EC Directive).

On safety grounds, please ensure that this equipment is used in total compliance with the instructions given on the ATEX certificate and nameplate. Please consult the user manuals, equipment installation and maintenance manuals and the various parts used in this device.

This item of equipment must be installed and serviced by trained, specialist staff who understand one of the languages used in the manual.

If you require a manual or any additional information, please contact the FAURE HERMAN After Sales team:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

ES

Recomendaciones ATEX

Este equipo certificado ATEX cumple con los requisitos esenciales relativos a la seguridad y la salud en el diseño y la construcción del material utilizable en atmósferas potencialmente explosivas (Directiva 94/9/CE).

Para un uso seguro, compruebe que el equipo se utiliza según las indicaciones descritas en el certificado ATEX y la placa de identificación, y respete los manuales de utilización, de instalación y de mantenimiento del equipo y de los elementos que lo componen.

La instalación, utilización y el mantenimiento deben efectuarse por un personal cualificado que entienda por lo menos uno de los idiomas del manual.

Si le falta un manual o para cualquier información, contacte con el servicio de postventa de FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

IT

Raccomandazioni ATEX

La presente apparecchiatura è certificata ATEX e conforme alle esigenze essenziali nell'ambito della sicurezza e la salute per la concezione e la costruzione d'apparecchi destinati a essere utilizzati in atmosfere potenzialmente esplosive (Direttiva 94/9/CE).

Per un utilizzo altamente sicuro, accertatevi che l'apparecchiatura sia usata conformemente alle indicazioni fornite nel certificato ATEX e nella piastra d'identificazione; rispettate i manuali d'utilizzo, installazione e manutenzione dell'apparecchiatura e dei sottoinsiemi che la compongono.

L'installazione, l'utilizzo e la manutenzione vanno effettuati da un personale formato e specializzato, edotto di una delle lingue del manuale.

Se vi manca un manuale o per qualsiasi informazione, contattate il Servizio Clientela di FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

DA

ATEX anbefalinger

Dette udstyr er ATEX-certificeret og overholder de væsentlige sundheds- og sikkerhedsmæssige krav til design og konstruktion af apparater, der er beregnet til anvendelse i eksplosive atmosfærer (Direktiv 94/9/EF).

For en sikker anvendelse bør De sørge for, at udstyret anvendes i henhold til de forskrifter, der er defineret i ATEX-certifikatet og på identifikationsskiltet, og at bruger-, installations- og vedligeholdelsesvejledningerne for udstyret og de underenheder, det er sammensat af, overholdes.

Installationen, anvendelsen og vedligeholdelsen skal foretages af specialuddannet personale, som forstår et af de sprog, manualerne er udfærdiget på.

Hvis De mangler en manual eller for enhver anden information, kontakt venligst FAURE HERMAN's Serviceafdeling:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

SV

ATEX rekommationer

Denna utrustning är certifierad enligt ATEX och uppfyller de väsentliga kraven i fråga om säkerhet och hälsa vid utformning och tillverkning av apparater som är avsedda för användning i explosionsfarliga omgivningar (Direktiv 94/9/EG).

För en fullt säker användning, se till att utrustningen används i överensstämmelse med de anvisningar som figurerar i ATEX-certifikatet samt på identifikationsskylten, och följ instruktionsböckerna för användning, installation och underhåll av utrustningen och dess ingående underenheter.

Installationen, användningen och underhållet skall utföras av personal som är utbildad, specialiserad och som förstår något av instruktionsbokens språk.

Om du saknar någon av instruktionsböckerna eller för all annan information, kontakta FAURE HERMANs kundservice:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com



NO

ATEX anbefalinger

Dette utstyret er ATEX-sertifisert og oppfyller hovedkravene når det gjelder hensyn til sikkerhet og helse ved utforming og konstruksjon av utstyr til bruk i eksplosjonsfarlige omgivelser (Europaparlaments- og Rådsdirektiv 94/9/EF).

For full sikkerhet må det kontrolleres at utstyret benyttes i samsvar med anvisningene i ATEX-sertifikatet og på merkeplaten. Instruksjonene i brukerhåndbøker samt installasjons- og vedlikeholdsanvisninger for utstyret og delene det består av, må følges omhyggelig.

Installasjon, bruk og vedlikehold må utføres av spesialisert, faglært personell som forstår et av språkene i håndbøkene.

Hvis det mangler en håndbok eller hvis du trenger ytterligere opplysninger, vennligst ta kontakt med serviceavdelingen i FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

PL

Zalecenia ATEX

Niniejsze wyposażenie posiada certyfikat ATEX i jest zgodne z podstawowymi wymaganiami dotyczącymi bezpieczeństwa i higieny odnoszącymi się do projektu i budowy urządzeń przeznaczonych do użytkowania w przestrzeniach zagrożonych wybuchem (Dyrektywa 94/9/WE).

W celu zapewnienia bezpiecznego użytkowania, należy upewnić się, że wyposażenie jest używane zgodnie z zaleceniami podanymi w certyfikacie ATEX i na tabliczce znamionowej oraz należy przestrzegać zaleceń instrukcji obsługi, instalacji i konserwacji wyposażenia i jego podzespołów.

Instalacja, użytkowanie i konserwacja muszą być realizowane przez przeszkolony i wyspecjalizowany personel korzystający z dokumentacji przygotowanej w języku, jakim się posługuje.

W przypadku braku dostępu do danego podręcznika lub informacji, prosimy o skontaktowanie się z działem obsługi po sprzedaży FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

PT

Recomendações ATEX

Este equipamento é certificado ATEX e está conforme às exigências essenciais no que concerne a segurança e a saúde para a concepção e a construção de aparelhos destinados a serem utilizados em atmosferas potencialmente explosivas. (Directiva 94/9/CE).

Para uma utilização com total segurança, assegure-se de que o equipamento é utilizado de acordo com as indicações definidas no certificado ATEX e na placa de identificação, e respeite os manuais de utilização, de instalação e de manutenção do equipamento e dos subconjuntos que o compõem.

A instalação, a utilização e a manutenção devem ser realizadas por um pessoal formado e especializado que compreenda uma das línguas do manual.

Se faltar-lhe um manual ou para quaisquer informações, entre em contacto com o Serviço Após-Venda da FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

NL

ATEX richtlijnen

Deze apparatuur heeft de ATEX certificering en beantwoordt aan de essentiële eisen inzake veiligheid en gezondheid voor het ontwerp en de bouw van apparaten bedoeld voor gebruik op plaatsen waar ontploffingsgevaar kan heersen (Richtlijn 94/9/EG).

Voor een veilig gebruik dient u te controleren of de apparatuur gebruikt wordt volgens de in het ATEX certificaat vermelde aanwijzingen en op het kenplaatje en de gebruiks-, installatie- en onderhoudshandleidingen van de apparatuur en de samenstellende onderdelen in acht te nemen.

De apparatuur moet geïnstalleerd, gebruikt en onderhouden worden door speciaal hiervoor opgeleid personeel dat minstens één van de talen van de handleiding begrijpt.

Indien een handleiding ontbreekt of u aanvullende informatie nodig heeft, neem dan contact op met de servicedienst van FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

DE

ATEX Empfehlungen

Dieses Gerät ist ATEX-zertifiziert und entspricht den grundlegenden Sicherheits- und Gesundheitsanforderungen an Konstruktion und Bau für Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen (Richtlinie 94/9/EG).

Für eine sichere Anwendung muss das Gerät gemäß den Angaben im ATEX-Zertifikat und dem Typenschild verwendet werden. Berücksichtigen Sie die Gebrauchs-, Installations- und Wartungshandbücher des Geräts und dessen Komponenten.

Installation, Gebrauch und Wartung müssen von spezialisiertem Fachpersonal durchgeführt werden, die eine der Handbuchsprachen verstehen.

Wenn Sie ein Handbuch oder weitere Informationen benötigen, wenden Sie sich bitte an den FAURE HERMAN-Kundendienst

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

FI

ATEX-Suosituksset

Tämä laite on ATEX-varmennettu ja vastaa turvallisutta ja terveyttä koskevia oleellisia vaatimuksia koskien räjähdysvaarallissa tiloissa käytettäviksi tarkoitettujen laitteiden suunnittelua ja valmistusta (Direktiivi 94/9/EY).

Turvallisuussyistä teidän tulee varmistaa, että laitetta käytetään ATEX-sertifikaatissa ja tunnistuslaatussa määriteltyjen ohjeiden mukaisesti ja teidän tulee noudattaa laitteen käyttö-, asentamis- ja huolto-ohjeita sekä laitteen että sen muodostamien osien ollessa kyseessä.

Asentamisen, käytön ja huollon saa toteuttaa ainoastaan koulutettu ja erikoistunut henkilökunta, joka ymmärtää jotain käyttöohjeissa käytettyä kieltä.

Jos teillä ei ole käyttöohjeita tai haluatte lisätietoja, ottakaa yhteyttä myynninjälkeishuoltoon FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

ATEX recommendations

EL

Συστάσεις περί ATEX

Ο παρών εξοπλισμός έχει πιστοποιηθεί ως ATEX και συμμορφώνεται με τις βασικές απαιτήσεις για την ασφάλεια και την υγεία σχετικά με το σχεδιασμό και την κατασκευή συσκευών που προορίζονται για χρήση σε εκρηξιμείς ατμόσφαιρες (Οδηγία 94/9/EK).

Για λόγους ασφαλείας, βεβαιωθείτε ότι ο εξοπλισμός χρησιμοποιείται σύμφωνα με τις οδηγίες που δίνονται στο πιστοποιητικό ATEX και την πλακέτα αναγνώρισης και τηρήστε τις οδηγίες των εγχειριδίων χρήσης, εγκατάστασης και συντήρησης του εξοπλισμού και των υποσυνόλων που αποτελούν τον εξοπλισμό αυτό.

Η εγκατάσταση, η χρήση και η συντήρηση πρέπει να πραγματοποιούνται από καταρτισμένο και ειδικευμένο προσωπικό που κατανόει μία από τις γλώσσες του εγχειριδίου.

Εάν χρειάζεστε κάποιο εγχειρίδιο ή για οποιαδήποτε άλλη πληροφορία, επικοινωνήστε με το Τμήμα Εξυπηρέτησης μετά την Πώληση της εταιρείας

FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com



ATEX recommendations for FH8400 transducer



This equipment is ATEX certified and complies with the essential health and safety requirements relating to the design and construction of equipment intended for use in potentially explosive atmospheres (94/9/CE directive).

For a safety utilisation, be sure that you use this equipment in totally compliance with its ATEX certificate and nameplate indications, and respect the equipment user's manual and recommendations below.

Equipment nameplate

Refer to the equipment nameplate for operating field specifications.

ATEX nameplate on each equipment includes this kind of indications (example):

Company name:	FAURE HERMAN
Company address:	Route de Bonnetable 72400 La Ferté Bernard – France
Model:	FHP100
Serial number	S/N...
Manufacturing year:	Year 2007
CE Logo:	CE
Notified organism number:	0081
ATEX marking:	
Equipment category:	II 2 G
Protection type:	Ex d
Gas classification:	IIB
Temperature classification:	T6 to T3
ATEX agreement number:	LCIE 04 ATEX 6047 X
Do not open while energized	

The equipment can also carry the usual marking required by the manufacturing standards applying to such equipments.

ATEX recommendations

Installation

WARNING: This equipment is suitable in hazardous area complying with the indications specified on its nameplate (Hazardous location information, operating conditions and restrictions, specific installation ...).

CAUTION: Handle the equipment with care and Select a mounting location so that the equipment will not be subjected to impact by heavy objects. Impacts can damage the equipment.

WARNING: Electrical power must be "OFF" before and during installation.

WARNING: The equipment shall be installed by means of the suitable tools. Never use a hammer or impact wrench.

WARNING: If this equipment is supposed to be connected to other devices, verify that the protection systems are compatible.

Maintenance

WARNING: Electrical power must be "OFF" before and during Maintenance.

WARNING: Always disconnect primary power source before opening equipment for inspection or service.

WARNING: Maintenance operation shall be done by means of the suitable tools. Never use a hammer or impact wrench.

- Frequent inspection should be made. A schedule for maintenance checks should be determined by the environment and frequency of use.
- Perform visual, electrical and mechanical checks on all components on a regular basis.
- Visually check for undue heating evidenced by discoloration of wires or other components, damaged or worn parts or leakage evidenced by water or corrosion in the interior.
- Electrically check to make sure that all connections are clean and that the device is operating properly.

For specifically installation and maintenance advices, contact FAURE HERMAN After Sales Department:

FAURE HERMAN
Route de Bonnétâble – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

Don't forget to give us your equipment serial number.

ATEX recommendations for FH8400 electronic enclosure



This equipment is ATEX certified and complies with the essential health and safety requirements relating to the design and construction of equipment intended for use in potentially explosive atmospheres (94/9/CE directive).

For a safety utilisation, be sure that you use this equipment in totally compliance with its ATEX certificate and nameplate indications, and respect the equipment user's manual and recommendations below.

Equipment nameplate

Refer to the equipment nameplate for operating field specifications.

ATEX nameplate on each equipment includes this kind of indications (example):

Company name:	FAURE HERMAN
Company address:	Route de Bonnetable 72400 La Ferté Bernard – France
Model:	FHB100
Serial number	S/N...
Manufacturing year:	Year 2007
CE Logo:	CE
Notified organism number:	0081
ATEX marking:	
Equipment category:	II 2 G
Protection type:	Ex d
Gas classification:	IIB
Temperature classification:	T6
ATEX agreement number:	LCIE 04 ATEX 6071 X
Do not open while energized	
Wait 10 minutes before opening	

The equipment can also carry the usual marking required by the manufacturing standards applying to such equipments.

ATEX recommendations

Installation

WARNING: This equipment is suitable in hazardous area complying with the indications specified on its nameplate (Hazardous location information, operating conditions and restrictions, specific installation ...).

CAUTION: Handle the equipment with care and Select a mounting location so that the equipment will not be subjected to impact by heavy objects. Impacts can damage the equipment.

WARNING: Electrical power must be "OFF" before and during installation.

WARNING: The equipment shall be installed by means of the suitable tools. Never use a hammer or impact wrench.

WARNING: If this equipment is supposed to be connected to other devices, verify that the protection systems are compatible.

Maintenance

WARNING: Electrical power must be "OFF" before and during Maintenance.

WARNING: Always disconnect primary power source before opening equipment for inspection or service.

WARNING: Maintenance operation shall be done by means of the suitable tools. Never use a hammer or impact wrench.

- Frequent inspection should be made. A schedule for maintenance checks should be determined by the environment and frequency of use.
- Perform visual, electrical and mechanical checks on all components on a regular basis.
- Visually check for undue heating evidenced by discoloration of wires or other components, damaged or worn parts or leakage evidenced by water or corrosion in the interior.
- Electrically check to make sure that all connections are clean and that the device is operating properly.

For specifically installation and maintenance advices, contact FAURE HERMAN After Sales Department:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 📠 +33 (0)2 43 60 28 89
✉ fhservices@idexcorp.com

Don't forget to give us your equipment serial number.



FAURE HERMAN
Mastering the Flow
www.faureherman.com

Chapter 1: General overview

The FH8400 ultrasonic flowmeter has been developed to meet oil and petrochemical markets needs and requirements. The FH8400 ultrasonic flowmeters are suitable for use in hazardous area thanks to explosion proof certification in accordance with the European Directive ATEX II 2 G (compatible with installation in zone 1, division 1, groups C & D).

By using the most innovative ultrasonic technology the FH8400 product line successfully covers a wide range of applications and flow conditions including laminar, turbulent, asymmetric flow velocity profiles and swirls.

The FH8400 ultrasonic flowmeters are designed for process applications of all liquids, crude or refined hydrocarbons, whose viscosity is lower than 180 cSt, including LPG.

The integration of all components into a single compact and integrated metering solution allows for a especially comfortable installation and commissioning.

The FH8400 does not generate any pressure drop. Its integrity is preserved even after being disturbed by gas pockets, solid bodies, spheres or scrapers.

Calibrated individually in our facilities, the FH8400 generates accurate measurements. FH8400 installation and commissioning does not require specialist's intervention.

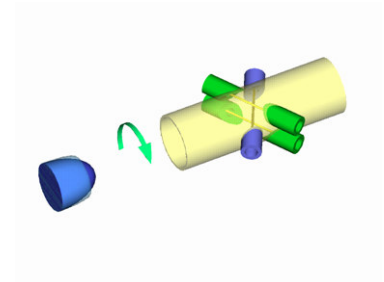
Remark : The FH8400 is delivered with an individual calibration certificate.



Measuring principle

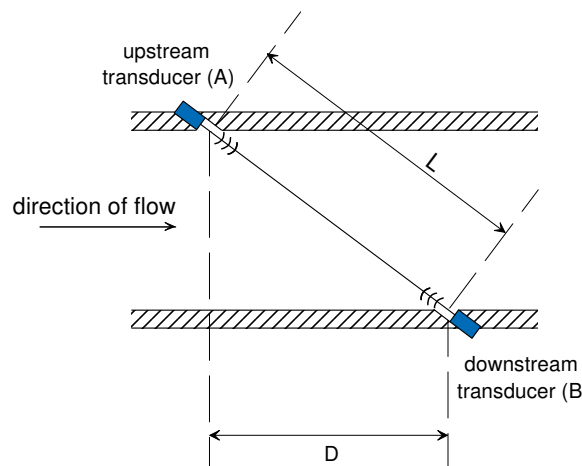
FH8400

- 3 beams
- ± 0.15 % accuracy
- DN 100 to DN 600 (4" to 24")
- Anti-swirl effect
- Flow profile compensation
(Multi product)



Chapter 1: General overview

The velocity of flow along the path between two paired transducers is determined by the method called "Transit Time Difference Method" based on the expression below:



$$V = \frac{L}{2 \cdot \cos \theta} \cdot \frac{\Delta T}{T_{BA} \cdot T_{AB}} \quad \text{where } \Delta T = T_{BA} - T_{AB}$$

(T_{AB} : transit time of the ultrasonic wave from the upstream transducer to the downstream; T_{BA} : transit time of the ultrasonic wave from the downstream transducer to the upstream).

Remark: The expression above is independent of the velocity of sound inside the product flowing in the pipe.

This velocity can be computed by the meter by using the following expression:

$$C = \frac{L}{2} \left(\frac{1}{T_{AB}} + \frac{1}{T_{BA}} \right)$$



Sizes and Flowrates

Faure Herman offers 10 standard flowmeter sizes, from 4" (DN100) to 24" (DN600), except 22".

Other sizes can be studied upon request.

See in Appendix I the dimensions and weight of each of these counters.

As a standard, the FH8400 body is made of either carbon steel or stainless steel. Other material can be provided as an option. The FH8400 bodies cover the following sizes and pressure ratings:

Diameters: DN100 to DN600 (4" to 24") (others upon request)

Flanges: ANSI #150, 300, 600 or 900

Chapter 1: General overview

Standard K-factors

The factory set K-factors are, depending on the size:

FH 8400 diameter	Pulses/ m3	Pulses/baril
4" (DN100)	32 000	5 000
6" (DN150)	16 000	2 500
8" (DN200)	8 000	1 300
10" (DN250)	6 000	1 000
12" (DN300)	4 000	650
14" (DN350)	3 000	480
16" (DN400)	2 200	350
18" (DN450)	1 600	250
20" (DN500)	1 400	220
24" (DN600)	1 000	160

Remark : For a given size, the recommended K-factor has been adjusted to provide the best measurement precision.

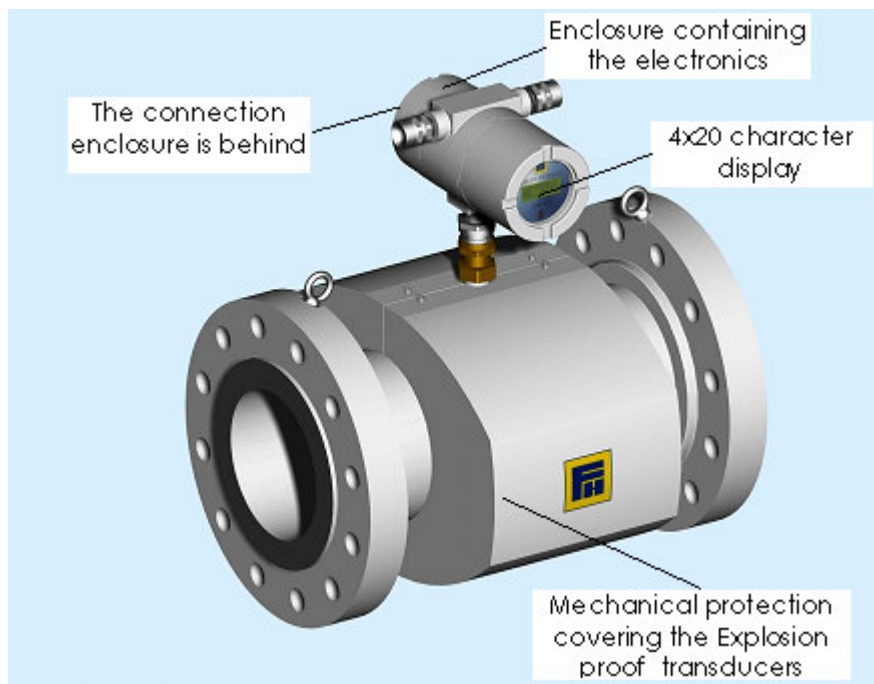
Constitutive parts of the FH8400

The FH8400 ultrasonic flowmeters provide a compact and integrated metering solution, consisting of:

- A flanged body in either carbon steel, stainless steel, or other optional materials,
- 6 ultrasonic transducers interchangeable under service conditions,
- An explosion proof flow converter.

In standard, the FH8400 is delivered with:

- Individual calibration certificate.
- ATEX certificates and its elements.
- User's manual.



Chapter 1: General overview

FH8400 inputs-outputs

As an option, 2x4-20mA analogue inputs are available for pressure and temperature display.

1 or 2 selectable 4-20mA analogue outputs are available for either flowrate, VOS, VOF or volume reading.

Data logger and Event logger

The FH8400 includes two loggers: Data and Event logger.

The Data logger records values in a non-volatile memory (756 available records), with a storage period which can be chosen from 1 s to 24 h, such as the counting mode, the flow-rate value, and the flow velocity (see the complete list of stored data).

Remark : The total recording duration depends on the selected period. The table below gives the recording duration for several period values.

Recording period	Total available recording duration
1 s	≈ 12 mn
10 s	≈ 2 h 06 mn
1 mn	≈ 12 h
10 mn	≈ 5 days and 6 h
1 h	≈ 31 days and 12 h
24 h	≈ 2 years and 36 days

The event logger records in a non volatile memory (756 available records) some events such as the FH8400 power on or off, the change of state of the alarms, the changeover from a counting mode to another (see page 88 for the complete list of recorded events).

Both Data and Event loggers can be read by means of either FHview software or any DCS (Distributed Control System) linked to the FH8400.

The reset of both loggers can be individually exercised by means of the remote control device, the FHview software or DSC.

Remark: Both loggers operate according to the cyclic memory principle: when all the available records are used, the most recent records erase the oldest ones.

Maximum line pressure

The FH8400 is designed for a line pressure of 150 bar max (1,450 psi).

Pressure drop

The FH8400 is a full bore flowmeter which does not generate pressure drop.

Power supply

The FH8400 can be powered by a 18 V to 36 Vdc power supply 300mA min.

Consumption: 8 W

On request, the FH8400 can be provided with a 110-220V power supply instead.

Protection for hazardous area

The FH8400 counter can be used in hazardous areas:

- Protection of the enclosure containing the electronic boards: connectors Ex d IIB T6 (flameproof enclosure, surface temperature which cannot exceed 85 °C)
- Protection of the ultrasonic probes: Ex d II T6 to T3
- Protection of the remote control: Ex ia IIC T4 (intrinsic safety, 2 possible faults, surface temperature which cannot exceed 135 °C)
- Protection of the power supply and the instrumentation cables (customers' scope): the protection must be made

Chapter 1: General overview

according to the local standards and rules. In particular, the cables must correspond to one of the following standards: IEC 60092-300 series / NEK600, BS 6883 / 7197, NF M 87-202.

Remark: The FH8400 is delivered with ATEX certificates and corresponding elements.

Other characteristics

- Approval: NMI approved, compliant with directive 2004/22/EC on Measuring Instrument (MID) and OIML Recommendation R117-1 (edition 2007)
- Repeatability: according to OIML R117-1 or customer specifications
- Ambient temperature: from -40 to +60 °C (-40 to +140 °F)
- Fluid temperature: from -40 to +120 °C (-40 to +248 °F)
- Fluid kinematic viscosity: from 0.2 to 10 cSt (greater on demand)
- Fluid density: from 400 to 1 500 kg/m³
- Ingress Protection : IP66 / NEMA 4X
- Available flanges: #150 (ISO PN 20), #300 (ISO PN 50), #600 (ISO PN 100), #900 (ISO PN 150)
- EMC according to EN 50081 and EN 50082-2 standards
- Back-up battery allowing data and parameter storage during at least 10 years
- Material used for the meter body: stainless steel or carbon steel (Other materials may be available upon request)
- Material used for both electronic enclosures: Copper-free Cast aluminium



FAURE HERMAN
Mastering the Flow
www.faureherman.com

Chapter 2:

Commissioning procedure

FH8400 handling

Like any measurement device, the FH8400 must be handled with the greatest care.

The handling must be done as follows:

- With lifting rings fitted on the FH8400, for equipments with a weight > 35 kilos
- Or with straps on both sides of the flowmeter body when there are no lifting rings

Reception and storage

- ❑ Check the general appearance of the packing and FH8400 in order to identify possible damages inflicted during transportation.
- ❑ Before installing the equipment, it is recommended to keep it in its initial packing.
- ❑ The flanges of the FH8400 equipped with protection covers which must be removed only during its installation on the pipe.
- ❑ Store the FH8400 in a dry and clean place. The storage temperature should be between -40 and +60 °C (-40 and +140 °F)
- ❑ In case of extended storage (typically more than one year), we recommend to re-calibrate the meter.

Choice of the FH8400 location on the pipe

Faure Herman recommends an upstream straight length of 10 to 30 times the pipe diameter as function of flow conditions. A flow straightener may be used upstream, depending on flow conditions. The downstream recommended straight length is equal to 3D min.

Please, contact Faure Herman so as to determine the most suitable flow straightener with regard to your application.

Installing the FH8400

- ❑ Check that the meter and the pipe are correctly aligned.
- ❑ Before installing the meter on the pipe, carefully check the cleanliness of flanges in order to obtain an absolute tightness between meter and pipe.
- ❑ Check that the meter positioning does not cause any traction effort on cables.

In case of remote electronics option

- ❑ View of the junction box at the reception of the material



Chapter 2: Commissioning procedure

- ❑ Pass the cables through the cable gland and screw the cable gland.



- ❑ Place the heat-shrink sleeve on the cable and connect the SMC connectors: the one labelled 1 with the number 1 and the number 2 with the 2 and so forth



- Slide the heat-shrink sleeve and warm it up to reduce it. Insure good electrical isolation.



Chapter 2: Commissioning procedure

Cabling the FH8400

FH 8400 USER TERMINALS

(Optional)

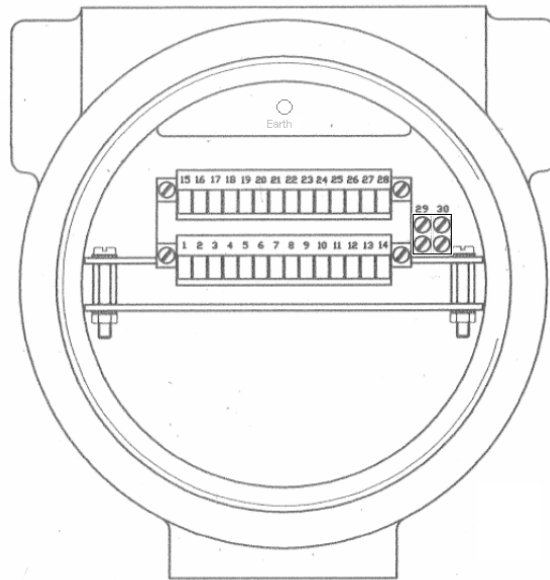
29	30
Neutral	Phase
110-220 VAC power	

TOP LINE

15	16	17	18	19	20	21	22	23	24	25	26	27	28
T+	T-	P+	P-	earth	TOR in	TOR in	earth	Out1	Out1	Out2	Out2	earth	NC
4/20 mA inputs				logic input			4/20 mA outputs						

BOTTOM LINE

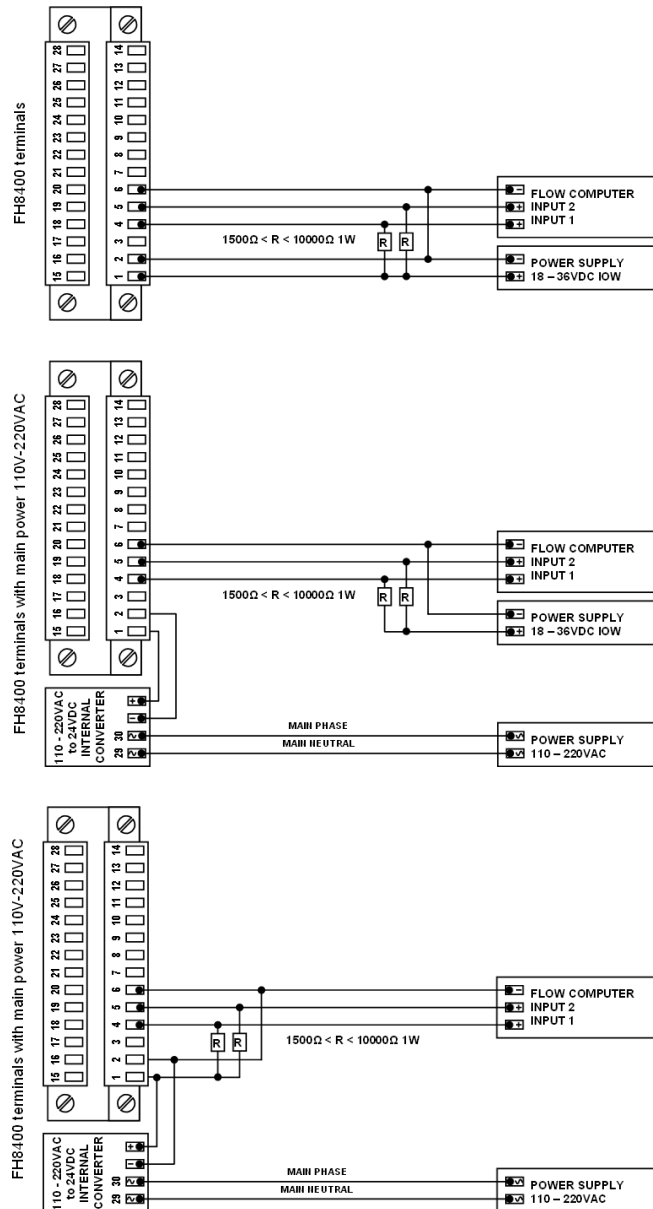
1	2	3	4	5	6	7	8	9	10	11	12	13	14
+	-	earth	P1	P2	0V	earth	485+	485-	earth	Out1	Out1	Out2	Out2
18-36 VDC power			pulse outputs				RS 485			logic outputs			



1	18-36 VDC power (+)	16	T- 4/20mA input
2	18-36 VDC power (-)	17	P+ 4/20mA input
3	Earth power (for VDC or VAC)	18	P- 4/20mA input
4	P1+ pulse output	19	Earth 4/20mA inputs
5	P2+ pulse output	20	TORIn logic input
6	0V pulse outputs	21	TORIn logic input
7	Earth pulse outputs	22	Earth logic inputs
8	RS485+	23	Out1 4/20mA output / HART+
9	RS485-	24	Out1 4/20mA output / HART+
10	Earth RS485	25	Out2 4/20mA output
11	Out1 logic output	26	Out2 4/20mA output
12	Out1 logic output	27	Earth 4/20mA outputs
13	Out2 logic output	28	NC
14	Out2 logic output	29	110-220 VAC Neutral (OPTIONAL)
15	T+ 4/20mA input	30	110-220 VAC Phase (OPTIONAL)

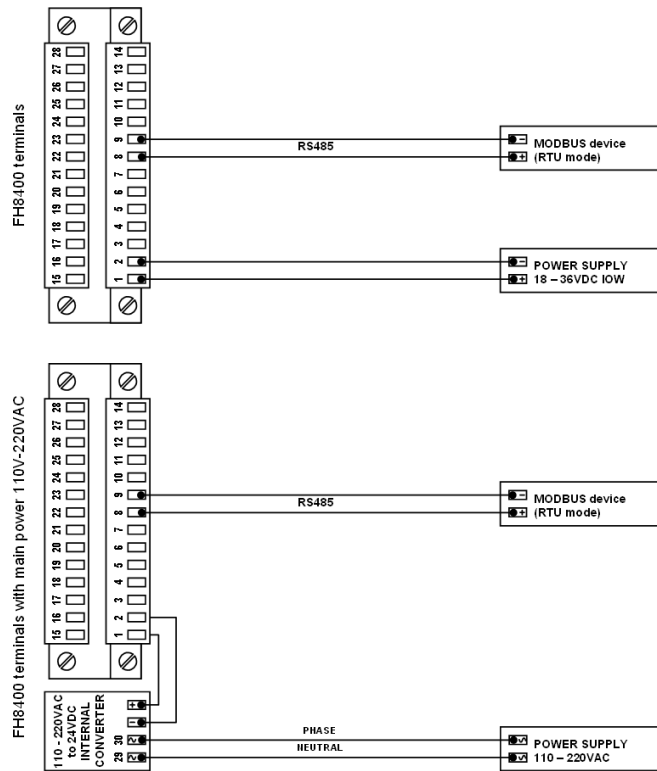
Chapter 2: Commissioning procedure

Connecting the FH8400 pulse output to a flow computer



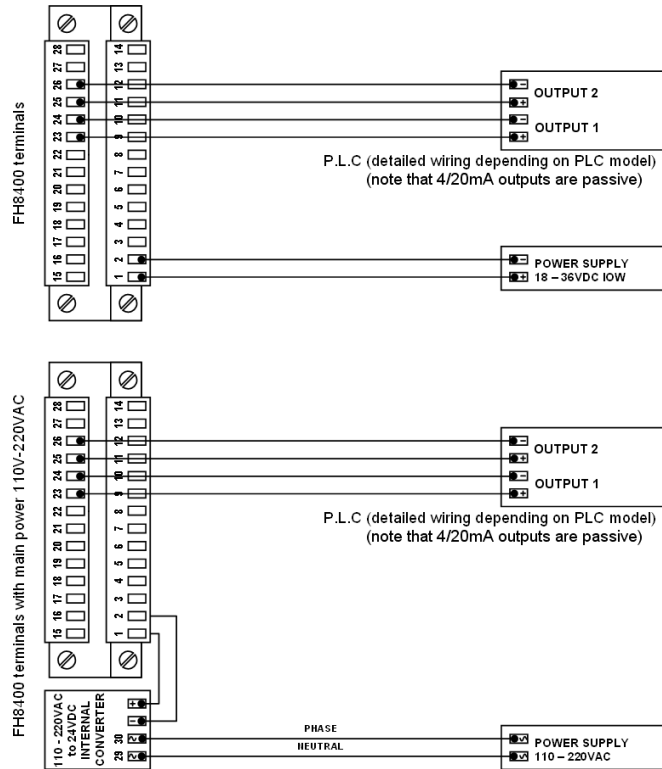


Connecting the FH8400 RS485 interface to a MODBUS device



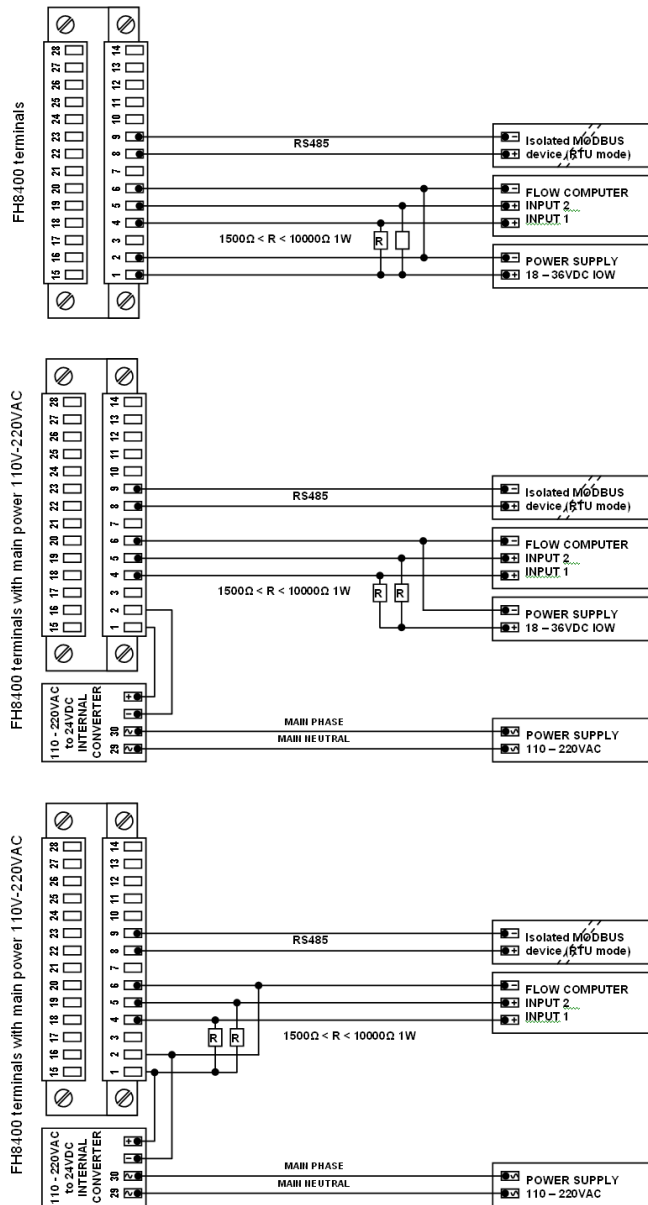
Chapter 2: Commissioning procedure

Connecting the FH8400 analog 4–20 mA output





Connecting the FH8400 pulse output to a flow computer and the RS485 interface to a MODBUS Device



Chapter 2: Commissioning procedure

Earthing of the meter to the pipe

As the meter's electronics is floating-potential designed, the meter can be connected to the pipe (without risk of damage in the case of pipe with cathodic protection).

Setting the FH8400's parameters

The FH8400 parameter setting is described in the next chapter.

Commissioning of the plant

Make sure that measurement is not altered by gas pockets or bubbles as well as particles in suspension. (The gas pockets or bubbles and the particles in suspension impede the propagation of ultrasonic waves. If their number is too large, the measurement may become invalid.)



FAURE HERMAN

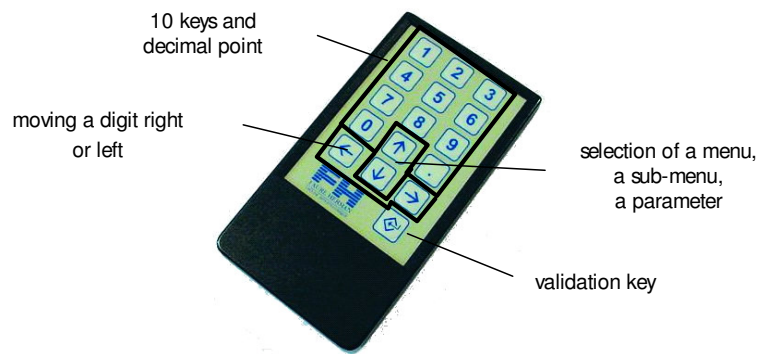
Mastering the Flow

www.faureherman.com

Chapter 3: Using the FH8400 remote control device

The parameter setting of the FH8400 can be achieved by means of the remote control device delivered with the FH8400 or the FHview PC software.

Remote control device keypad



Information displayed in measure mode

In measure mode, the screen displays the following information

- Number of paths in operation
- Velocity of sound
- Temperature
- Pressure
- Flow rate
- Volume

The first two parameters are displayed alternately.
Flow rate and volume are displayed permanently.



Remark: temperature and pressure inputs are only optional.

General parameter setting procedure

From the local display, enter the parameter setting mode by pressing the Enter key of the remote control device.

Use the ↑ and ↓ keys for selecting a sub-menu or a parameter.

The selected option is indicated by an arrow → on the left of the item. The parameters stored in the FH8400 are indicated by a * character.



For the numerical values, select the value of each digit separately. (The sign is modified by means of the ↓ and ↑ keys).

Press the Enter key to validate the selected parameter or value.

Remark: Each parameter setting screen includes an "Exit" line and a "Stop" / "Start" line. (The "Stop" / "Start" line is displayed only when the FH8400 is in non custody transfer mode.)

The "Exit" Line allows to return into the measure mode display.

The "Stop" / "Start" line allows to stop and restart the meter. (The stopping and restarting of the meter are recorded in the Event logger.)

Chapter 3: Using the FH8400 remote control device

Principle of menus and sub-menus numbering

Each menu or sub-menu is numbered by means of a 1, 2, 3 or 4 figure digit.

Example: The 113 menu corresponds to the following structure:

1. Settings

11 4/20 + Alarm units

113 Volume

Important: The sub-menus of the 2nd, 3rd and 4th levels are numbered from 0.

Menus and sub-menus structure

"1 Settings": Setting of the parameters having no influence on the measurement

- "10 Display units": Selection of the display units
- "11 4/20 + Alarm units": Selection of the units used for the analog outputs and alarms

Remark: It is possible to define separately the display units and the units used for 4-20 mA outputs and the alarms.

- "12 Set 4/20 Outputs": Allocation of the analog outputs and calibration of the corresponding 4 and 20 mA limits
- "13 Set T Input": Calibration of the 4 and 20 mA limits of the temperature input
- "14 Set P Input": Calibration of the 4 and 20 mA limits of the pressure input
- "15 Set Alarms": Setting of the alarms
- "16 Set Serial bus": Setting of the serial link
- "17 Set Loggers": Selection of the Data logger storage period and reset of the Data or Event loggers
- "18 Real Time Clock": Updating of the date and time
- "19 Set Backlight": Setting of the backlight

"2 Reset Totalizer": Reset of the totalizer

"3 Corrected diameter": Value of the inside diameter (in mm, with a 1 μm resolution) according to the temperature

"4 Serial Number": Display of the FH8400 serial number

"5 Configuration": Setting of the measurement parameters (parameters modifiable only in non custody transfer mode after a meter stop)

- **"50 Calibration"** : Definition of the damping (filter time constant) and display of the factory set parameters
- **"51 Set Pulse Output"** : Definition of the K-factor unit

"6 Zeroing": Adjustment of the zero, normally achieved in factory and accessible only in non custody transfer mode after a meter stop

Selection of units

Display unit for the flow rate

"100 Flowrate" menu

Possible units: m^3/h ; m^3/mn ; m^3/s ; l/h ; l/mn ; l/s ; gpm (gallon per minute) ; bph (blue barrel per hour)

Display unit for the temperature

"101 Temperature" menu

Possible units: $^{\circ}\text{C}$; $^{\circ}\text{F}$; K

Display unit for the pressure

"102 Pressure" menu

Possible units: bar ; kPa ; psi

Display unit for the totalizer

"103 Totalizer" menu

Chapter 3: Using the FH8400 remote control device

Possible units: m³; l; gal; bbl (blue barrels)

Display unit
for the velocity
of sound

"104 VOS" menu

Possible units: : m/s ; ft /s

Transmission unit
for the velocity
of sound

"110 V.O.S" menu

Possible units: m/s ; ft /s

Transmission unit
for the velocity of flow

"111 V.O.F" menu

Possible units: m/s ; ft /s

Transmission unit
for the flow rate

"112 Flow rate" menu

Possible units: m³/h ; m³/mn ; m³/s ; l/h ; l/mn ; l/s ; gpm ; bph

Transmission unit
for the totalizer

"113 Totalizer" menu

Possible units: m³; l; gal; bbl

Transmission unit
for the pressure

"114 Pressure" menu

Possible units: bar; kPa; psi

Transmission unit
for the temperature

"115 Temperature" menu

Possible units: °C; °F; K

Setting the analog outputs

Allocation
of the output n° 1

"1200 Set 04-20 Var" menu

The output n° 1 can be allocated to one of these variables:

- Velocity of sound
- Velocity of flow
- Flow
- Totalizer
- Pressure
- Temperature
- Gain

The gain corresponds to the average value, for the paths in operation, of the attenuation of ultrasonic waves through the fluid.

The acceptable values go from -2 dB (not very attenuated signal; risk of saturation above) to -45 dB (strongly attenuated signal; risk of interference below)

Calibration of 4 and 20 mA limits
of the analog output n° 1

"1201 Set 04 mA Value" and "1202 Set 20 mA Value" menus

Chapter 3: Using the FH8400 remote control device

Setting of the analog output n° 2

1210, 1211 and 1212 menus

See above

Setting of the analog output n° 3

1220, 1221 and 1222 menus

See above

Setting the temperature input

"130 Set 04 mA Value" and "131 Set 20 mA Value" menus

Define the values corresponding respectively to 4 and 20 mA, the unit being the one defined in the "115" menu.

Setting the pressure input

"140 Set 04 mA Value" and "141 Set 20 mA Value" menus

Define the values corresponding respectively to 4 and 20 mA, the unit being the one defined in the "114" menu.

Setting the alarms

Allocation of the alarm n° 1

"150 Set Alarm1 Var" menu

The alarm can be allocated to one of these variables:

- Velocity of sound
- Velocity of flow
- Flow rate
- Volume
- Pressure
- Temperature
- Gain

Number of paths in operation (opening of the contact if the number of paths in operation becomes inferior to this value)

Switching mode of the alarm n° 1

"151 Set Alarm1 Lim" menu

Possible choices: < and > (except for the alarm allocated to the number of paths in operation where comparison corresponds systematically to <)

The alarm is active (opening of the contact) when the parameter value becomes inferior or superior to the value defined in the 152 menu.

Threshold of the alarm n° 1

"152 Set Alarm1 Val" menu structured as follows:

<Variable allocated to the alarm> Limit Value
<threshold value> <unit defined in the 11 menu>

Summary of the alarm n° 1

"153 Alarm1 registered" menu

Setting of the alarm n° 2

154, 155, 156 and 157 menus corresponding respectively to the 150, 151, 152 and 153 menus

Setting the serial link

Selection of the link protocol

"160 Modbus / Hart" menu

In Modbus link, the FH8400 works in slave mode (query by the device linked to the FH8400, response by the FH8400)

Remark: If the Hart protocol is selected, the transmission rate is set to 1,200 bauds.

Chapter 3: Using the FH8400 remote control device

Modbus protocol baud rate

"161 Modbus Baudrate" menu (displayed only if the selected protocol is Modbus)

Possible choices: 9,600 and 19,200 bauds

Make sure that both equipments (FH8400 and control-command system) have the same baud rate.

Modbus slave number

"162 Modbus address" menu (displayed only if the selected protocol is Modbus)

Setting the data logger and resetting both loggers

Choosing the data logger storage period

"170 Set Data Freq" menu

Possible values: 1 s ; 5 s ; 10 s ; 30 s ; 1 min ; 2 min ; 5 min ; 10 min ; 15 min ; 30 min ; 1 hr ; 2 hrs ; 6 hrs ; 12 hrs ; 24 hrs

Resetting the Data Logger

"171 Clear Data Log" menu

Resetting the Event logger

"172 Clear Event Logger" menu

Setting FH8400 date and time

Setting the date

"180 Date Setting" menu

The date is stored and displayed in the international format : dd / mm / yy

Remark: Day, month and year must be validated separately.

Setting the time

"181 Clock Setting" menu

The time is stored and displayed in the format hh : mm.

Setting the backlight

"19 Set Backlight" menu

Possible choices:

On (permanent backlight)

Off (backlight switched off)

Timer (backlight switched on during about 10 s after pressing the key)

Resetting the totalizer

"2 Reset Totalizer" menu

Display of the temperature corrected inside diameter

"3 Corrected diameter" menu

Display of the serial number

"4 Serial Number"

The serial number is composed of up to 20 characters.

Time constant of the floating average filter

"500 Damping" menu

Indicate the number of flow measurements used for the calculation of the average flow rate. (The average flow rate is displayed by the FH8400 and is used for the pulse outputs, the analog outputs and the alarms, and is transmitted via the serial link.)

The greater the "Damping" parameter is, the more filtered the fluctuations and fast variations are.

Factory set parameters

Those can be found under the calibration coefficients (501 menu), the inside diameter (502 menu) and the diameter temperature correction factor (503 menu) menus.

Chapter 3: Using the FH8400 remote control device

Setting the K-factor

K-factor unit

"510 Set KF Unit" menu

Possible choices: pulses / m³ ; pulses / litre ; pulses / gallon ; pulses / barrel

Value of the K-factor

"511 Set KF" menu

Indicate the K-factor value (number of pulses per volume unit) according to the unit selected in 510 menu.

Zeroing

"6 Zeroing" menu

The FH8400 zero (nil flow rate value for a nil flow) is set in factory. On site zeroing must be done only by Faure Herman or by an authorized operator.



FAURE HERMAN
Mastering the Flow
www.faureherman.com

Chapter 4:

Spare parts and Maintenance

The FH8400 ultrasonic flow meter is a maintenance-free instrument, mainly because it does not have any moving part. However, it might happen that users have to replace transducers, gasket or electronics.



Warning: The replacement of any parts requires turning off the power supply. Once power supply is off, wait at least one minute before opening the converter's enclosure.

Spare parts

To reduce the downtime period which might be due to either transducer, gasket or electronics failures, Faure Herman recommends the following spare parts:

- A transducer set (transducer, wires set, cable gland, etc.)
- A gasket
- Complete electronics set

Important: The replacement of the electronics must be done by a Faure Herman technician.

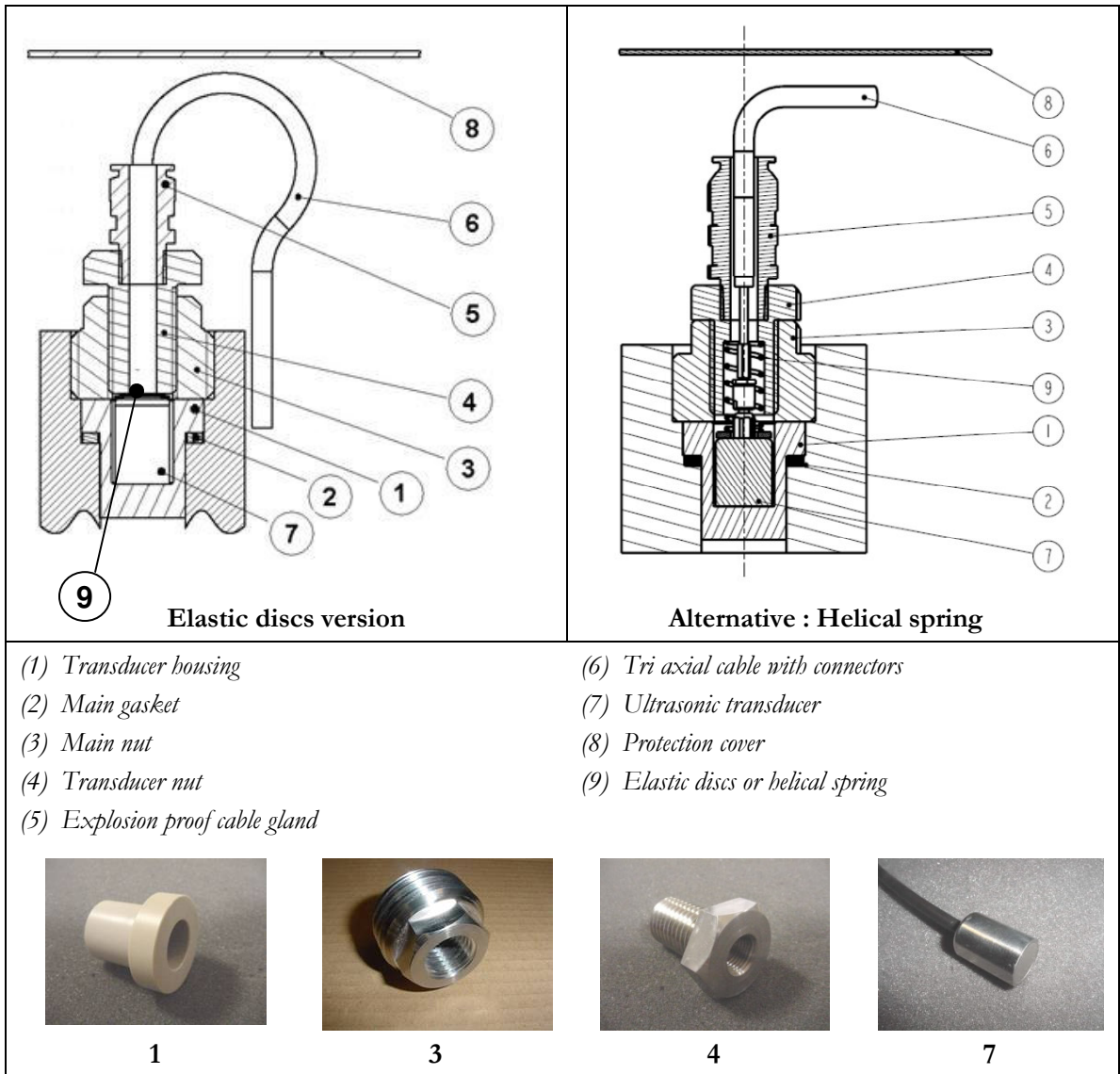
Removing and replacing the transducers or gasket

In case of failed beam, identify the missing ultrasonic path and the failed transducer(s) by using FHview. One path corresponds to two transducers.

To determine the failed transducer, measure the transducer capacitance after removing as described here after.

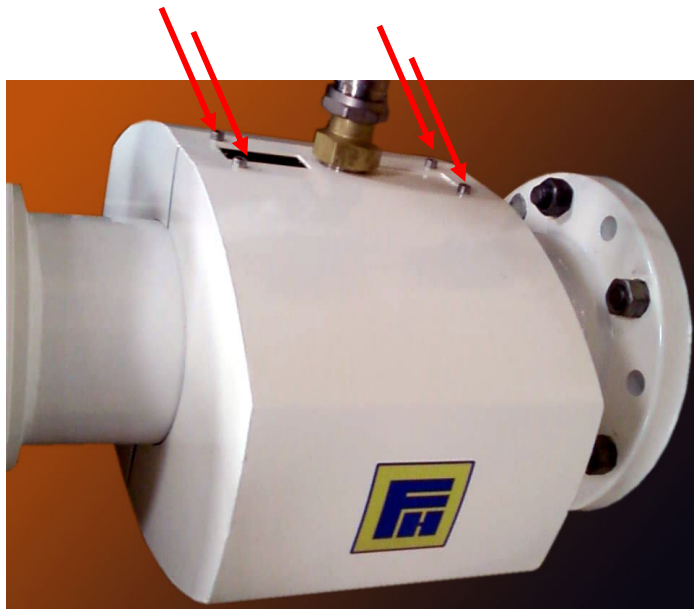
The value must be about 1nF for a half inch transducer and about 4nF for one inch transducer.

Chapter 4: Spare parts and Maintenance



Removing a gasket

- Identify the location of the leak.
- Empty the line.
- **Turn the power supply off.**
- Unscrew and remove transducer protection casing.

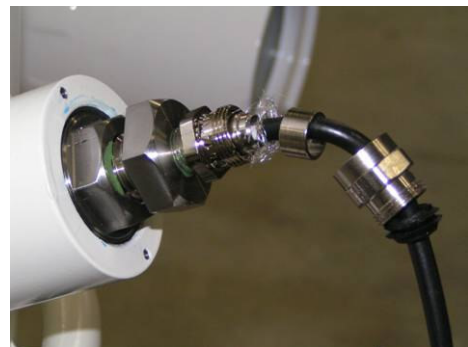


Chapter 4: Spare parts and Maintenance

- Unscrew the top part of the cable gland (with flat spanner 19).



- Unscrew the middle part of the cable gland (with flat spanner 19).



- Unscrew the base of the cable gland with a flat spanner 19 by holding the transducer nut with a flat spanner 30 (1/2" transducer) or a flat spanner 42 (1" transducer).





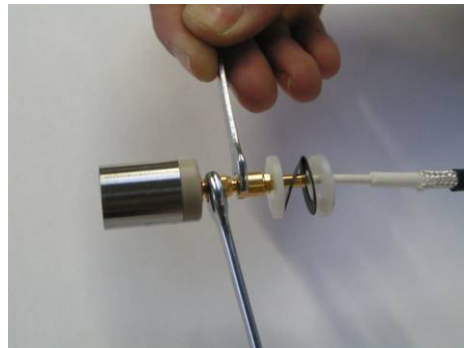
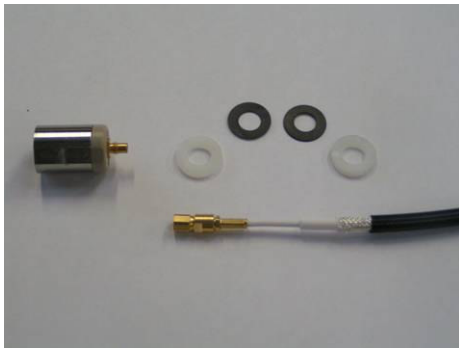
- Unscrew the transducer nut and remove the transducer with a flat spanner 30 (1/2" transducer) or a flat spanner 42 (1" transducer).



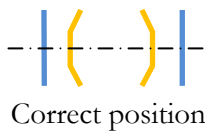
Chapter 4: Spare parts and Maintenance

Only in case of transducer replacement

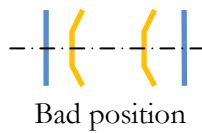
- ❑ Unscrew the transducer (with flat spanners 6 and 5.5).
- ❑ Replace with a new transducer.
- ❑ Put isolation wire/tube around connector.



CAUTION ! Only for elastic discs version



Correct position



Bad position



Alternative : Helical spring

Only in case of gasket replacement requirement



Warning: Be sure there is no pressure in the tube before changing the gasket.

Cause of death or serious injury possible.

- Unscrew the main nut with a flat spanner 30 (1/2" transducer) or a flat spanner 42 (1" transducer).



- Remove the transducer housing and the main gasket.



Chapter 4: Spare parts and Maintenance

- ❑ Check the transducer housing if any damage.



- ❑ Clean the body spool piece.



Installing a new gasket

- ❑ Take a new main gasket and/or new transducer housing.
- ❑ Place them in their location.



- ❑ Take the main nut.
- ❑ Put threadlocking ref. Loctite 243 on main nut.

- Screw the main nut with a flat spanner 30 (1/2" transducer) or a flat spanner 42 (1" transducer) until in contact with the body spool piece and screw carefully with a flat spanner 30 at 79Nm or with a flat spanner 42



Installing a transducer



Warning: Put the assembly made with the two electric discs and the two washers as shown below.

- Take the transducer and put a thin layer of ultrasonic liquid connects (REFERENCE HT50G FROM ELECTROLUBE).



Chapter 4: Spare parts and Maintenance



- Screw the base of the cable gland with a flat spanner 30 (1/2" transducer) or a flat spanner 42 (1" transducer) and a flat spanner 19.



- Screw the middle part of the cable gland with flat spanner 19.



- Screw the top part of the cable gland with flat spanner 19.



- Screw the transducer protection casing.



Chapter 4: Spare parts and Maintenance

Performing a zeroing procedure

- ❑ If possible turn down the flow as soon as possible and keep the pipe at the working pressure or at a pressure greater than 4 bars.
- ❑ Shut off the closest upstream and downstream valves if possible. The pressure shall stay at the value obtained in the previous step.
- ❑ Wait 10 to 15 minutes for the random velocities to become quiet.
- ❑ Perform the zeroing operation by using the remote control device.



FAURE HERMAN
Mastering the Flow
www.faureherman.com

Chapter 5 :

Modbus transmission tables

Available tables

The FH8400 comprises 8 data tables:

- **Table n° 1** (reference address 0h):

Table containing the main measure data, in particular:

display units

units used for the 4-20 mA and the alarms

flow rate in m³/s

temperature in °C

pressure in bar

volume in m³

velocity of flow in m/s

average velocity of sound in m/s

same measure data in selected units

- **Table n° 2** (reference address 100h)

Table containing the alarm and working data of the FH8400, in particular

alarm counters

number of paths in operation

average value of the signal attenuation

working mode (non custody)

alarm settings

- **Table n° 3** (reference address 200h)
Table containing the variables measured by the paths, in particular:
 - for each path, velocity of flow, velocity of sound, signal attenuation
- **Table n° 4** (reference address 400h)
Table containing the custody and calibration parameters and, in particular
 - K-factor value and unit
 - filter time constant
 - inside diameter
 - calibration coefficients
- **Table n° 5** (reference address 500h)
Table containing the non custody parameters, in particular:
 - setting of the 2 analog outputs
 - setting of the temperature and pressure inputs
 - date and time of the FH8400
- **Table n° 6** (reference address 600h)
Table containing the release numbers of the FH8400 components
- **Table n° 7** (reference address 1000h)
Table containing the Data logger data, in particular:
 - contents of the last record
 - number of the last record
 - number of the record to be read
 - Data logger period

Chapter 5 : Modbus transmission tables

- **Table n° 8** (reference address 1800h)

Table containing the Event logger data, in particular:
contents of the last record
number of the last record
number of the record to be read

Main characteristics of the transmission

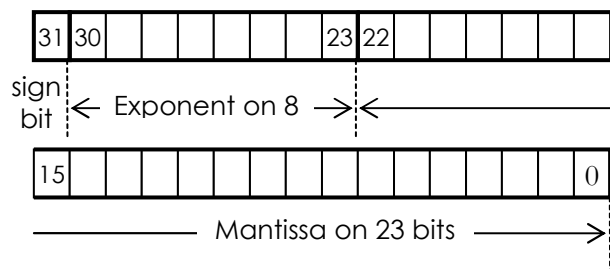
- Protocol used: Modbus RTU (8-bit binary transmission)
- Working mode of the FH8400 : slave
- Baud rate: 9,600 or 19,200 bauds
- Number of bits : 8
- Number of start bits: 1
- Number of stop bits : 1
- Parity : None
- Error check: CRC16

Transmission formats

A Modbus word is composed of two bytes.

Data are transmitted according to one the following formats:

- Integer (symbol INT) : 1 Modbus word, that is 2 bytes
- Long integer (symbol LINT) : 2 Modbus words, that is 4 bytes
- IEEE 32-bit floating number (symbol FLOAT) : 2 Modbus words, that is 4 bytes, constituted as follows



$$V = (-1)^s \left(1 + \frac{M}{2^{23}} \right) \cdot 2^{E-127}$$

Example: Given the value 40.21.80.40h

0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

(S = 0, E = 128, M = 218040h = 2195520)

$$V = (-1)^0 \left(1 + \frac{2195520}{2^{23}} \right) \cdot 2^{128-127} = 2,523452759$$

Data are put in the tables starting with the most significant byte (MSB), except for the CRC 16 control word which is transmitted beginning by the least significant byte.

The Modbus functions accepted by the FH8400 are the function 3 (reading of n words) and the function 16 (writing of n words).

Framework for the reading of "n" Modbus words (1 ≤ n ≤ 125)

Request

Slave number	Function code (3)	Address of the 1st word	Number of words (n)	CRC16 Control
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Response

Slave number	Function code (3)	Number of read bytes	Value of the 1st word	Value of the last word	CRC16 Control
1 byte	1 byte	1 byte	2 bytes	2 bytes	2 bytes

Chapter 5 : Modbus transmission tables

Framework for the writing of "n" Modbus words ($1 \leq n \leq 123$)

Request

Slave number	Function code (16)	Address of the 1st word	Number of words (n)	Nb of bytes in words	Value of the 1st word		Value of the last word	CRC16 control
1 byte	1 byte	2 bytes	2 bytes	1 byte	2 bytes		2 bytes	2 bytes

Response

Slave number	Function code (16)	Address of the 1st word	Number of words (n)	CRC16 control
1 byte	1 byte	2 bytes	2 bytes	2 bytes



Structure of the table n°1

Reference address 000h; main measure data

	Modbus address	Name and description	Format	Access
Dsiplayed values	000h	<p style="text-align: center;">DISPLAYED FLOW RATE</p> <hr/> Gross flow expressed in the unit selected for the display (see 040h)	FLOAT	R
	002h	<p style="text-align: center;">DISPLAYED VELOCITY OF FLUID</p> <hr/> Fluid velocity expressed in the unit selected for the display (see 041h)	FLOAT	R
	004h	<p style="text-align: center;">DISPLAYED VELOCITY OF SOUND</p> <hr/> Sound velocity expressed in the unit selected for the display (see 042h)	FLOAT	R
	006h	<p style="text-align: center;">DISPLAYED TEMPERATURE</p> <hr/> Temperature expressed in the unit selected for the display (see 043h) <i>Remark : 0 if temperature sensor not wired</i>	FLOAT	R
	008h	<p style="text-align: center;">DISPLAYED PRESSURE</p> <hr/> Pressure expressed in the unit selected for the display (see 044h) <i>Remark : 0 if pressure sensor not wired</i>	FLOAT	R
	00Ah	<p style="text-align: center;">DISPLAYED TOTALIZER</p> <hr/> <i>Totalizer expressed in the unit selected for the display (see 045h)</i>	FLOAT	R

Chapter 5 : Modbus transmission tables

	Modbus address	Name and description	Format	Access
Units for the 4-20 mA outputs and alarms	00Ch	FLOW RATE UNIT	INT	R/W
		Unit used for the gross flow (4-20 mA and alarms)		
		1 m ³ /h		
		2 m ³ /mn		
	00Dh	VELOCITY OF FLUID UNIT	INT	R/W
Unit used for the velocity of fluid (4-20 mA and alarms)				
1 m/s				
2 ft /s				
	00Eh	VELOCITY OF SOUND UNIT	INT	R/W
Unit used for the velocity of sound (4-20 mA and alarms)				
1 m/s				
2 ft /s				
	00Fh	TEMPERATURE UNIT	INT	R/W
Unit used for the temperature (4-20 mA and alarms)				
1 °C				
2 °F				
		3 K		



	Modbus address	Name and description	Format	Access							
Units for 4-20 mA and alarms (followed)	010h	<p>PRESSURE UNIT</p> <hr/> Unit used for the pressure (4-20 mA, alarms and transmission) <table border="1" style="margin-left: 40px;"> <tr><td>1</td><td>bar</td></tr> <tr><td>2</td><td>kPa</td></tr> <tr><td>3</td><td>psi</td></tr> </table>	1	bar	2	kPa	3	psi	INT	R/W	
		1	bar								
2	kPa										
3	psi										
011h	<p>TOTALIZER UNIT</p> <hr/> Unit used for the totalizer (4-20 mA, alarms and transmission) <table border="1" style="margin-left: 40px;"> <tr><td>1</td><td>m³</td></tr> <tr><td>2</td><td>l</td></tr> <tr><td>3</td><td>gal</td></tr> <tr><td>4</td><td>bbl</td></tr> </table>	1	m ³	2	l	3	gal	4	bbl	INT	R/W
1	m ³										
2	l										
3	gal										
4	bbl										
Values expressed in SI units	012h	<p>FLOW RATE IN S.I. UNIT</p> <hr/> Flow rate expressed in m ³ /s	FLOAT	R							
	014h	<p>T IN S.I. UNIT</p> <hr/> Temperature expressed in °C	FLOAT	R							
	016h	<p>P IN S.I. UNIT</p> <hr/> Pressure expressed in bar	FLOAT	R							
	018h	<p>TOTALIZER IN S.I. UNIT</p> <hr/> Totalizer expressed in m ³	FLOAT	R							
	01Ah to 021h	Words not used	FLOAT	R							
	022h	<p>VELOCITY OF SOND IN S.I. UNIT</p> <hr/> Velocity of sound expressed in m/s	FLOAT	R							
	024h	<p>VELOCITY OF FLUID IN S.I. UNIT</p> <hr/> Velocity of fluid expressed in m/s	FLOAT	R							
	026h to 03Fh	Words not used									

Chapter 5 : Modbus transmission tables

	Modbus address	Name and description	Format	Access
Display units	040h	<p style="text-align: center;">FLOW RATE DISPLAY UNIT</p> <hr/> Unit used for the display of the flow rate (see 00Ch for the list of units)	INT	R/W
	041h	<p style="text-align: center;">VELOCITY OF FLUID DISPLAY UNIT</p> <hr/> Unit used for the display of the velocity of fluid (see 00Dh for the list of units)	INT	R/W
	042h	<p style="text-align: center;">VELOCITY OF SOUND DISPLAY UNIT</p> <hr/> Unit used for the display of the velocity of sound (see 00Eh for the list of units)	INT	R/W
	043h	<p style="text-align: center;">TEMPERATURE DISPLAY UNIT</p> <hr/> Unit used for the display of the temperature (see 00Fh for the list of units)	INT	R/W
	044h	<p style="text-align: center;">PRESSURE DISPLAY UNIT</p> <hr/> Unit used for the display of the pressure (see 010h for the list of units)	INT	R/W
	045h	<p style="text-align: center;">TOTALIZER DISPLAY UNIT</p> <hr/> Unit used for the display of the totalizer (see 011h for the list of units)	INT	R/W
Reset of the totalizer	046h	<p style="text-align: center;">TOTALIZER RESET</p> <hr/> Write a 1 value to reset the totalizer <i>Remark: This word is reset to 0 when the totalizer reset is over.</i>	INT	R/W



Structure of the table n° 2

Reference address 100h; alarm and operation data

	Modbus address	Name and description	Format	Access
Alarm counters	100h	ALARM 1 COUNTER Counter of occurrences of alarm 1	INT	R
	101h	ALARM 2 COUNTER Counter of occurrences of alarm 2	INT	R
Validity of measure	102h	VALID BEAMS Number of valid beams	INT	R
	103h	SIGNAL Average attenuation of the ultrasonic signals, in dB	FLOAT	R
Working mode	105h	WORKING MODE	FLOAT	R
		FH8400 working mode FFFFh non custody mode		
Reset alarms	106h	ALARM CLEAR Reset of both alarm counters (write a 0 value for resetting)	INT	W
	107h	Word reserved for internal use		

Chapter 5 : Modbus transmission tables

	Modbus address	Name and description	Format	Access
Definition of the alarm 1	108h	ALARM 1 VARIABLE	INT	R/W
		Variable assigned to the alarm 1		
		1 Velocity of sound		
		2 Velocity of fluid		
		3 Flow rate		
		4 Volume		
		5 Pressure		
		6 Temperature		
		7 Gain		
		8 Number of valid paths		
		ALARM 1 LIMIT		
	109h	Type of comparison with the alarm 2 threshold	INT	R/W
		1 >		
		2 <		
	10Ah	ALARM 1 THRESHOLD	FLOAT	R/W
		Value of the alarm 1 threshold		
	10Ch	ALARM 1 UNIT	INT	R/W
		Unit assigned to the alarm 1 threshold		
Definition of the alarm 2	10Dh	ALARM 2 VARIABLE	INT	R/W
		Variable assigned to the alarm 2 (see 108h for the list of units)		
	10Eh	ALARM 2 LIMIT	INT	R/W
		Type of comparison with the alarm 2 threshold (see 109h)		
10Fh	ALARM 2 THRESHOLD	FLOAT	R/W	
	Value of the alarm 2 threshold			
111h	ALARM 2 UNIT	INT	R/W	
	Unit assigned to the alarm 2 threshold idem 10Ch			



	Modbus address	Name and description	Format	Access
Alarm thresholds in S.I. units	112h	<u>ALARM 1 THRESHOLD IN S.I. UNIT</u> Value of the alarm 1 threshold expressed in the SI unit of the variable assigned to the alarm 1 (for example, m ³ /s if the variable assigned to the alarm 1 is the flow rate)	FLOAT	R
	114h	<u>ALARM 2 THRESHOLD IN S.I. UNIT</u> Value of the alarm 2 threshold expressed in the SI unit of the variable assigned to the alarm 2	FLOAT	R

Chapter 5 : Modbus transmission tables

Structure of the table n° 3

Reference address 200h ; data measured by paths

	Modbus address	Name and description	Format	Access
Values calculated by the path 1	200h	<u>BEAM01 VELOCITY</u> Velocity of fluid, in m/s, computed by the path 1 <i>Remark : The value is equal to 0 if the path is not valid.</i>	FLOAT	R
	202h	<u>BEAM01 VOS</u> Velocity of sound, in m/s, computed by the path 2 <i>Remark : The value is equal to 0 if the path is not valid.</i>	FLOAT	R
	204h	<u>BEAM01 SIGNAL</u> Attenuation, in dB, computed by the path 1	FLOAT	R
	206h	<u>BEAM01 BIAS_STAT</u> Correction brought to the path 1 (bias)	FLOAT	R
Values calculated by the other paths	208h to 20Fh	Words not used		
	210h to 216h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 2	FLOAT	R
	218h to 21Fh	Words not used		
	220h to 226h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 3	FLOAT	R
	228h to 22Fh	Words not used		
Processing of the zeroing	230h to 329h	Words not used		
	32Ah	<u>ZEROING PROCESSING</u> Processing of the FH8400 zeroing (0 to 100%)	LONG	R




Structure of the table n° 4

Reference address 400h; custody and calibration parameters

	Modbus address	Name and description	Format	Access							
Definition of K-factor	400h	<p>KFACTOR VALUE</p> <hr/> K-factor value expressed in the unit stored in 402h	FLOAT	R/W							
	402h	<p>KFACTOR UNIT</p> <hr/> K factor unit <table border="1" style="margin-left: 40px;"> <tr> <td>1</td> <td>pulses / m³</td> </tr> <tr> <td>2</td> <td>pulses / l</td> </tr> <tr> <td>3</td> <td>pulses / gallon</td> </tr> <tr> <td>4</td> <td>pulses / barrel</td> </tr> </table>	1	pulses / m ³	2	pulses / l	3	pulses / gallon	4	pulses / barrel	LONG
1	pulses / m ³										
2	pulses / l										
3	pulses / gallon										
4	pulses / barrel										
Tuning values	404h	<p>NOMINAL DIAMETER</p> <hr/> Flowmeter diameter	FLOAT	R/W							
	406h	<p>TOTALIZER VALUE BEFORE POWER OFF</p> <hr/> Value of the totalizer before the last power off	FLOAT	R/W							
	408h	<p>TEMPERATURE COEF</p> <hr/> Expansion temperature coefficient in 10 ⁻⁶ m/m/°C									
	40Ah	<p>DAMPING</p> <hr/> Filter time constant	FLOAT	R/W							
	40Ch	<p>COEF 1</p> <hr/> Calibration coefficient 1	FLOAT	R/W							
	40Eh	<p>COEF 2</p> <hr/> Calibration coefficient 2	FLOAT	R/W							
	410h	<p>COEF 3</p> <hr/> Calibration coefficient 3	FLOAT	R/W							
412h	<p>COEF 4</p> <hr/> Calibration coefficient 4	FLOAT	R/W								

Chapter 5 : Modbus transmission tables

	Modbus address	Name and description	Format	Access
Tuning values (followed) 	414h	COEF 5 Calibration coefficient 5	FLOAT	R/W
	416h	COEF 6 Calibration coefficient 6	FLOAT	R/W
	418h	COEF 7 Calibration coefficient 7	FLOAT	R/W
	41Ah	COEF 8 Calibration coefficient 8	FLOAT	R/W
	41Ch	COEF 9 Calibration coefficient 9	FLOAT	R/W
	41Eh	COEF 10 Calibration coefficient 10	FLOAT	R/W
	420h	K FACTOR IN S.I. UNIT K-factor expressed in pulses / m ³	FLOAT	R
424h	REAL INSIDE DIAMETER Real flowmeter inside diameter in mm	FLOAT	R/W	



Structure of the table n° 5

Reference address 500h ; non custody parameters

	Modbus address	Name and description	Format	Access													
Setting of the analog output n° 1	500h	<p>OUTPUT 4/20 mA N° 1 UNIT</p> <p>Depending on the variable assigned to the analog output n°1, unit used by the output (see words 00Ch to 011h of the table 1)</p>	INT	R													
	501h	<p>OUTPUT 4/20 mA N°1 : 4 mA VALUE</p> <p>Scale limit assigned to the 4 mA value of the analog output n°1, in the unit stored in 500h</p>	FLOAT	R/W													
	503h	<p>OUTPUT 4/20 mA N°1 : 20 mA VALUE</p> <p>Scale limit assigned to the 20 mA value of the analog output n°1, in the unit stored in 500h</p>	FLOAT	R/W													
	505h	<p>OUTPUT 4/20 mA N° 1 : TYPE</p> <p>Variable assigned to the analog output n°1</p> <table border="1"> <tr><td>1</td><td>Velocity of sound</td></tr> <tr><td>2</td><td>Velocity of fluid</td></tr> <tr><td>3</td><td>Flowrate</td></tr> <tr><td>4</td><td>Volume</td></tr> <tr><td>5</td><td>Pressure</td></tr> <tr><td>6</td><td>Temperature</td></tr> <tr><td>7</td><td>Gain</td></tr> </table>	1	Velocity of sound	2	Velocity of fluid	3	Flowrate	4	Volume	5	Pressure	6	Temperature	7	Gain	INT
1	Velocity of sound																
2	Velocity of fluid																
3	Flowrate																
4	Volume																
5	Pressure																
6	Temperature																
7	Gain																
	506h to 508h	Words not used															
Setting of the temperature	509h	<p>INPUT TEMPERATURE : 4 mA VALUE</p> <p>Scale limit assigned to the 4 mA value of the temperature input, expressed in the unit defined in table 1's 00Fh word</p>	FLOAT	R/W													
	50Bh	<p>INPUT TEMPERATURE : 20 mA VALUE</p> <p>Scale limit assigned to the 20 mA value of the temperature input, expressed in the unit defined in table 1's 00Fh word</p>	FLOAT	R/W													

Chapter 5 : Modbus transmission tables

	Modbus address	Name and description	Format	Access
Setting of the pressure	50Dh	<u>INPUT PRESSURE : 4 mA VALUE</u> Scale limit assigned to the 4 mA value of the pressure input, expressed in the unit defined in table 1's 010h word	FLOAT	R/W
	50Fh	<u>INPUT PRESSURE : 20 mA VALUE</u> Scale limit assigned to the 20 mA value of the pressure input, expressed in the unit defined in table 1's 010h word	FLOAT	R/W
Date and time of the FH8300	511h	YEAR	INT	R/W
	512h	MONTH	INT	R/W
	513h	DAY	INT	R/W
	514h	HOUR	INT	R/W
	515h	MINUTE	INT	R/W
	516h	SECOND	INT	R/W
	517h	Word not used		
Calibration of temperature and pressure inputs	518h	<u>INPUT TEMPERATURE : 4 mA VALUE CALIBRATION</u> Calibration value for the 4 mA limit of temperature input	FLOAT	R
	51Ah	<u>INPUT TEMPERATURE : 20 mA VALUE CALIBRATION</u> Calibration value for the 20 mA limit of temperature input	FLOAT	R
	51Ch	<u>INPUT PRESSURE : 4 mA VALUE CALIBRATION</u> Calibration value for the 4 mA limit of pressure input	FLOAT	R
	51Eh	<u>INPUT PRESSURE : 20 mA VALUE CALIBRATION</u> Calibration value for the 20 mA limit of pressure input	FLOAT	R

	Modbus address	Name and description	Format	Access
Scale limits 4 and 20 mA in S.I. units	520h	OUTPUT 4/20 mA N°1 : 4 mA IN S.I. UNIT Scale limit assigned to the 4 mA value of the analog output n°1, in the SI unit corresponding to the variable assigned to the output	FLOAT	R
	522h	OUTPUT 4/20 mA N°1 : 20 mA IN S.I. UNIT Scale limit assigned to the 20 mA value of the analog output n°1, in the SI unit corresponding to the variable assigned to the output	FLOAT	R
	524h	Word not used		
	525h	INPUT TEMPERATURE : 4 mA IN S.I. UNIT Scale limit assigned to the 4 mA value of the temperature input, in °C	FLOAT	R
	527h	INPUT TEMPERATURE : 20 mA IN S.I. UNIT Scale limit assigned to the 20 mA value of the temperature input, in °C	FLOAT	R
	529h	INPUT PRESSURE : 4 mA IN S.I. UNIT Scale limit assigned to the 4 mA value of the pressure input, in bar	FLOAT	R
	52Bh	INPUT PRESSURE : 20 mA IN S.I. UNIT Scale limit assigned to the 20 mA value of the pressure input, in bar	FLOAT	R
Calibration of the analog output n° 1	52Dh to 538h	Words not used		
	539h	OUTPUT 4/20 mA N°1 : 4 mA VALUE CALIBRATION Calibration value for the 4 mA limit of output n° 1	FLOAT	R
	53Bh	OUTPUT 4/20 mA N°1 : 20 mA VALUE CALIBRATION Calibration value for the 20 mA limit of output n° 1	FLOAT	R
	53Dh to 54Fh	words not used		

Chapter 5 : Modbus transmission tables

	Modbus address	Name and description	Format	Access
Setting of the analog output n° 2	550h	<u>OUTPUT 4/20 mA N° 2 UNIT</u> Depending on the variable assigned to the analog output n°2, unit used by the output (see words 00Ch to 011h of the table 1)	INT	R
	551h	<u>OUTPUT 4/20 mA N° 2 : 4 mA VALUE</u> Scale limit assigned to the 4 mA value of the analog output n° 2, in the unit stored in 550h	FLOAT	R/W
	553h	<u>OUTPUT 4/20 mA N° 2 : 20 mA VALUE</u> Scale limit assigned to the 20 mA value of the analog output n° 2, in the unit stored in 550h	FLOAT	R/W
	555h	<u>OUTPUT 4/20 mA N° 2 : TYPE</u> Variable assigned to the analog output n°2 (see 505h)	INT	R/W
4-20 mA scale limits for the analog output n° 2 in S.I units	556h	<u>OUTPUT 4/20 mA N° 2 : 4 mA IN S.I. UNIT</u> Scale limit assigned to the 4 mA value of the analog output n°2, in the U.S.I unit corresponding to the variable assigned to the output	FLOAT	R
	558h	<u>OUTPUT 4/20 mA N° 2 : 20 mA IN S.I. UNIT</u> Scale limit assigned to the 20 mA value of the analog output n°2, in the SI unit corresponding to the variable assigned to the output	FLOAT	R
	55Ah to 55Eh	words not used		
Calibration of the analog output n° 2	55Fh	<u>OUTPUT 4/20 mA N° 2 : 4 mA VALUE CALIBRATION</u> Calibration value for the 4 mA limit of output n° 2	FLOAT	R
	561h	<u>OUTPUT 4/20 mA N° 2 : 20 mA VALUE CALIBRATION</u> Calibration value for the 20 mA limit of output n° 2	FLOAT	R
	563h to 581h	words not used		

Structure of the table n° 6

Reference address 600h; version of the components.

The version number and the release dates are expressed in ASCII by means of 64 character chains (32 Modbus containing each two characters) ended by CR LF \0.

Example : V 2.0 17/11/2002 \n.

Modbus address	Name and description	Format	Access
600h	METER TYPE Type of the counter (example : FH8400-3)	32*INT	R
620h	METER S/N	32*INT	R
640h	INTERFACE BOARD CPU CODE	32*INT	R
660h to 69Fh	words not used		
6A0h	PROCESS BOARD DSP CODE	32*INT	R

Chapter 5 : Modbus transmission tables

Structure of the table extended calibration coefficients type 2

Reference address 700h ; extended calibration coefficients type 2 over the 10 standards coefficients

The number of extended calibration coefficients is at maximum $125 + 2$ and is equal to the product of the 2 values of parameters “Number of points in X” (abscissa axe) and “Number of points in Y” (ordinate axe) plus 2 : ex. if $N_X = 6$ and $N_Y = 5$, so the first 30 coefficients starting at address 702h are used.

Modbus address	Name and description	Format	Access
700h	NUMBER POINTS X	INT	R/W
	Number of points in abscissa of the extended calibration type 2		
701h	NUMBER POINTS Y	INT	R/W
	Number of points in ordinate of the extended calibration type 2		
702h	COEF T2 1	FLOAT	R/W
	Extended calibration coefficient 1		
704h	COEF T2 2	FLOAT	R/W
	Extended calibration coefficient 2		
706h	COEF T2 3	FLOAT	R/W
	Extended calibration coefficient 3		
708h	COEF T2 4	FLOAT	R/W
	Extended calibration coefficient 4		
70Ah à 7F8h	COEF T2 3 ... COEF T2 124	120* FLOAT	R/W
	Extended calibration coefficient 3 to 124		
7FAh	COEF T2 125	FLOAT	R/W
	Extended calibration coefficient 125		



Structure of the table n° 7

Reference address 1000h; consultation of the data logger

Modbus address	Name and description	Format	Access																														
1000h to 10FFh	<p style="text-align: center;">DATA LOGGER RECORD</p> <hr/> Data logger record corresponding to the number given in 1101h (see page 85)																																
1100h	<p style="text-align: center;">MOST RECENT RECORD NUMBER</p> <hr/> Number of the last record performed by FH8400	INT	R																														
1101h	<p style="text-align: center;">RECORD NUMBER</p> <hr/> Number of the transmitted record or number of the record to be read	INT	R/W																														
1102h	<p style="text-align: center;">DATA LOGGER PERIOD</p> <hr/> Recording period of the data logger <table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td>1</td><td>1 s</td></tr> <tr><td>2</td><td>5 s</td></tr> <tr><td>3</td><td>10 s</td></tr> <tr><td>4</td><td>30 s</td></tr> <tr><td>5</td><td>1 mn</td></tr> <tr><td>6</td><td>2 mn</td></tr> <tr><td>7</td><td>5 mn</td></tr> <tr><td>8</td><td>10 mn</td></tr> <tr><td>9</td><td>15 mn</td></tr> <tr><td>10</td><td>30 mn</td></tr> <tr><td>11</td><td>1 h</td></tr> <tr><td>12</td><td>2 h</td></tr> <tr><td>13</td><td>6 h</td></tr> <tr><td>14</td><td>12 h</td></tr> <tr><td>15</td><td>24 h</td></tr> </table>	1	1 s	2	5 s	3	10 s	4	30 s	5	1 mn	6	2 mn	7	5 mn	8	10 mn	9	15 mn	10	30 mn	11	1 h	12	2 h	13	6 h	14	12 h	15	24 h	INT	R/W
1	1 s																																
2	5 s																																
3	10 s																																
4	30 s																																
5	1 mn																																
6	2 mn																																
7	5 mn																																
8	10 mn																																
9	15 mn																																
10	30 mn																																
11	1 h																																
12	2 h																																
13	6 h																																
14	12 h																																
15	24 h																																
1103h	<p style="text-align: center;">DATA LOGGER CLEAR</p> <hr/> Reset of the data logger by writing a 0 value	INT	W																														

Chapter 5 : Modbus transmission tables

Structure of a Data logger record

Modbus address	Name and description	Format	Access
1000h	<p style="text-align: center;">FLOW RATE</p> <hr/> Gross flowrate, in m ³ /s	FLOAT	R
1002h	<p style="text-align: center;">VELOCITY OF FLUID</p> <hr/> Velocity of fluid, in m/s	FLOAT	R
1004h	<p style="text-align: center;">VELOCITY OF SOUND</p> <hr/> Velocity of sound, in m/s	FLOAT	R
1006h	<p style="text-align: center;">TEMPERATURE</p> <hr/> Temperature, in °C	FLOAT	R
1008h	<p style="text-align: center;">PRESSURE</p> <hr/> Pressure in bar	FLOAT	R
100Ah	<p style="text-align: center;">SIGNAL</p> <hr/> Average signal, in dB	FLOAT	R
100Ch	<p style="text-align: center;">FLUID VELOCITY ON BEAM 1</p> <hr/> Fluid velocity on beam 1, in m/s	FLOAT	R
100Eh	<p style="text-align: center;">FLUID VELOCITY ON BEAM 2</p>	FLOAT	R
1010h	<p style="text-align: center;">FLUID VELOCITY ON BEAM 3</p>	FLOAT	R
1012h to 102Fh	<p style="text-align: center;">words not used</p>		



Modbus address	Name and description	Format	Access
1030h	VELOCITY OF SOUND ON BEAM 1 Velocity of sound on beam 1, in m/s	FLOAT	R
1032h	VELOCITY OF SOUND ON BEAM 2	FLOAT	R
1034h	VELOCITY OF SOUND ON BEAM 3	FLOAT	R
1036h to1052h	words not used		
1054h	SIGNAL ON BEAM 1 Signal attenuation on beam 1, in dB	FLOAT	R
1056h	SIGNAL ON BEAM 2	FLOAT	R
1058h	SIGNAL ON BEAM 3	FLOAT	R
105Ah to 10FFh	Words not used		

Chapter 5 : Modbus transmission tables

Structure of the table n° 8

Reference address 1800h; consultation of the Event logger

Modbus address	Name and description	Format	Access
1800h to 1807h	<u>EVENT LOGGER RECORD</u> Event logger record corresponding to the number given in 1809h (see page 88)		
1808h	<u>MOST RECENT RECORD NUMBER</u> Number of the last record performed by FH8400	INT	R
1809h	<u>RECORD NUMBER</u> Number of the transmitted record or number of the records to be read	INT	R/W
180A	<u>EVENT LOGGER CLEAR</u> Reset of the event logger by writing a 0 value	INT	W

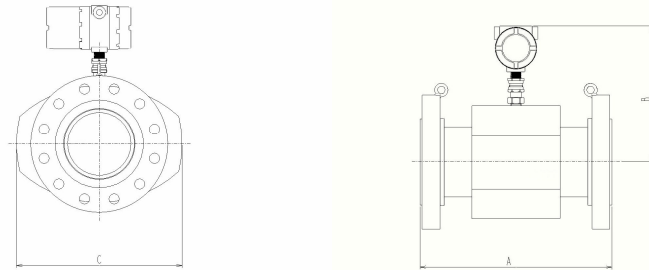


Structure of an Event logger record

Modbus address	Name and description	Format	Access																										
1800h	<p style="text-align: center;">RECORD NUMBER</p> <hr/> Number of the current record	INT	R																										
1801h	<p style="text-align: center;">STATUS REGISTER</p> <hr/> 4-byte status register : <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">bit</th> <th></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td>Power on</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Power off</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Alarm 1 on</td> </tr> <tr> <td style="text-align: center;">3</td> <td>Alarm 1 off</td> </tr> <tr> <td style="text-align: center;">4</td> <td>Alarm2 on</td> </tr> <tr> <td style="text-align: center;">5</td> <td>Alarm2 off</td> </tr> <tr> <td style="text-align: center;">6 and 7</td> <td>Operating mode (00 : non custody mode)</td> </tr> <tr> <td style="text-align: center;">8</td> <td>Flow rate on</td> </tr> <tr> <td style="text-align: center;">9</td> <td>Flow rate off (VOF = 0 for all the beams)</td> </tr> <tr> <td style="text-align: center;">10</td> <td>Oil presence</td> </tr> <tr> <td style="text-align: center;">11</td> <td>Oil absence (VOF = 0 and VOS = 0 for all the beams)</td> </tr> <tr> <td style="text-align: center;">12 to 31</td> <td>bits not used</td> </tr> </tbody> </table>	bit		0	Power on	1	Power off	2	Alarm 1 on	3	Alarm 1 off	4	Alarm2 on	5	Alarm2 off	6 and 7	Operating mode (00 : non custody mode)	8	Flow rate on	9	Flow rate off (VOF = 0 for all the beams)	10	Oil presence	11	Oil absence (VOF = 0 and VOS = 0 for all the beams)	12 to 31	bits not used	INT	R
bit																													
0	Power on																												
1	Power off																												
2	Alarm 1 on																												
3	Alarm 1 off																												
4	Alarm2 on																												
5	Alarm2 off																												
6 and 7	Operating mode (00 : non custody mode)																												
8	Flow rate on																												
9	Flow rate off (VOF = 0 for all the beams)																												
10	Oil presence																												
11	Oil absence (VOF = 0 and VOS = 0 for all the beams)																												
12 to 31	bits not used																												
1803h	YEAR	INT	R																										
1804h	DAY	INT	R																										
1805h	HOUR	INT	R																										
1806h	MINUTE	INT	R																										
1807h	SECOND	INT	R																										

Appendix I

Dimensions, weight, maximal flow rate vs meter size



Standard dimensions : ANSI 150 to ANSI 900 RF WN flanged													
Sizes		A : Length		B		C (ANSI 600)		Approx. Weights (ANSI 150)		Minimum Flowrate (1m/s)		Maximum flowrates (10 m/s)	
In.	DN	in.	mm	in.	mm	in.	mm	Kg	lbs	m3/h	Bbl/h	m3/h	Bbl/h
4	100	20.5	520	14.4	366	15.3	390	38	84	27	170	270	1700
6	150	18.9	480	15.6	397	17.7	450	57	126	60	377	600	3770
8	200	21.3	540	16.7	424	20.0	506	92	203	110	692	1100	6920
10	250	22.8	580	17.8	452	22.2	565	123	271	170	1069	1700	10690
12	300	25.6	650	18.8	478	24.4	620	190	419	240	1510	2400	15100
14	350	26.8	680	19.5	495	25.8	656	221	487	290	1824	2900	18240
16	400	28.3	720	20.5	521	28.0	711	288	635	380	2390	3800	23900
18	450	30.3	770	21.5	546	30.2	767	355	783	480	3019	4800	30190
20	500	31.5	800	22.5	572	32.2	817	442	974	600	3774	6000	37740
24	600	35.4	900	24.5	623	36.8	936	652	1437	850	5346	8500	53460



FAURE HERMAN
Mastering the Flow
www.faureherman.com

Appendix II

FH8X00 HART Commands list

Universal Commands

Command 0	Read unique identifier
Command 1	Read primary variable
Command 2	Read loop current and percent of range
Command 3	Read dynamic variables and loop current
Command 6	Write polling address
Command 7	Read loop configuration
Command 8	Read dynamic variable classifications
Command 9	Read device variables with status
Command 11	Read unique identifier associated with tag
Command 12	Read message
Command 13	Read tag, descriptor, date
Command 14	Read primary variable transducer information
Command 15	Read device information
Command 16	Read final assembly number
Command 17	Write message
Command 18	Write tag, descriptor, date
Command 19	Write final assembly number
Command 20	Read long tag
Command 21	Read unique identifier associated with long tag
Command 22	Write long tag

Transmitter Specific Commands

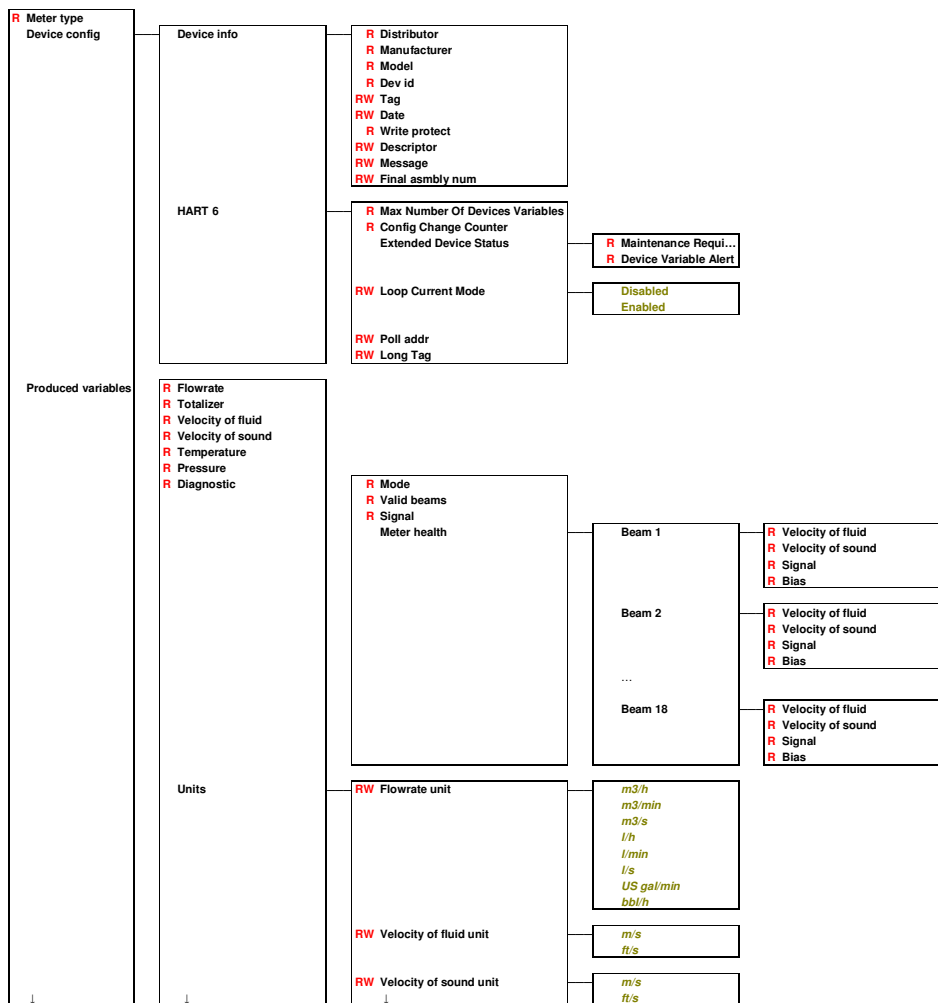
Command 140	Read variables produced
Command 141	Read units of variables produced
Command 142	Write units of variables produced
Command 143	Read custody configuration
Command 145	Read inputs/outputs configuration
Command 146	Write inputs/outputs configuration
Command 147	Read alarms configuration
Command 148	Write alarms configuration
Command 151	Read versions n°1
Command 152	Read meter type
Command 153	Read versions n°2
Command 154	Read units of alarms & inputs/outputs
Command 155	Write units of alarms & inputs/outputs
Command 157	Read measures on beams 1 to 3
Command 158	Read measures on beams 4 to 9
Command 159	Read measures on beams 10 to 18

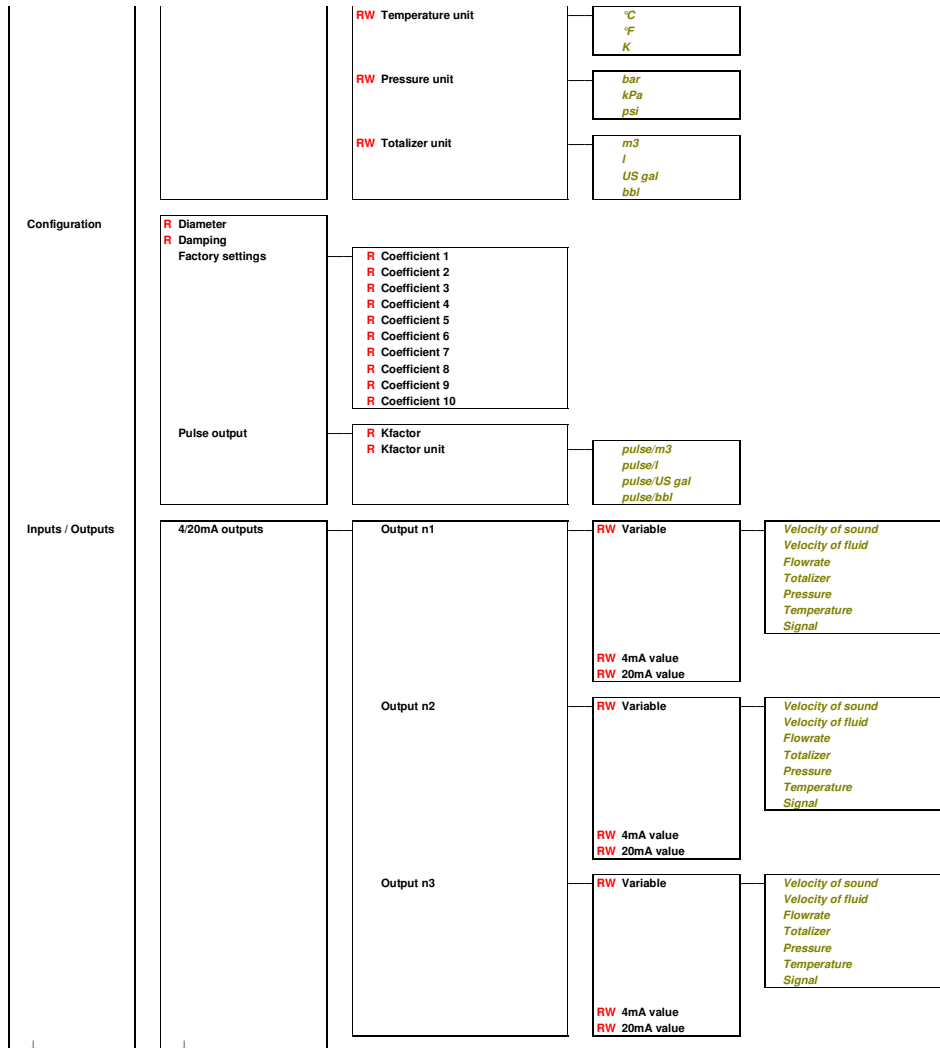


FAURE HERMAN
Mastering the Flow
www.faureherman.com

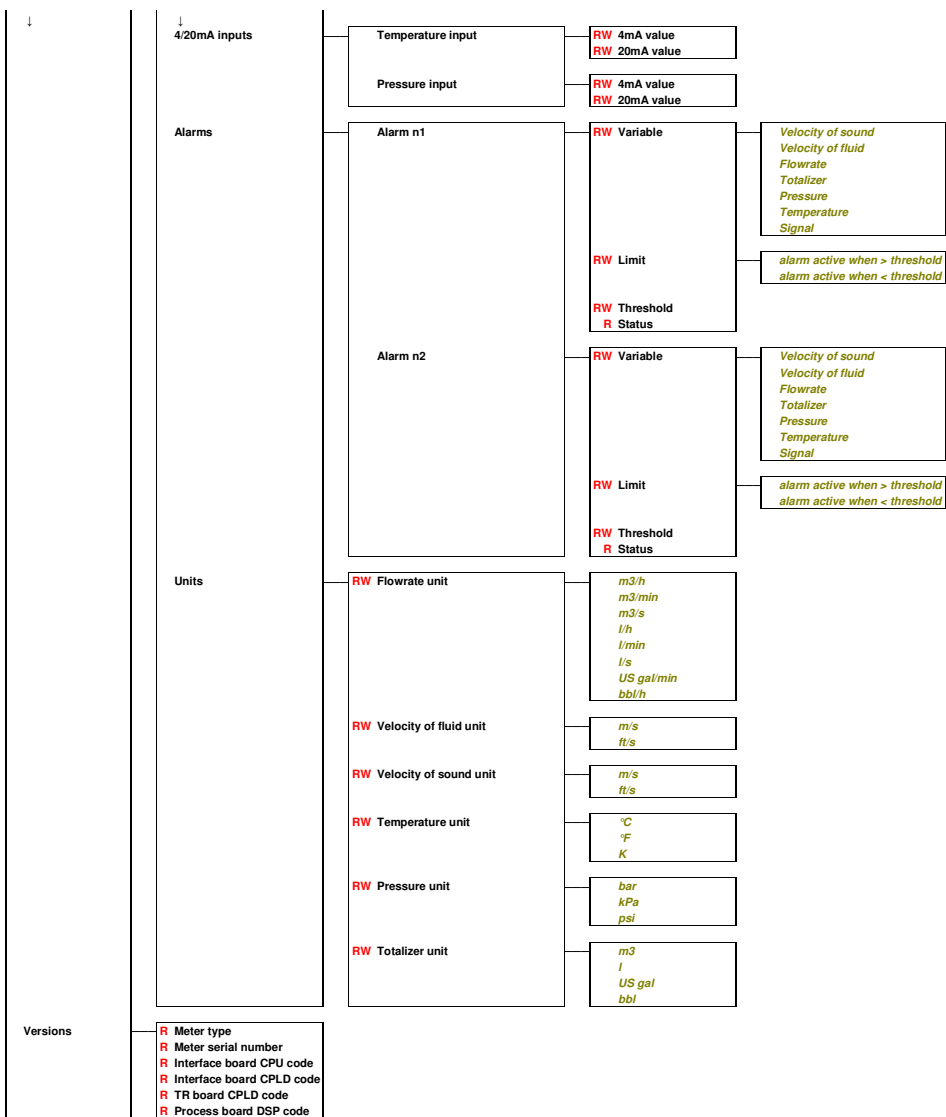
Appendix III

FH8X00 HART Menu Tree





Appendix III





FAURE HERMAN

Mastering the Flow

www.faureherman.com

Appendix IV

Operating restrictions – Special recommendations

The equipment nominal operating field is specified on its nameplate. This field is mainly defined in terms of:

- Minimum/Maximum – Flowrate
- Maximum – Pressure
- Minimum/Maximum – Temperature

The flowrate restrictions specify the equipment optimal performance field (measurement accuracy and repeatability).

The pressure and temperature restrictions involve exclusively the equipment mechanical dimensions and define the authorized operating field.

Remark: When the operating temperature is higher than the indicated value the maximum authorized pressure shall be reduced, in strict application of the NF EN 1759-1 Standard.

Gasket

The equipment shall be assembled with gaskets according to NF EN 1514 and NF EN 12560 standards and depending on flange type.

Spiral wound gaskets are forbidden for flanges rating below class 300 or PN 63.

Flange bolting

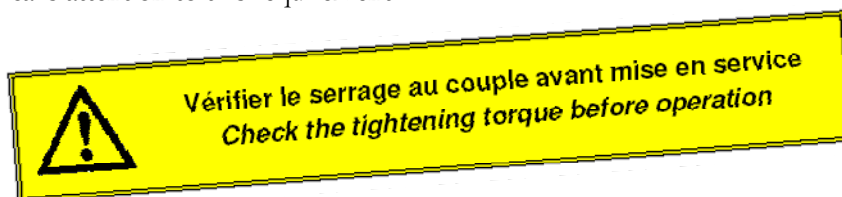
The material of flange bolting shall be chosen in ASTM A 193 B7 (rods) and ASTM A 194 2H (nuts) according to EN ISO 898-1 standard for temperature between -45°C and +480°C.

Tightening torque

Recommended tightening torque for Klingersil gasket type

Bolt size	Nm	Bolt size	Nm
M14	110	M30	1130
M16	170	M33	1520
M20	330	M36	1960
M24	570	M39	2525
M27	828	M42	3135

The link of a flowmeter equipped with a flow straightener is tightened at the factory but must be checked and retightened before commissioning. A label affixed to the flanges of this link calls attention to this requirement.



Appendix IV

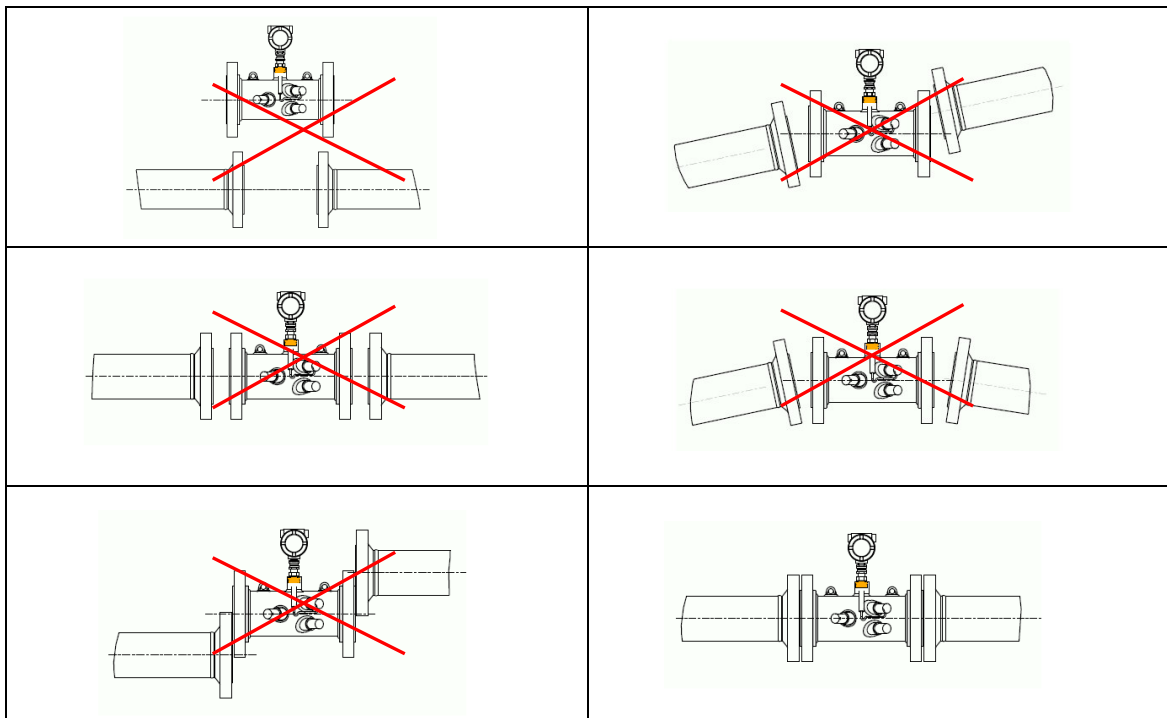
Equipment installation

Before installation, keep the equipment in its original packing, sheltered from bad weather and possible impacts.

The equipment mechanical installation on the measurement line shall not generate excessive stresses. Especially, the alignment of upstream and downstream flanges shall allow to avoid the transmission of stresses on the equipment body.

The equipment shall be installed by means of the suitable tools.

- ❑ Never use a hammer or impact wrench.
- ❑ No equipment element is designed to contribute to the tightening of connecting rods.
- ❑ Specific tools shall be used, when necessary, for the spacing between upstream and downstream flanges.



Lifting or pre-positioning means used, when necessary, shall be kept in place until installation achievement (tightening of all connecting rods).

Check the fitting of new gaskets, adapted to the application (material) and flange size.

Equipment disassembly

By definition, the equipment is designed to operate under fluid pressure. Allowing for the potential danger these fluids represent, the equipment shall be imperatively and completely drained, before disassembling the equipment (complete disassembly or removal of a component under pressure).



Should this draining need partial de-tightening of the equipment connecting rods, check the line is perfectly de-pressurized before de-tightening and implementation of the liquid recovery tank.

Flange gaskets shall not be re-used.

Important

The equipment is a measuring instrument and shall be used as such.

The equipment body of the associated components (flowstraightener, bosses ...) are designed to support stresses in reasonably foreseeable operating conditions. They are not designed to be used as supports, equipment carry means or step.

Appendix IV

Any modification brought to the equipment, susceptible to affect the pressure resistance, after delivery, is **STRICTLY PROHIBITED**.

For any replacement of Electronic Board, the used Electronic Board is subjected to restrictive disposal according to the WEEE Directive.

The disposal of the used Electronic Board should be either sent back to Faure Herman who will take care of its disposal, or dispose by the customer according to the EPA rules of its country.



FAURE HERMAN
Mastering the Flow
www.faureherman.com

Detailed contents

General contents	5
ATEX recommendations	7
ATEX recommendations for FH8400 transducer	10
ATEX recommendations for FH8400 electronic enclosure	12
Chapter 1: General overview	15
Measuring principle	16
Sizes and Flowrates	18
Standard K-factors	19
Constitutive parts of the FH8400	20
FH8400 inputs-outputs	21
Data logger and Event logger	21
Maximum line pressure	22
Pressure drop	22
Power supply	22
Protection for hazardous area	22
Other characteristics	23
Chapter 2: Commissioning procedure	25
FH8400 handling	25
Reception and storage	25

Choice of the FH8400 location on the pipe	25
Installing the FH8400	26
In case of remote electronics option	26
Cabling the FH8400	29
Connecting the FH8400 pulse output to a flow computer	31
Connecting the FH8400 RS485 interface to a MODBUS device	32
Connecting the FH8400 analog 4-20 mA output	33
Connecting the FH8400 pulse output to a flow computer and the RS485 interface to a MODBUS Device	34
Earthing of the meter to the pipe	35
Setting the FH8400's parameters	35
Commissioning of the plant	35

Chapter 3: Using the FH8400 remote control device 37

Remote control device keypad	37
Information displayed in measure mode	37
General parameter setting procedure	38
Principle of menus and sub-menus numbering	39
Menus and sub-menus structure	39
Selection of units	40
Setting the analog outputs	42
Setting the temperature input	43
Setting the pressure input	43
Setting the alarms	43

Detailed contents

Setting the serial link	44
Setting the data logger and resetting both loggers	45
Setting FH8400 date and time	45
Setting the backlight	46
Resetting the totalizer	46
Display of the temperature corrected inside diameter	46
Display of the serial number	46
Time constant of the floating average filter	46
Factory set parameters	46
Setting the K-factor	47
Zeroing	47
Chapter 4: Spare parts and Maintenance	49
Spare parts	49
Removing and replacing the transducers or gasket	50
Installing a new gasket	57
Installing a transducer	58
Performing a zeroing procedure	61
Chapter 5 : Modbus transmission tables	63
Avalaible tables	63
Main characteritics of the transmission	65
Transmission formats	65
Framework for the reading of "n" Modbus words ($1 \leq n \leq 125$)	66

Framework for the writing of "n" Modbus words ($1 \leq n \leq 123$)	67
Structure of the table n°1	68
Structure of the table n° 2	72
Structure of the table n° 3	75
Structure of the table n° 4	76
Structure of the table n° 5	78
Structure of the table n° 6	82
Structure of the table extended calibration coefficients type 2	83
Structure of the table n° 7	84
Structure of a Data logger record	85
Structure of the table n° 8	87
Structure of an Event logger record	88
Appendix I	89
Dimensions, weight, maximal flow rate vs meter size	89
Appendix II	91
FH8X00 HART Commands list	91
Appendix III	93
FH8X00 HART Menu Tree	93
Appendix IV	97
Operating restrictions – Special recommendations	97
Gasket	98

Detailed contents

Flange bolting	98
Tightening torque	98
Recommended tightening torque for Klingersil gasket type	98
Equipment installation	99
Equipment disassembly	100
Detailed contents	103
Personal notes	109



FAURE HERMAN

Mastering the Flow

www.faureherman.com

Personal notes
