Application Note 21
Version 001
08 Oct 2015

EtherMeter® Firmware For The Kamstrup Flow IQ Ultrasonic Water Meter With Extended AMR Alarm Flags

This document describes the unique features inherent in the 'KAMSTRUP'-compatible firmware version of the EtherMeter. This new firmware was developed specifically for use with Kamstrup's new Flow IQ Series Ultrasonic Water Meters.

The Flow IQ, which is available in residential and commercial sizes ranging from 5/8" to 3", is capable of transmitting Extended Alarm Flags in its AMR consumption message. In order to accommodate the meter's advanced alarming features, this unique EtherMeter firmware was built with the ability to parse the extended alarm flags and transmit them to network clients using MODBUS®, DF1, and EtherNet/IP™ industrial protocols.

KAMSTRUP FLOW IQ
ULTRASONIC WATER METERS

Communication Protocols:

1. The 'KAMSTRUP'-version firmware offers the following industrial protocols:

    - MODBUS/TCP (Ethernet)
    - MODBUS/UDP (Ethernet)
    - MODBUS/RTU (RS-232)
    - MODBUS/RTU (RS-485)
    - MODBUS/ASCII (RS-232)
    - MODBUS/ASCII (RS-485)
    - EtherNet/IP (Ethernet)
    - DF1 Full Duplex (RS-232)
    - DF1 Full Duplex (RS-485)
    - DF1 RadioModem (RS-232)
    - DF1 RadioModem (RS-485)

Customized Factory Defaults:

1. The KAMSTRUP-version firmware is preset to calculate the flow rate using the 'Fixed-Delta-Time' method: FCALC1=DTIME, FCALC2=DTIME. The Meter Sampling Periods are preset to 300 seconds: SAMP1=300, SAMP2=300. PWR1 and PWR2 are both preset to 500 milliseconds. CLKLOW1 and CLKLOW2 are both preset to 2. The registrations units are both set to Gallons (UNIT1=GAL, UNIT2=GAL), and the Totalizer Exponents are both set for 1/100th Gallon Registration (EXP1= –2, EXP2= –2). It is important to note that all presets may be field-modified using the HyperTerminal Setup Procedures. For detailed explanations of setup parameters, please refer to the EtherMeter User Manual.

MODBUS Memory Map:

1. The KAMSTRUP-version firmware has a modified MODBUS memory map to accommodate the additional Alarm Flags:

Modbus Function 03 (Read Registers)

Registers	Descriptors
40001,40002*	METER 1 TOTAL (UNSCALED)
40003,40004*	METER 2 TOTAL (UNSCALED)
40005,40006**	FLOW 1 X 1000
40007,40008**	FLOW 2 X 1000
40009	ROLLOVERS – METER 1
40010	ROLLOVERS – METER 2
40011	AIN 1 (0-10000)
40012	AIN 2 (0-10000)
40013	SUPPLY VOLTS X 10
40014	DIGITAL STATUS BITS (For Details – See Figure 1)
40015	KAMSTRUP WORD – METER 1 (For Details – See Figure 2)
40016	KAMSTRUP WORD – METER 2 (For Details – See Figure 2)
40017	METER 1 READ FAULT
40018	METER 2 READ FAULT
40019,40020*	SYSTEM UPTIME (MINUTES)
40021	METER 1 nDIGITS
40022	METER 2 nDIGITS
40023	METER 1 EXPONENT
40024	METER 2 EXPONENT
40025	METER 1 UNITS
40026	METER 2 UNITS
40027	METER 1 READ FAULT COUNTER
40028	METER 2 READ FAULT COUNTER

*DATA OCCUPYING THESE REGISTERS ARE 32-BIT UNSIGNED LONG INTEGERS.
**DATA OCCUPYING THESE REGISTERS ARE 32-BIT SIGNED LONG INTEGERS.
ALL OTHERS ARE 16-BIT SIGNED INTEGERS.

DF1 and ETHERNET/IP Memory Map:

1. The KAMSTRUP-version firmware has a modified DF1, EtherNet/IP memory map to accommodate the additional Alarm Flags:

PROTECTED TYPED LOGICAL READ/WRITE WITH 3 ADDRESS FIELDS

[CMD,FNC,FILE#,FILETYPE] = [0F,A2,07,89] (READ N7 REGISTERS)

Registers	Descriptors
N7:0-1*	METER 1 TOTAL (UNSCALED)
N7:2-3*	METER 2 TOTAL (UNSCALED)
N7:4-5**	FLOW 1 X 1000
N7:6-7**	FLOW 2 X 1000
N7:8	ROLLOVERS – METER 1
N7:9	ROLLOVERS – METER 2
N7:10	AIN 1 (0-10000)
N7:11	AIN 2 (0-10000)
N7:12	SUPPLY VOLTS X 10
N7:13	DIGITAL STATUS BITS (For Details – See Figure 1)
N7:14	KAMSTRUP WORD – METER 1 (For Details – See Figure 2 or 3)
N7:15	KAMSTRUP WORD – METER 2 (For Details – See Figure 2 or 3)
N7:16	METER 1 READ FAULT
N7:17	METER 2 READ FAULT
N7:18-19*	SYSTEM UPTIME (MINUTES)
N7:20	METER 1 nDIGITS
N7:21	METER 2 nDIGITS
N7:22	METER 1 EXPONENT
N7:23	METER 2 EXPONENT
N7:24	METER 1 UNITS
N7:25	METER 2 UNITS
N7:26	METER 1 READ FAULT COUNTER
N7:27	METER 2 READ FAULT COUNTER

*DATA OCCUPYING THESE REGISTERS ARE 32-BIT UNSIGNED LONG INTEGERS.
**DATA OCCUPYING THESE REGISTERS ARE 32-BIT SIGNED LONG INTEGERS.
ALL OTHERS ARE 16-BIT SIGNED INTEGERS.

Bit Position	Contents
00 (Least Significant Bit)	Aux Digital I/O 1 Status (1=ON, 0=OFF)
01	Aux Digital I/O 2 Status (1=ON, 0=OFF)
02	Aux Digital I/O 3 Status (1=ON, 0=OFF)
03	-reserved/future-
04	-reserved/future-
05	-reserved/future-
06	-reserved/future-
07	-reserved/future-
08	Meter 1 Read Fault (1=Fault, 0=OK)
09	Meter 2 Read Fault (1=Fault, 0=OK)
10	Meter 1 Fwd Flow (1=Fwd Flow)
11	Meter 2 Fwd Flow (1=Fwd Flow)
12	Meter 1 Rev Flow (1=Rev Flow)
13	Meter 2 Rev Flow (1=Rev Flow)
14	-reserved/future-
15 (Most Significant Bit)	-reserved/future-

FIGURE 1. DIGITAL STATUS BIT MAP

Kamstrup Alarm Implementation:

The Alarm Fields for the Kamstrup Meter are embedded within the AMR message string. The Alarm Fields May be transmitted after the Meter Reading or after the Meter ID. There are three (3) possible implementations that are auto-detected and supported by the EtherMeter:

1. Kamstrup Alarm Implementation #1
   7-Bit Binary (Non-ASCII) Encoding – 2 Bytes
   Example: **`V;RBnnnnnnnnn;IBnnnnnnnnnn;Ann<CR>`**
   … Where the 2-Digit Alarm Code (nn) is Non-ASCII, 7-Bit Binary

2. Kamstrup Alarm Implementation #2
   Hexadecimal ASCII Encoding – 4 Bytes
   Example: **`V;RBnnnnnnnnn;IBnnnnnnnnnn;Annnn<CR>`**
   … Where the 4-Digit Alarm Code (nnnn) is Hexadecimal-ASCII.
   For example, AB9F

3. Kamstrup Alarm Implementation #3
   Decimal ASCII Encoding – 5 Bytes
   Example: **`V;RBnnnnnnnnn;IBnnnnnnnnnn;Annnnn<CR>`**
   … Where the 5-Digit Alarm Code (nnnn) is Decimal-ASCII.
   For example, 61234

Bit Position	Type	Description
00 (LSB)	RE1	Reverse – Active
01	RE2	Reverse – Historic (last 30 days)
02	DR1	Dry – Active
03	DR2	Dry – Historic (last 30 days)
04	BR1	Burst – Active
05	BR2	Burst – Historic (last 30 days)
06	EOC	Encoder Setup Changed One Or More Times Since Production
07	–	– Unused –
08	LK1	Leak – Active
09	LK2	Leak – Historic (last 30 days)
10	TF1	Triggers For The Minimum Detected Meter Temp Since Midnight: TF2/TF1: 0/0 – The temp has been >= 10C (50°F) 0/1 – The temp has been between 6-9C (42°-49°F) 1/0 – The temp has been between 3-5C (37°-41°F) 1/1 – The temp has been <= 2C (36°F)
11	TF2	
12	TO1	Triggers for the Maximum Detected Meter Temp Since Midnight: TO2/TO1: 0/0 – The temp has been <= 35C (95°F) 0/1 – The temp has been between 36-45C (96°-113°F) 1/0 – The temp has been between 46-52C (114°-125°F) 1/1 – The temp has been >= 53C (126°F)
13	TO2	
14	NU	No Usage Detected on V1 for Last 35 Days
15 (MSB)	–	– Unused –

FIGURE 2. KAMSTRUP WORD BIT MAP
(For Kamstrup Alarm Implementation #1)

Bit Position	Type	Description
00 (LSB)	RE1	Reverse – Active
01	RE2	Reverse – Historic (last 30 days)
02	DR1	Dry – Active
03	DR2	Dry – Historic (last 30 days)
04	BR1	Burst – Active
05	BR2	Burst – Historic (last 30 days)
06	EOC	Encoder Setup Changed One Or More Times Since Production
07	LK1	Leak – Active
08	LK2	Leak – Historic (last 30 days)
09	TF1	Triggers For The Minimum Detected Meter Temp Since Midnight: TF2/TF1: 0/0 – The temp has been >= 10C (50ºF) 0/1 – The temp has been between 6-9C (42º-49ºF) 1/0 – The temp has been between 3-5C (37º-41ºF) 1/1 – The temp has been <= 2C (36ºF)
10	TF2	
11	TO1	Triggers for the Maximum Detected Meter Temp Since Midnight: TO2/TO1: 0/0 – The temp has been <= 35C (95ºF) 0/1 – The temp has been between 36-45C (96º-113ºF) 1/0 – The temp has been between 46-52C (114º-125ºF) 1/1 – The temp has been >= 53C (126ºF)
12	TO2	
13	NU	No Usage Detected on V1 for Last 35 Days
14	TAM	Tamper Detect
15 (MSB)	–	– Unused –

FIGURE 3. KAMSTRUP WORD BIT MAP
(For Kamstrup Alarm Implementations #2 and #3)

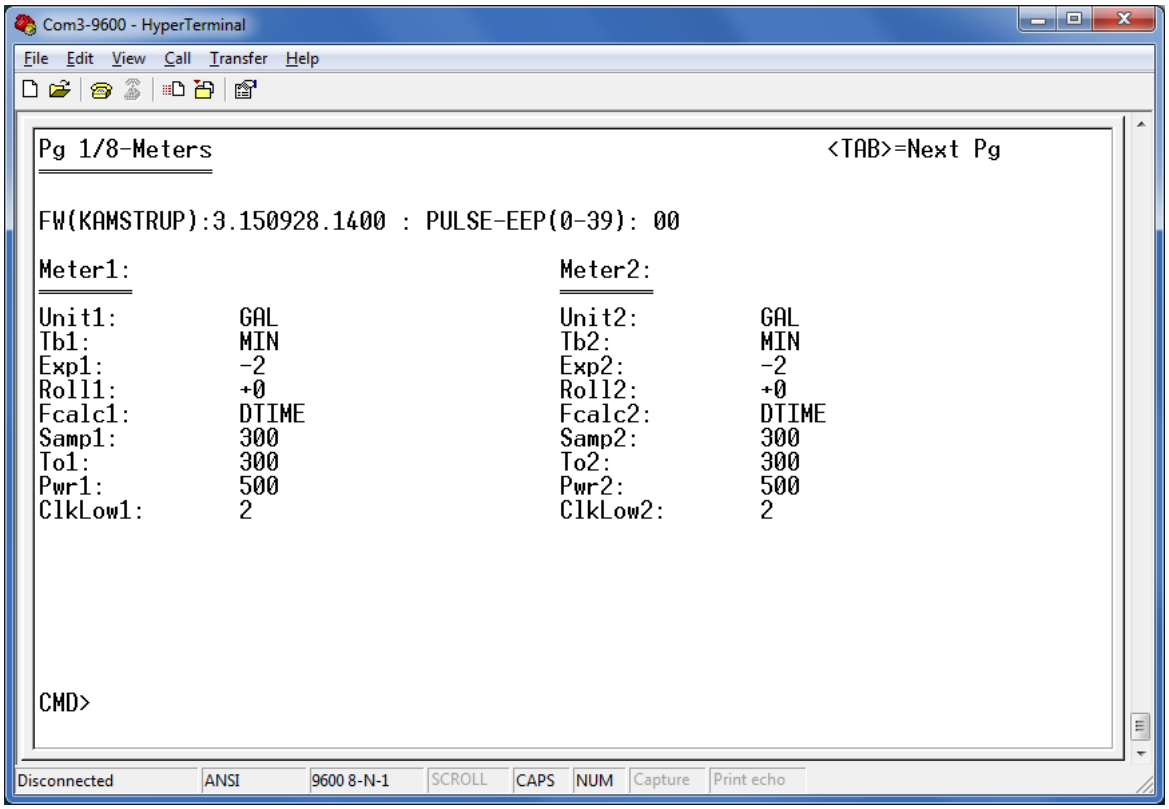

Figure 4. EtherMeter Setup Screen Snapshot – Page 1 of 8.
Note That The 'KAMSTRUP' Firmware Version Is Shown On This Page.

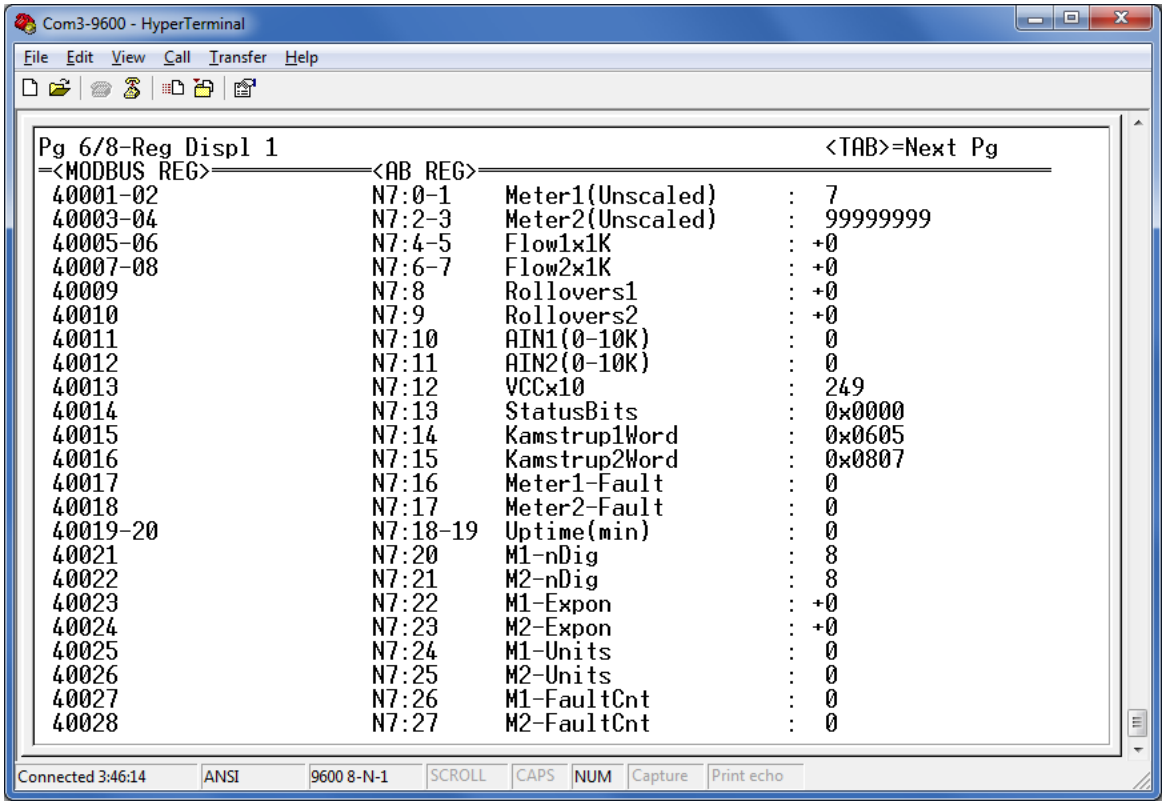

Figure 5. EtherMeter Setup Screen Snapshot – Page 6 of 8.
Note The Presence Of Kamstrup1Word (Kamstrup Flags – Meter 1)
and Kamstrup2Word (Kamstrup Flags – Meter 2).

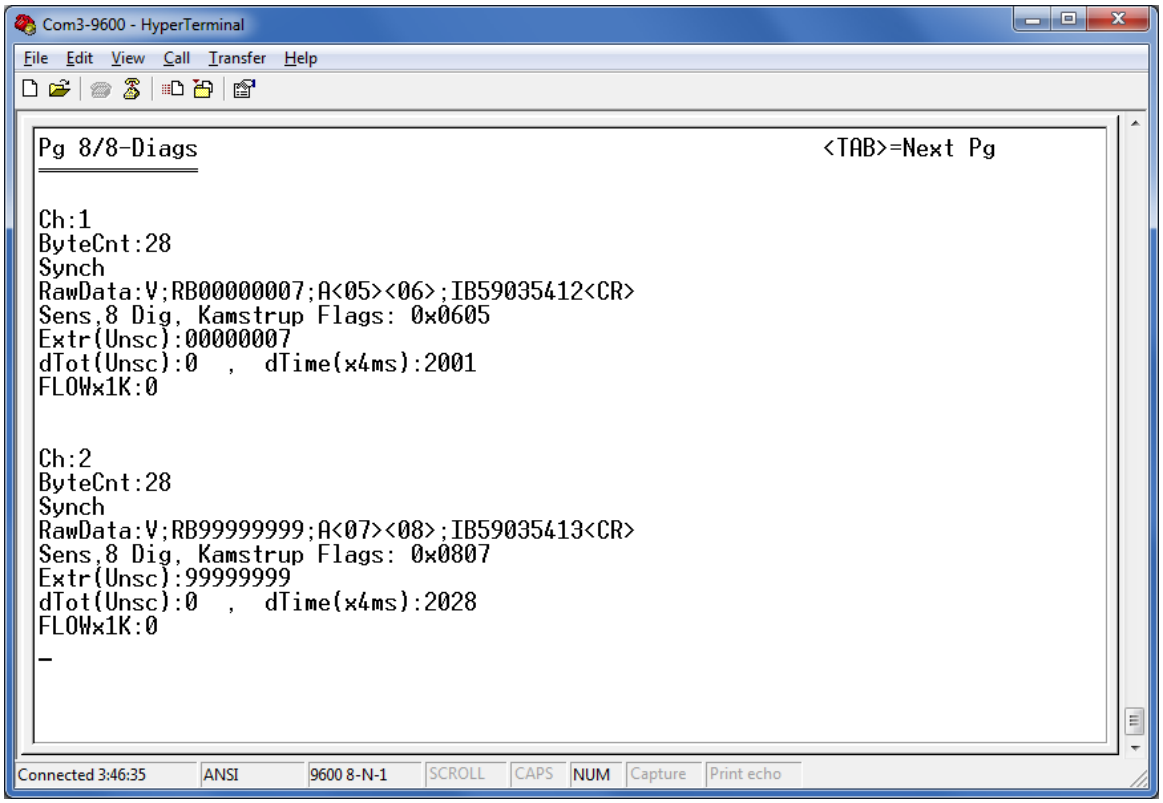

Figure 6. EtherMeter Setup Screen Snapshot – Page 8 of 8

In The Above Example, Implementation #1 Is Illustrated.

The Alarm Codes of Meter #1 Are Transmitted As <05> and <06> (Binary).
The Alarm Codes of Meter #2 Are Transmitted As <07> and <08> (Binary).

The First Alarm Code: Info-code Dry, Reverse, Burst, SetupChanged.
The Second Alarm Code: Info-code Leak, Temperature Triggers, NoUsage

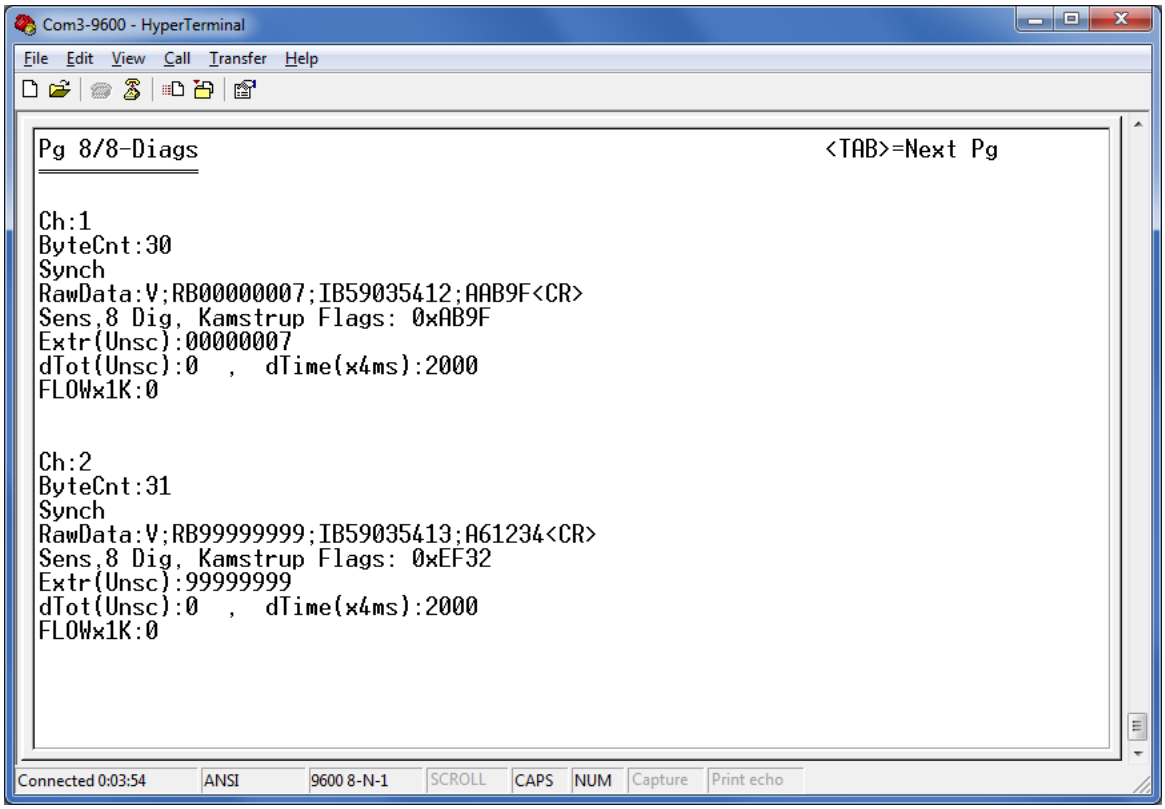

Figure 7. EtherMeter Setup Screen Snapshot – Page 8 of 8
In The Above Example, Implementation #2 Is Illustrated on Channel 1 (ASCII Hex);
and Implementation #3 Is Illustrated on Channel 2 (ASCII Decimal).

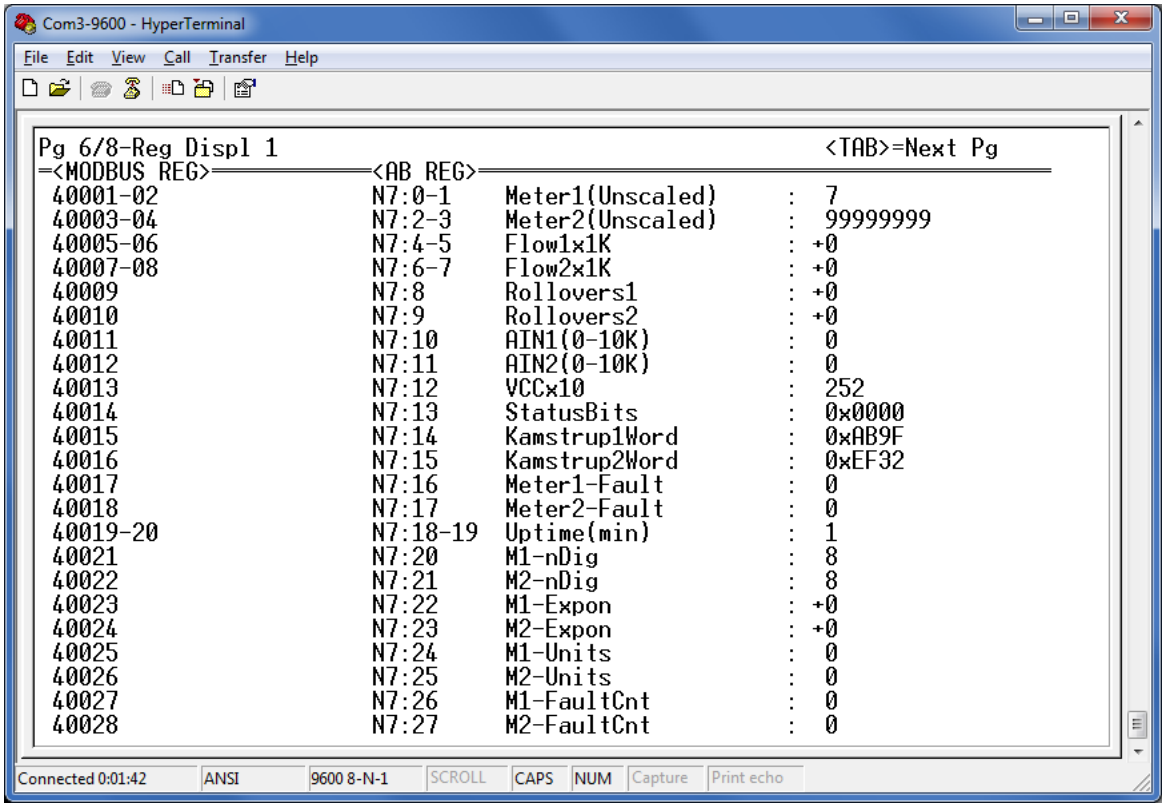

Figure 8. EtherMeter Setup Screen Snapshot – Page 6 of 8.
Note The Presence Of Kamstrup1Word (Kamstrup Flags – Meter 1)
and Kamstrup2Word (Kamstrup Flags – Meter 2).