Time/date stamps are considered an integral part of a single data record and are included when accessing data records that have associated with them such information. They have the form (YY-MM-DD) or (YY-MM-DD hh:mm). In this case, the time and date stamp will be included as a new data set within the same data line as follows:

STX 0401 (0000.00*kW)(93-12-31 12:53) ETX BCC

When writing data, only available in the Register, Variable, and Parameter categories, the form of the data shall be compatible with the data set structure. When information is not explicitly sent by the programming device, the receiving unit may assume certain items, like units or decimal points or leading zeros. Writing the value 0 to a particular data record is the same as erasing or resetting the record. The preferred method in this case is to send a write command with an empty data field () which is defined as resetting the addressed information. Because programming historical data is not considered a desired feature, write commands used in the Season, Group or Load profile data categories are defined as erase commands.

C.4 Coding capabilities

The coding scheme allows up to eight CHANNELS of data (each can have a different channel type), 64 REGISTERS per channel, each with four DATA TYPES and 16 TARIFFS per type. See clause C.2 for expansion capabilities. Throughout the rest of this annex, words in CAPITALS will have specific meanings as defined in the various subclauses.

The eight major data categories are shown below with the associated code areas. Within each data category, further division is used when possible to create a smart code and to make the creation of new codes possible.

Code	Data category
0xxx	Register
:	
7xxx	
8xxx	Season
9xxx	Load profile
Axxx	Group
Bxxx	Extended function
Cxxx	Variable
Dxxx	Parameter
Exxx	RESERVED
Fxxx	Manufacturer-specific

C.4.1 Register data category

C.4.1.1 Register coding

The REGISTER data category provides read and write access to all measurement data records excluding seasonal (memory or stored value) and load profile data.

Code (binary)

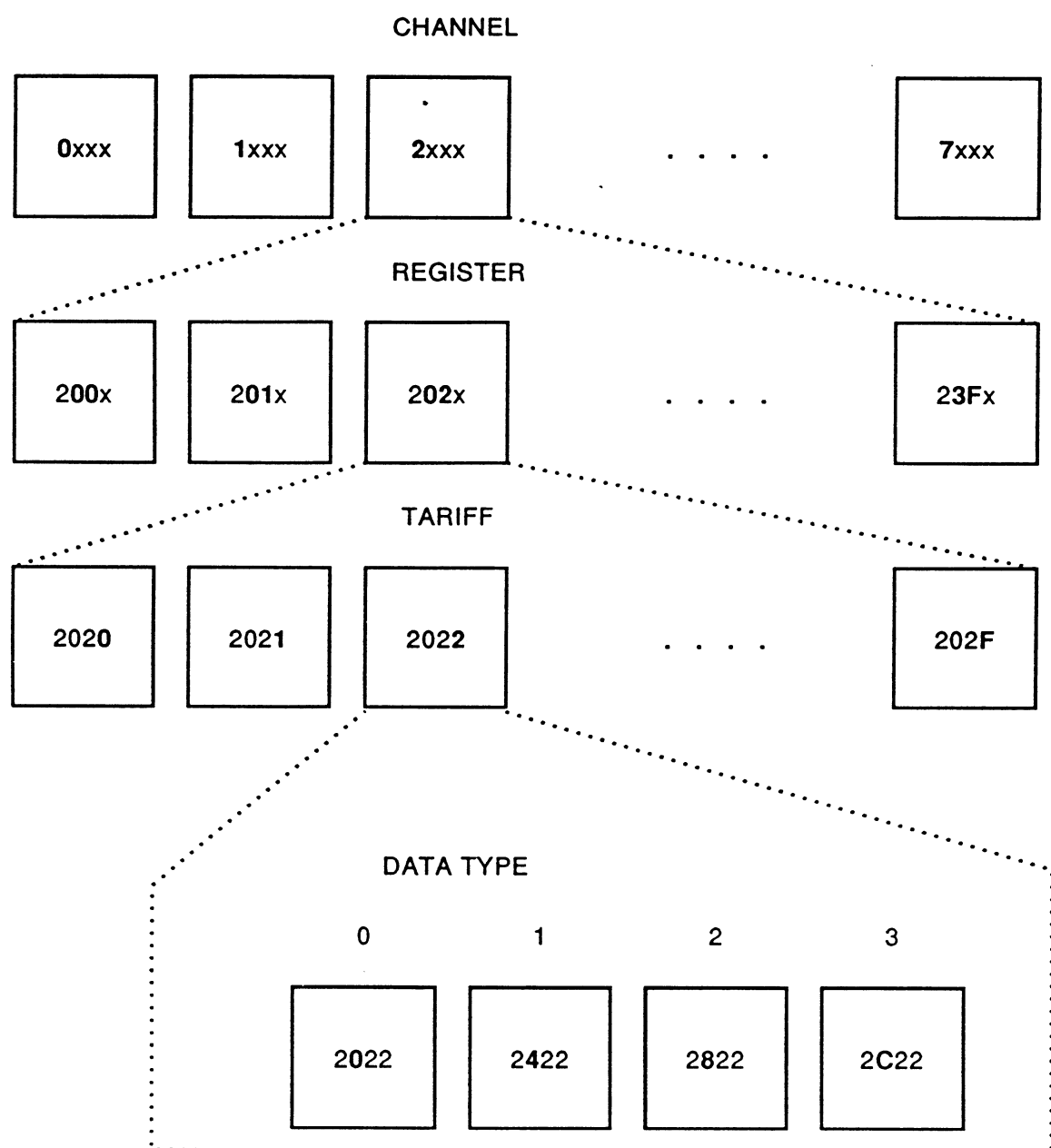| 0ccc	xxxx	xxxx	xxxx	ccc = CHANNEL (000 = channel 0)
0xxx	ddxx	xxxx	xxxx	dd = DATA TYPE
				00 = 0
				01 = 1
				10 = 2
				11 = 3
0xxx	xx r r	r r r r	xxxx	r r r r r r = REGISTER
				00 0000 = Register 0
				00 0001 = Register 1
				00 0010 = Register 2
				00 0011 = Register 3
				00 0100 = Register 4
				00 0101 = Register 5
				00 0110 = Register 6
				00 0111 = Register 7
				00 1000 = Register 8
				:
				11 1111 = Register 63
0xxx	xxxx	xxxx	t t t t	t t t t = TARIFF

There are 64 REGISTERS reserved for each CHANNEL. Using the DATA TYPE field, each REGISTER can be interpreted in up to four different ways. The validity of a particular DATA TYPE depends on the information being measured. Note that the DATA TYPE does not appear in the command mnemonic when it is 0. When reading from the REGISTER category, the predefined code that was transmitted to the metering unit is returned from the metering unit as the ID field of the returned data set. This is most important when groups of registers are read in the group category in order to distinguish between the individual registers. When writing registers, an ACK is returned only if the message has been accepted and processed successfully, otherwise an error message will be returned.

CHANNEL

0xxx	1xxx	2xxx	. . . .	7xxx

REGISTER

200x	201x	202x	. . . .	23Fx

TARIFF

2020	2021	2022	. . . .	202F

DATA TYPE

0	1	2	3
2022	2422	2822	2C22

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Figure C.2 – Register coding diagram

C.4.1.2   Register examples

Code	Mnemonic	Data	Function and data form
0000	c0_r0_t0	-	Channel 0 Type 0 Register 0 Tariff 0
0001	c0_r0_t1	-	Channel 0 Type 0 Register 0 Tariff 1
0002	c0_r0_t2	-	Channel 0 Type 0 Register 0 Tariff 2
0003	c0_r0_t3	-	Channel 0 Type 0 Register 0 Tariff 3
0004	c0_r0_t4	-	Channel 0 Type 0 Register 0 Tariff 4
0021	c0_r2_t1	-	Channel 0 Type 0 Register 2 Tariff 1
0022	c0_r2_t2	-	Channel 0 Type 0 Register 2 Tariff 2
0023	c0_r2_t3	-	Channel 0 Type 0 Register 2 Tariff 3

0024	c0_r2_t4	-	Channel 0 Type 0 Register 2 Tariff 4
0010	c0_r1_t0	-	Channel 0 Type 0 Register 1 Tariff 0
0410	c0_t1_r1_t0	-	Channel 0 Type 1 Register 1 Tariff 0
0810	c0_t2_r1_t0	-	Channel 0 Type 2 Register 1 Tariff 0
0012	c0_r1_t2	-	Channel 0 Type 0 Register 1 Tariff 2
0013	c0_r1_t3	-	Channel 0 Type 0 Register 1 Tariff 3
0014	c0_r1_t4	-	Channel 0 Type 0 Register 1 Tariff 4
0080	c0_r8_t0	-	Channel 0 Type 0 Register 8 Tariff 0
0081	c0_r8_t1	-	Channel 0 Type 0 Register 8 Tariff 1
0082	c0_r8_t2	-	Channel 0 Type 0 Register 8 Tariff 2
0083	c0_r8_t3	-	Channel 0 Type 0 Register 8 Tariff 3
0084	c0_r8_t4	-	Channel 0 Type 0 Register 8 Tariff 4
1xxx	-	-	Channel 1
2xxx	-	-	Channel 2
3xxx	-	-	Channel 3
4xxx	-	-	Channel 4
5xxx	-	-	Channel 5
6xxx	-	-	Channel 6
7xxx	-	-	Channel 7

C.4.2   Season data category

C.4.2.1   Season coding

The Season data category allows read access to the seasonal data (memory or stored value) using the R2 command, and erase access using the W2 command. The same fields are used as in the Register data category, but they are shifted one hex digit to the right, causing the tariff number to be defined in the data field. Additionally, the data field is used to specify which season location(s) is(are) to be addressed and the access type. The youngest, or most recently stored, season location is assigned a season number of 0. Using this coding scheme, every season location is individually addressable, or groups of registers may be accessed. In the Season data category, the ID field returned from the metering unit consists of the code and data field that was used in the read command. This results in an eight digit ID field. In order to conserve time and storage in a reading device, the code portion of the ID field does not need to be repeated if it has not changed since the last time it was sent. This means that when reading single seasonal records, the returned ID will always contain eight digits but when reading multiple seasonal records, only the first season record within a block of records shall contain the code field as long as the code applies to all other records within the block.

Refer to the examples in C.4.2.2. When writing (erasing) registers, an ACK will be returned only if the message has been accepted and processed successfully, otherwise an error message will be returned. The following code and data descriptions define this scheme.

Code (binary)

1000	xccc	xxxx	xxxx	ccc = CHANNEL
1000	xxxx	ddxx	xxxx	dd = DATA TYPE
				00 = 0
				01 = 1
				10 = 2
				11 = 3

```
1000   xxxx   xxr r   r r r r   r r r r r r = REGISTER
                                 00 0000 = Register 0
                                 00 0001 = Register 1
                                 00 0010 = Register 2
                                        :
                                 11 1111 = Register 63
```

Data field (binary)

```
t t t t   xxxx   xxxx   xxxx   t t t t = TARIFF
xxxx   ssss   ssss   xxxx   ssss ssss = SEASON number
                              00h - FFh
xxxx   xxxx   xxxx   aaaa   aaaa = ACCESS
                            0000 = Single Record
                            0001 = All Seasons
                            0010 = All Tariffs (and all Seasons)
                            0011 = All Registers (Tariffs & Seasons)
                            0100 = All Types (Register, Tariffs, Seasons)
                            0101 = All Channels (Types, Reg., Tar., Seasons)
                            0110 = RESERVED
                                 :
                            1111 = RESERVED
```

The ACCESS codes have the following definitions:

- single record – only the specified SEASON will be accessed;
- all SEASONS – all SEASONS under the specified record will be accessed regardless of the SEASON number used in the command;
- all TARIFFS – all TARIFFS and all SEASONS of the specified CHANNEL, REGISTER and DATA TYPE will be accessed;
- all REGISTERS – all season locations of the specified CHANNEL and DATA TYPE will be accessed;
- all DATA TYPES – all season locations of the specified CHANNEL will be accessed;
- all CHANNELS – all season locations will be accessed.

C.4.2.2   Season read examples (R2)

Code	Mnemonic	Data	Function and data form
8000	c0_r0_t1_m00	1000	Channel 0 Type 0 Register 0 Tariff 1 Season 0
	Returned ID:	*80001000*	*(Channel 0 Type 0 Reg. 0 Tariff 1 Season 0)*
8000	c0_r0_t1_m01	1010	Channel 0 Type 0 Register 0 Tariff 1 Season 1
	Returned ID:	*80001010*	*(Channel 0 Type 0 Reg. 0 Tariff 1 Season 1)*
8040	c0_t1_r0_t1_m01	1010	Channel 0 Type 1 Register 0 Tar. 1 Season 1
	Returned ID:	*80401010*	*(Channel 0 Type 1 Register 0 Tar. 1 Season 1)*
8080	c0_t2_r0_t1_m01	1010	Channel 0 Type 2 Register 0 Tar. 1 Season 1
	Returned ID:	*80801010*	*(Channel 0 Type 2 Register 0 Tar. 1 Season 1)*
8000	c0_r0_t1_mff	1FF0	Channel 0 Type 0 Reg. 0 Tar. 1 Season 255
	Returned ID:	*80001FF0*	*(Channel 0 Type 0 Reg. 0 Tar. 1 Seas. 255)*

8002	c0_r2_t1_m*	1001	Channel 0 Type 0 Reg. 2 Tar. 1 All Seasons
	Returned IDs	*80021001*	*(Channel 0 Type 0 Reg. 2 Tariff 1 Season 0)*
	if present:	1011	(Channel 0 Type 0 Reg. 2 Tariff 1 Season 1)
		1021	(Channel 0 Type 0 Reg. 2 Tariff 1 Season 2)
		1031	(Channel 0 Type 0 Reg. 2 Tariff 1 Season 3)
		1041	(Channel 0 Type 0 Reg. 2 Tariff 1 Season 4)
		:	
		1FF1	(Channel 0 Type 0 Reg. 2 Tar. 1 Seas. 255)

Note that only the first record contains the code field from the read command.

8000	c0_r*	1003	Channel 0 All Registers
	Returned IDs	*80000003*	*(Channel 0 Type 0 Reg. 0 Tariff 0 Season 0)*
	if present:	*0013*	*(Channel 0 Type 0 Reg. 0 Tariff 0 Season 1)*
	:		
	0FF3		*(Channel 0 Type 0 Reg. 0 Tar. 0 Seas. 255)*
	1003		*(Channel 0 Type 0 Reg. 0 Tariff 1 Season 0)*
	:		
	1FF3		*(Channel 0 Type 0 Reg. 0 Tar. 1 Seas. 255)*
	: :		
	F003		*(Channel 0 Type 0 Reg. 0 Tar. 15 Seas. 0)*
	:		
	FFF3		*(Channel 0 Type 0 Reg. 0 Tar. 15 Seas. 255)*
	80010003		*(Channel 0 Type 0 Reg. 1 Tariff 0 Season 0)*
	0013		*(Channel 0 Type 0 Reg. 1 Tariff 0 Season 1)*
	:		
	0FF3		*(Channel 0 Type 0 Reg. 1 Tar. 0 Seas. 255)*
	80011003		*(Channel 0 Type 0 Reg. 1 Tariff 1 Season 0)*
	1013		*(Channel 0 Type 0 Reg. 1 Tariff 1 Season 1)*
	:		
	1FF3		*(Ch. 0 Type 0 Register 1 Tariff 1 Season 255)*
	: :		
	F003		*(Ch. 0 Type 0 Register 1 Tariff 15 Season 0)*
	:		
	FFF3		*(Ch. 0 Type 0 Reg. 1 Tariff 15 Season 255)*
	80020003		*(Ch. 0 Type 0 Register 2 Tariff 0 Season 0)*
	: : :		
	80030003		*(Ch. 0 Type 0 Register 3 Tariff 0 Season 0)*
	: : :		
	803F0003		*(Ch. 0 Type 0 Register 63 Tariff 0 Season 0)*
	0013		(Ch. 0 Type 0 Register 63 Tariff 0 Season 1)
	:		
	0FF3		(Ch. 0 Type 0 Reg. 63 Tariff 0 Season 255)
	: :		
	F003		(Ch. 0 Type 0 Register 63 Tariff 15 Season 0)
	:		
	FFF3		(Ch. 0 Type 0 Register 63 Tar. 15 Season 255)

Note that, in this example, each unique code (8000, 8001, ... , 803F) appears only once and at the beginning of the block of associated records. It may also be repeated.

Code	Mnemonic	Data	Function and data form
8001	c0_r1_t2_m00	2000	Channel 0 Type 0 Register 1 Tariff 2 Season 0
8001	c0_r1_t3_m00	3000	Channel 0 Type 0 Register 1 Tariff 3 Season 0
8001	c0_r1_t4_m00	4000	Channel 0 Type 0 Register 1 Tariff 4 Season 0
81xx	-	-	Channel 1
82xx	-	-	Channel 2
83xx	-	-	Channel 3
84xx	-	-	Channel 4
85xx	-	-	Channel 5
86xx	-	-	Channel 6
87xx	-	-	Channel 7

C.4.2.3 Season erase examples (W2)

Code	Mnemonic	Data	Function and data form
8000	er_c0_r0_t1_m00	1000	Channel 0 Type 0 Register 0 Tar. 1 Season 0
8000	er_c0_r0_t1_m01	1010	Channel 0 Type 0 Register 0 Tar. 1 Season 1
8040	er_c0_t1_r0_t1_m01	1010	Channel 0 Type 1 Register 0 Tar. 1 Season 1
8000	er_c0_r0_t1_mff	1FF0	Channel 0 Type 0 Register 0 Tar. 1 Season 255
81xx	-	-	Channel 1
82xx	-	-	Channel 2
83xx	-	-	Channel 3
84xx	-	-	Channel 4
85xx	-	-	Channel 5
86xx	-	-	Channel 6
87xx	-	-	Channel 7
8000	er_c0_r0_t1_m*	1001	Ch. 0 Type 0 Register 0 Tariff 1 All Seasons
8000	er_c0_r0_t*	0002	Channel 0 Type 0 Register 2 All Tariffs
8000	er_c0_r*	0003	Channel 0 Type 0 All Registers
8000	er_c0_*	0004	Channel 0 All Data Types
8000	er_c*	0005	All Channels

C.4.3 Load profile data category

C.4.3.1 Load profile coding

The Load profile data category allows read access to the load profile records using the R2 command and erasure of records using the W2 command. This category reserves load profile capabilities for each of the 64 available REGISTERS. The code field is used to specify the CHANNEL and REGISTER number. The data field is used to specify the actual records requested. This is in the form of start and end dates. When addressing load profile data, a distinction is made between data records and status records. Generally, a status record is any record that does not have the same units as the register being accessed. This includes time/date records and status flag records. Using the LOAD PROFILE Access field, the user can distinguish between these records. In addition, the user can indicate that all REGISTERS be accessed regardless of the one defined in the command. The code field is defined below.

Code (binary)

| 1001 | xccc | xxxx | xxxx | ccc = CHANNEL |

| 1001 | xxxx | l lxx | xxxx | l l = LOAD PROFILE Access |

00 = Data + Status records for specified register only

01 = Data + Status records for all registers

10 = Data records for all registers

11 = Status records for all registers

| 1001 | xxxx | xxr r | r r r r | r r r r r r = REGISTER |

00 0000 = Register 0

00 0001 = Register 1

00 0010 = Register 2

00 0011 = Register 3

:

11 1111 = Register 63

When specifying dates to be addressed, the data field is formatted as follows:

(YYMMDDyymmdd)

where YYMMDD refers to the start date and yymmdd refers to the end date of the period to be read. When the two dates are the same, or only the start date is defined, a single day is selected. The end date must be later than the start date. A day is defined as all records stored within the period 00:00:01 to 24:00:00 of any given day. When no date is specified, the complete load profile array is addressed. This applies to reading and erasing. The load profile data is transmitted chronologically with the oldest record first and the most recent record last.

In order to ensure that the returned load profile records are uniquely identifiable and understandable, the tariff unit shall indicate to which REGISTER the data records refer. For example, a unit with load profile records available for REGISTER 0 and REGISTER 4, in response to a read command requesting all REGISTERS (i.e. 9040), the unit shall indicate which records in the returned data refer to REGISTER 0 and which to REGISTER 4. In addition, if records are read without timing information, or the provided information does not allow a chronological reconstruction of the load profile records, the unit shall include data messages which allow such chronological reconstruction. These data messages have the form (YY-MM-DD hh:mm).

These requirements also apply to reading load profile data with an execute command.

C.4.3.2   Load profile examples

Code	*Mnemonic*	*Data*	*Function and data form*
9000	c0_r0	911201911201	Channel 0 Register 0 Day 91-12-1
9000	c0_r0	911201911231	Ch. 0 Register 0 Day 91-12-1 to 91-12-31
9000	c0_r0	911202	Channel 0 Register 0 Day 91-12-2
91xx	-	-	Channel 1
92xx	-	-	Channel 2
93xx	-	-	Channel 3
94xx	-	-	Channel 4
95xx	-	-	Channel 5
96xx	-	-	Channel 6
97xx	-	-	Channel 7
9040	c0_r*	930101930131	Channel 0 All Reg. Day 93-01-01 to 93-01-31
Returned Registers		Channel 0 Register 0	
if present:		Channel 0 Register 1	
		Channel 0 Register 2	
		:	
		Channel 0 Register 63	

C.4.4   Group data category

C.4.4.1   Group coding

In contrast to the Register data category, the Group data category allows access to ranges of Register records instead of individual records. Reading, using R2, and erasing, using W2, of a group of records is supported. The user can specify wild cards to indicate which ranges of data records to operate on. The coding is as follows:

Code (binary)

```
1010   bbbb   xxxx   xxxx      bbbb = GROUP Access type
                                0000 = Register Wild card mask
                                0001 = RESERVED
                                 :
                                1111 = RESERVED
1010   0000   qqqq   xxxx      qqqq = WILD CARD Indicators
```

Group Commands are interpreted as follows. The requested records are specified using the data field. This field is simply the code field as defined in the Register category. That is, the data field always defines a single specific data record within the metering unit. The coding used has defined fields, for example CHANNEL. Each of these fields can be designated as fixed or wild. This is accomplished using the q parameters in the Group code. Beginning from left to right, each parameter is assigned a bit q in the WILD CARD field. These bits are assigned as follows:

1010 xxxx qqqq xxxx

— TARIFF
— REGISTER
— TYPE
— CHANNEL

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Figure C.3 – Bit assignment for group data

A one in the corresponding bit position indicates that a field takes on all possible values. A zero indicates that the field is fixed. In this way, wild cards can be assigned so that all CHANNEL 1 registers are read, or all REGISTER 1 records on a particular channel will be erased, and so on.

C.4.4.2 Group read examples (R2)

Code	Mnemonic	Data	Function and data form
A000	gr_c0_r0_t0	0000	Group read Channel 0 Type 0 Reg. 0 Tariff 0

NOTE   This is the same as simply reading the Ch. 0 Type 0 Register 0 Tariff 0 in the Register category (Code = 0000).

A080	gr_c*_r0_t0	0000	Group read Ch. * Type 0 Register 0 Tariff 0

This command reads from all eight CHANNELS all records with REGISTER 0, TYPE 0 and TARIFF 0. In this case, the command data field could be 0000, 1000, 2000 ... 6000 or 7000 and the command still has the same meaning. Since the channel field is considered a wild card, varying it has no meaning.

A040	gr_*_c0_t0	0000	Group read Channel 0 All Types Register 0 Tariff 0

This command reads from CHANNEL 0 all DATA TYPES from REGISTER 0 and TARIFF 0.

A020	gr_c0_r*_t0	0000	Group Read Ch. 0 Type 0 Register * Tariff 0

This command reads from CHANNEL 0 all REGISTERs with TYPE 0 and TARIFF 0.

A010	gr_c0_r0_t*	0000	Group Read Ch. 0 Type 0 Register 0 All Tariffs

This command reads all records from CHANNEL 0, TYPE 0, REGISTER 0, regardless of TARIFF.

C.4.4.3 Group erase examples (W2)

Code	Mnemonic	Data	Function and data form
A010	ge_c0_r0_t*	0000	Group Erase Ch. 0 Type 0 Register 0 Tariff *

This command erases from CHANNEL 0, TYPE 0, REGISTER 0, all TARIFFs.

A0FF	ge_*	0000	Group erase all wild

This command erases all data records in the Register category.

C.4.5 Extended function

The extended function category reserves 4k worth of pages for further expansion.

C.4.6 Variable data category

C.4.6.1 Variable coding

Variable data includes values or parameters that are dynamic in nature and represent a state within a metering unit. This includes such items as time, date and days since last cumulation. Data format in this group is explicit and shall be followed. Some data fields can contain variable length data. These are indicated by a trailing + sign. If the data length received by a metering unit is not what is expected, the unit can decide what course of action to pursue, i.e. truncation, ignoring, error message, etc. In this group, the coding is not as smart as in previous categories.

Code (binary)

1100	t t t t	xxxx	xxxx	$t\,t\,t\,t$ = Variable TYPE
				0000 = Time and Date Related Items
				0001 = Data Related Items
				0010 = RESERVED
				:
				1111 = RESERVED
1100	xxxx	vvvv	vvvv	vvvv vvvv = VARIABLE Identifier

C.4.6.2 Variable data examples

Code	Mnemonic	Data	Function and data form
C000	time_date	yymmddhhmmss	Time and Date (decimal)
C001	time_date_cal	yymmddhhmmsswwn	Time, Date, Week and Day (decimal)
			ww = week number (1 - 53)
			n = day of week (1 = Monday)
C002	day_season	ddddss	Day Counter and Season Number
			dddd = day counter in days
			ss = season number
C003	time_date_cals	yymmddhhmmsswwnz	Time, Date, Week, Day and Summer
			as C001 with
			z = summer time flag
			(1 = active)
C004	day_count	d+ or d+.d	Day Counter (decimal)
			i.e. ddd or ddd.d
C006	last_com_date	yy-mm-dd hh:mm	Last Programming Mode
			Communication Date & Time
			Stamp (Time is optional)
C100	c0_cum_counter	n+	Ch. 0 Cumulation Counter (decimal)
C107	c7_cum_counter	n+	Ch. 7 Cumulation Counter (decimal)
C110	c0_fail_count	n+	Ch. 0 Power Fail Counter (decimal)
C111	c1_fail_count	n+	Ch. 1 Power Fail Counter (decimal)

C117	c7_fail_count	n+	Ch. 7 Power Fail Counter (decimal)
C120	c0_over_count	n+	Ch. 0 Overvoltage Counter (decimal)
C127	c7_over_count	n+	Ch. 7 Overvoltage Counter (decimal)
C130	c0_under_count	n+	Ch. 0 Undervoltage Counter (decimal)
C137	c7_under_count	n+	Ch. 7 Undervoltage Counter (decimal)
C140	battery_time	n+	Battery Hour Counter (decimal)
C150	error	n+	Error Code
C151	rev_run	n+	Reverse-Running Flag

C.4.7   Parameter data category

C.4.7.1   Parameter data coding

Parameter data includes values or parameters that are static in nature and represent the programming or configuration of a unit. These include such items as channel type identification, identification numbers and passwords. Data format in this group is explicit and shall be followed. Some data fields can contain variable length data. These are indicated by a trailing + sign. If the data length received by a metering unit is not what is expected, the unit can decide what course of action to pursue, i.e. truncation, ignoring, error message, etc. One method of preventing ambiguity would be to perform a formatted read of the data record first to obtain its internal dimensions.

Code (binary)

1101	t t t t	xxxx	xxxx	t t t t = Parameter TYPE
				0000 = General Data Items
				0001 = Communications
				0010 = Configuration
				0011 = RESERVED
				:
				1111 = RESERVED
1101	xxxx	pppp	pppp	pppp	pppp = PARAMETER Identifier

C.4.7.2   Parameter data examples

Code	*Mnemonic*	*Data*	*Function and data form*
D000	id_1	n+	Identification Number 1
D001	id_2	n+	Identification Number 2
			:
D00F	id_par	n+	Parameter Set ID
D007	id_8	n+	Identification Number 8
D010	season1_length	n+	Season 1 Length in Days
			:
D01F	season16_length	n+	Season 16 Length in Days
D104	pass4_1	pppp	4 Character Password 1
D114	pass4_2	pppp	4 Character Password 2
			:
D174	pass4_8	pppp	4 Character Password 8
D105	pass5_1	ppppp	5 Character Password 1
D106	pass6_1	pppppp	6 Character Password 1
D107	pass7_1	ppppppp	7 Character Password 1
D108	pass8_1	pppppppp	8 Character Password 1
D110	address	n+	32 Character Address