SUBJECT: LOAD PROFILE FORMAT FOR THE A1700 METER

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CONTENTS

1 INTRODUCTION

The load profile record is a fixed length block of memory that holds successive demand period values for the measurement channels.

At the end of each demand period, a record for each measurement channel configured is written to the load profile record along with a status value that identifies whether certain events have occurred during that period.

The load profile memory is circular so that eventually the most recent record will overwrite the oldest record.

The load profile record will store up to a preset number of days (set at the time of manufacture) of data configured at half hour demand periods and one channel enabled. Increasing the number of channels or decreasing the demand period - thus increasing the amount of data stored - will reduce the number of days of load profile accordingly.

2 LOAD PROFILE FORMAT

The load profile data consists of a series of records that are constructed using the following:

i) Power Up marker

ii) Configuration Change marker

iii) Power Down marker

iv) New Day marker

v) Time Change marker

vi) Data Entry

vii) External Data Entry

viii) Time and Date stamp

ix) End of data

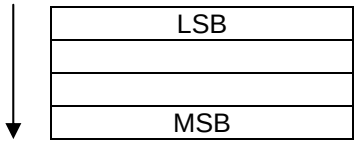
x) Daylight Saving marker

xi) Load Profile Cleared marker

xii) Forced End of Demand marker

2.1 Time and Date Stamp

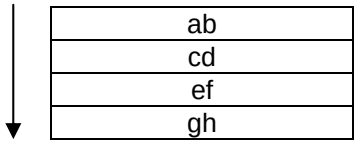
A time and date stamp is used in conjunction with all the markers above and comprises a string of 8 characters (4 bytes, HEX) forming a 32 bit hexadecimal number.



Seconds since 00:00:00 01/01/70, UTC.
4 bytes HEX

Note: The arrow indicates direction of increasing memory offset as the data is written to the load profile, and consequently pointing towards the most recent data.

The string pairs:



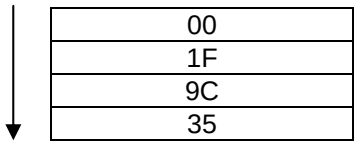
Seconds since 00:00:00 01/01/70, UTC.
4 bytes HEX

represents the hexadecimal number: **ghefcdab**

and indicates the number of seconds since 00:00:00 on 1/1/1970, UTC format.

For example:

Load Profile Time/Date stamp:



359C1F00h seconds since 00:00:00 01/01/70, UTC.
4 bytes HEX

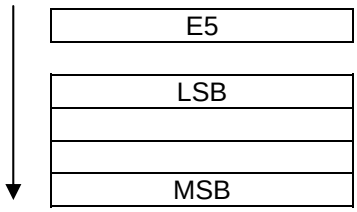
Hexadecimal number is therefore: **359C1F00**

Implying **899424000** seconds since 00:00:00 on 1/1/1970, translating to **00:00:00 on 3/7/1998**.

2.2 Power-Up Marker

A Power Up marker comprises: 10 characters (5 bytes)

a) **'E5'** - 2 characters (1 byte, HEX) followed by
b) Time/Date stamp - 8 characters (4 bytes, HEX)



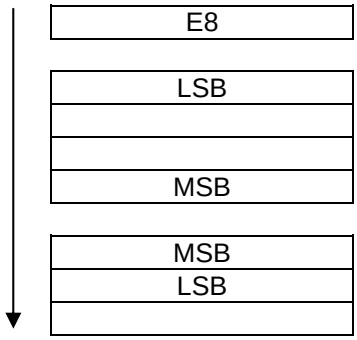
Power Up ID 1 byte HEX

Seconds since 00:00:00 01/01/70, UTC.
4 bytes HEX

2.3 Configuration Change Marker

A Configuration Change marker comprises: 16 characters (8 bytes)

a) **'E8'** - 2 characters (1 byte, HEX) followed by
b) Time/Date stamp- 8 charaters (4 bytes, HEX) followed by
c) Configuration record - 6 characters (3 bytes, HEX)



Configuration Change ID 1 byte HEX

Seconds since 00:00:00 01/01/70, UTC.
4 bytes HEX

Channels and GMT/ Daylight Saving
2 bytes HEX
Demand Period. 1 byte HEX

2.4 Power-Down Marker

A Power Down marker comprises: 10 characters (5 bytes)

a) **'E6'** - 2 characters (1 byte, HEX) followed by
b) Time/Date stamp- 8 characters (4 bytes, HEX)

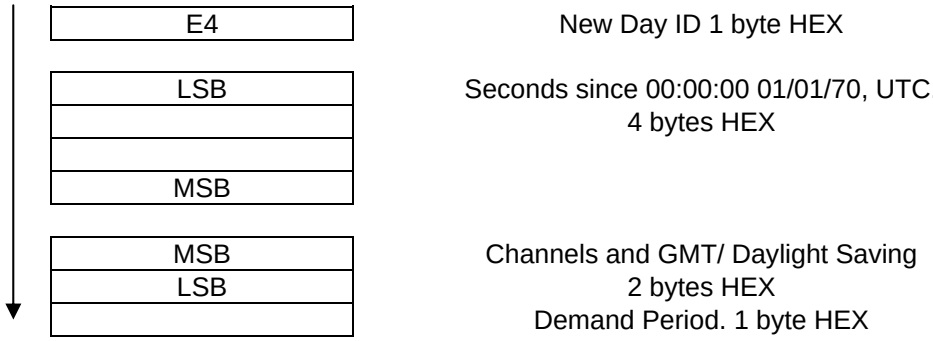
Power Down ID 1 byte HEX

Seconds since 00:00:00 01/01/70, UTC.
4 bytes HEX

2.5 New Day Marker

A New Day marker comprises: 16 characters (8 bytes)

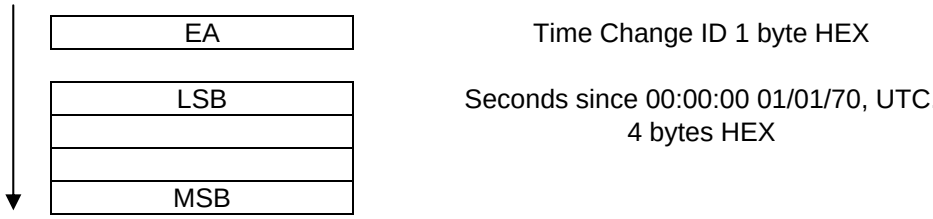
a) **'E4'** - 2 characters (1 byte, HEX) followed by
b) Time/Date stamp- 8 characters (4 bytes, HEX) followed by
c) Configuration record - 6 characters (3 bytes, HEX)



2.6 Time Change Marker

A Time Change marker comprises: 10 characters (5 bytes)

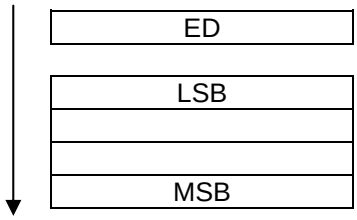
a) **'EA'** - 2 characters (1 byte, HEX) followed by
b) Time/Date stamp- 8 characters (4 bytes, HEX)



2.7 DayLight Saving Marker

A Daylight Saving marker comprises: 10 characters (5 bytes)

a) **'ED'** - 2 characters (1 byte, HEX) followed by
b) Time/Date stamp - 8 characters (4 bytes, HEX) (local time)



2.8 Load Profile Cleared Marker

A Load Profile cleared marker comprises: 10 characters (5 bytes)

a) **'EB'** - 2 characters (1 byte, HEX) followed by
b) Time/Date stamp- 8 characters (4 bytes, HEX)

2.9 Forced End of Demand Marker

A Forced End of Demand marker comprises : 10 characters (5 bytes)

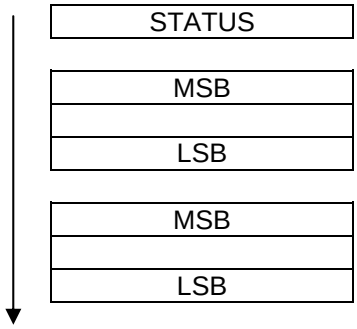
a) **'E9'** - 2 characters (1 byte, HEX) followed by
b) Time/Date stamp- 8 characters (4 bytes, HEX) (local time)

2.10 Demand Data Entry

Load profile data entry comprises:

a) **Status** entry 2 characters (1 byte, HEX) followed by
b) Load Profile Entry x (Number of load profile channels), 6 characters (3 bytes BCD) per Load Profile Entry

E.g. For only two channels active:



2.10.1 Load Profile Status Entry

The Status Entry comprises 2 characters (1 byte) providing up to 7 status flags – most significant bit (MSb) is not used.

Depending upon the firmware build of the particular meter, the status flags represent the following events :-

Bit No.		Standard (COP5) Build	Vietnam Build
0	LSb	Meter Transient Reset*	Reverse Run*
1		Time Synchronisation*	Time Synchronisation*
2		Data Change*	Data Change*
3		Battery Fail**	Battery Fail**
4		Not Used	Phase A Failure*
5		Reverse Run*	Phase B Failure*
6		Phase (any)Failure*	Phase C Failure*
7	MSb	Not Used	Not Used

E.g. the character pair on a Standard (COP5) build

2D	STATUS, 1 byte HEX

represents the following:

							LSb
0	0	1	0	1	1	0	1

							x	**Meter Reset (LSb)**
								Time Sync
					x			**Data Change**
				x				**Battery Fail**
			-					Not Used (0)
		x						**Reverse Run**
								Phase Failure
-								Not Used (0) (MSb)

* Flag set if indicated event occurred at any time during the current data period record.

** Remains set for all periods following failure detection, until cleared by a battery change.

Meter Reset - A Transient Meter Reset occurred during this period.

Time Sync - A time synchronisation has occurred during this period (of up to 5 seconds).

Data Change - A communications activity has changed data within the meter during this period.

Battery Fail - The RTC battery has expired.

Reverse Run - Reverse run has been detected by the meter during this period.

Phase Failure - A phase or combination of phases has fallen below the failure threshold level during this period.

2.10.2 Load Profile Demand Data Entry

The Load Profile entry comprises 6 characters (3 bytes), the mantissa (five) and exponent (one) of a BCD number, representing mW, mvar or mVA.

External data is represented as the number of pulses counted during the demand period.

E.g. character pairs

34	MSB
56	
72	LSB

represent the value 34567 x 10^2 i.e. 3456.700, similarly

56	MSB
02	
10	LSB

represent the value 56021 x 10^0 i.e. 56.021.

N.B. The load profile entries are derived from 14 digit (11.3) internal registers within the meter. The residual values are carried forward and added to the following period.

e.g. 00000123456.789 W is represented in the load profile as 123454 mW (123450.000 W) with the remaining 6.789 W being added to the following demand period result.

2.11 Configuration Record

A Configuration record comprises:

a) Channel information followed by
b) Period information

MSB	Channels and GMT/ Daylight Saving
LSB	2 bytes HEX
	Demand and Sub-Interval periods. 1 byte HEX

2.11.1 Channel Information

A string of 4 characters forming a 16-bit hexadecimal number represent channel information.

For example the character pairs

34	MSB
5C	LSB

represent 7 channels of load profile data:

LS bit

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

																Import mW
																Export mW
													X			Q1 (mvar)
												X				Q2 (mvar)
											X					Q3 (mvar)
																Q4 (mvar)
									X							mVA
																Daylight Saving
																Cust Def 1
																Cust Def 2
					X											Cust Def 3
																External 1
			X													External 2
		X														External 3
																External 4
-																Not Used (0)

The channel data is packed against each other in the order indicated on the right hand side of the table above, i.e. the profile data will show Q1 (1st active channel), followed by Q2 (2nd active channel) and so on.

Typically, the period data for the above would be as follows:

STATUS	1 byte HEX
MSB	Q1 (mvar)
	3 bytes BCD
LSB	
MSB	Q2 (mvar)
	3 bytes BCD
LSB	
.	
.	
.	
MSB	External 3
	3 bytes BCD
LSB	

If the Daylight Saving (DLS) flag is set **AND** the Local Event Time within the meter is also set to DLS then the load profile time base will track that of the meter. Consequently, time stamps will reflect the local/DLS time as opposed to GMT.

2.11.2 Period Information

Period information comprises 2 characters (1 byte) indicating the demand.

The characters used for both period values are:

Character	0	1	2	3	4	5	6	7	8	9	A
Period (mins)	1	2	3	4	5	6	10	15	20	30	60

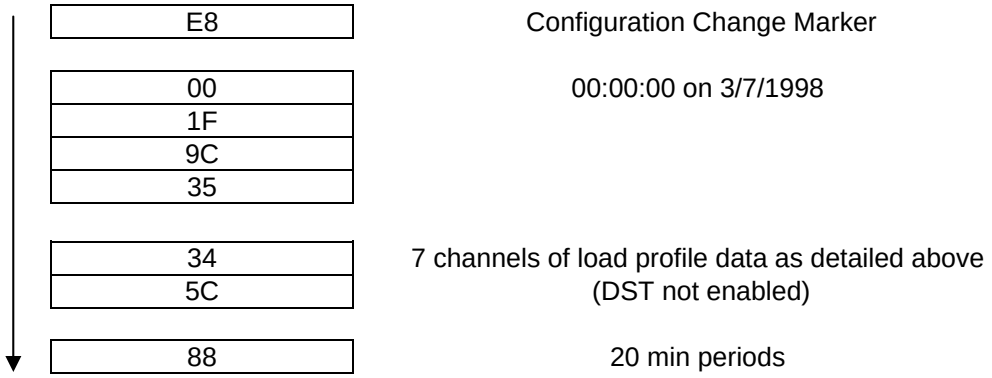
For example, the character pair

88	1 byte HEX

represents 20-minute demand periods.

2.11.3 Example

Using the examples set out above for channel and period information, a configuration change marker in the load profile would show the following:



2.12 External Data Entry

The following is only applicable when an input module is fitted and after a meter power down when the data logged in the input module board has been recovered and written to the meter load profile memory.

On power up the meter determines from the input module how many periods of demand data were logged whilst the power was off and subsequently allows enough space within the load profile to write the External Data Entry.

An External Data Entry comprises:

a) '**E2**' (1 byte)

b) External data entry size (2 bytes)

c) External Load Profile Entry (3 bytes) x Number of Configured Load Profile Channels x Number of Demand Periods

d) **'E2**' (1 byte)

A configured load profile channel that represents internal data will be included in the External Data Entry but will always contain zero data. For example if the number of configured load profile channels is 3 made up of 1 internal channel and 2 external channels and the input module had logged N demand periods whilst the meter power had been turned off, the External Data Entry would be formatted follows.

E2	Start of external data marker, 1 byte HEX
LSB	Size of external data = [4 + N x 3 x Number of Configured Channels] 2 bytes HEX
MSB	
MSB	Internal channel data, for period 1 (zero data)
	3 bytes BCD
LSB	
MSB	External channel 1 data for period 1
	3 bytes BCD
LSB	
MSB	External channel 2 data for period 1
	3 Bytes BCD
LSB	

.
.

MSB	Internal channel data, for period n (zero data)
	3 bytes BCD
LSB	
MSB	External channel 1 data for period n
	3 bytes BCD
LSB	
MSB	External channel 2 data for period n
	3 Bytes BCD
LSB	

E2	End of external data marker, 1 byte HEX

There will be only one External Data Entry created by the meter during its power up sequence. If present, the single External Data Entry will appear in sequence immediately following any partial demand data and immediately before the Power Up event.

Note that the input module can only record up to 96 periods (i.e. 2 days at 30 minute periods) of data.

2.13 End Of Data

An End of Data record comprises:

'**FFh**'

At least one character pair of **FFh** (up to a maximum of 63 pairs) could be present in the retrieved data.

Note: The above only applies if the retrieved data does not fill a 128 character packet (64 bytes).

3 LOAD PROFILE EXTRACTION

3.1 COMMUNICATIONS READ MODES

Refer to the FLAG protocol defined in specification 'Optical Communications Protocol', **102M050**, and the Data Identities for the A1700 Meter, **104M023**.

The FLAG protocol allows the reading device to specify the data identity, packet number and number of bytes to read to be defined explicitly.

Data Stream Mode (DSM) can also be used to read the Load Profile Data with an increased data rate – see 'A1700 Communications – Data Stream Mode (DSM) Specification, **102M152**.

3.2 READOUT VIA COMMUNICATION PORTS

The load profile data is read on a day-by-day basis. This will be set-up by **writing** the number of days to be read to the data identity 551, 'Load Profile Configure Read'. The number of days is the number of New Day markers prior to and including the current day. These **do not necessarily** represent complete whole days.

Note that requesting more data than the meter has will result in the meter limiting the available data accordingly, e.g. if 20 days of data is requested but only 18 days of data exist, then only 18 days worth of data will be recovered. Similarly, requesting more days than the maximum (set at manufacture) will result in only the maximum number of days of data being recovered. Reading data identity 554 will indicate the maximum number of days available.

Note that these days may not be contiguous, i.e. if the meter had been powered down for longer than a day.

Once the number of days requested has been set, reading from the same data identity (551) will retrieve the number of 128 character (64 byte) packets AND the number of 512 character (256 byte) packets (for Data Stream Mode – DSM) of data available for that number of days, represented as a pair of 4 character, 2 byte hexadecimal numbers.

The load profile data is recovered using the data identity 550, 'Load Profile Read Data', which extracts the data by hexadecimal packet number, e.g. 550003 will retrieve packet number 3 from the start of the data of the requested number of days, similarly 550020 will retrieve packet number 32 (decimal).

The data read from the meter will start at the New Day marker of the oldest day record available or requested, and read forwards to the current day. The data will show load profile up to the last completed period in the current day at the time of the last packet request. The last packet may be padded out with FFh pairs (see: End Of Data).

If necessary, the load profile data can read out from the meter in a 'raw' state, by packet number, using data identity 552 'Read Raw Load Profile Data'. This essentially allows the Load Profile memory to be read from the base address (packet number 1) to the maximum (see **104M023**).

4 EVENT RESULTS

The following describes the results, in terms of data recorded in the load profile, expected when such events occur.

4.1 Time Change Event

Changing the time of the meter will cause the following sequence to be recorded in the load profile memory:

Implied Partial	Forced EOD
New Day Marker	Only if new date is different from the last date recorded
Time Change Marker	
Implied Partial	Next natural EOD

4.2 Power-Down Event

A Power Down event will cause the following to be recorded in the load profile memory:

Power Down Marker	only

4.3 Power-Up Event

A Power Up event will cause the following to be recorded in the load profile memory:

Implied Partial	Demand up to a previous Power Down Event, but only if the power down time spans one or more period boundaries.
New Day Marker	Only if new date is different from the last date recorded
Power Up Marker	
Implied Partial	Next natural EOD

4.4 Channel Reconfiguration

Altering the channels to be recorded in the load profile will cause the following to be recorded in the load profile memory:

Implied Partial	Forced with previous Channel Configuration
Configuration Change Marker	Showing the new configuration
Implied Partial	Next natural EOD

4.5 Demand Period Change

Altering the demand or sub-interval periods will cause the following to be recorded in the load profile memory:

Implied Partial	Forced with previous period settings
Configuration Change Marker	Showing the new period settings
Implied Partial	Next natural EOD

4.6 GMT/DST Change

If the meter is configured for local daylight saving, a reconfiguration event is effectively created and the following will be recorded in the load profile memory:

Implied Partial	Forced with previous channel/period settings
Configuration Change Marker	Showing the channel/period settings and setting/resetting the DST bit.
Implied Partial	Next natural EOD

4.7 New Day Event

A New Day Marker will be written to the load profile memory at :-

1) the start of a new day

2) if the load profile is cleared

3) if power to the meter is restored in a different day to the power loss, and

4) if a time change is to a different day to that prior to the change.

4.8 Daylight Saving Event

A Daylight Saving Marker will be written to the load profile memory at the time of the daylight saving occurrence (usually twice a year), but only if the load profile has been configured as such **AND** the meter is configured to work with local time generally. The following will be recorded in the load profile memory:

4.9 External Data Entry Event

An External Data entry will be written (when an input module is used AND the load profile configured to store channels from the module) when the power has been removed from the meter for an amount of time that spans at least one demand period boundary.

Daylight Saving Marker	With local time stamp

4.10 Load Profile Clear Event

A Load Profile Clear Marker will be written to the load profile memory when the meter is first used, cleared by a write to data identity 550 or if at power up the checking system detects an error. In the occurrence of the latter two actions, the load profile data is not lost and can be retrieved in a raw state via the data identity 552. The following will be recorded in the load profile memory:

New Day Marker	With time and configuration

Load Profile Cleared Marker	With time stamp

4.11 Forced end of demand event

If the meter is configured for local daylight saving, a reconfiguration event is effectively created and the following will be recorded in the load profile memory:

Implied Partial	Demand up to the point of the event
Forced End of Demand Marker	Showing the channel/period settings and setting/resetting the DST bit.
Implied Partial	Next natural EOD

5 INTERPRETATION OF DATA EXAMPLES

The following gives examples of Load Profile events. These examples assume an input module is used and the load profile is configured to include these channels at 30 minute demand periods. If an input module is not used, omit any reference to the external data below:-

5.1 Power Loss (case1)

Power down at 9:40, power recovery at 9:50 (i.e. same period), no external data entry:-

Load Profile (LP) Data	9:00 to 9:30
Power Down Marker	@ 9:40
Power Up Marker	@ 9:50
Implied Partial LP Data	9:30 to 10:00
LP Data	10:00 to 10:30

5.2 Power Loss (case2)

Power down at 9:40, power recovery at 10:10 (i.e. different period), external data entry (only when the meter is off across at least one demand boundary):-

Load Profile (LP) Data	9:00 to 9:30
Power Down Marker	@ 9:40
Implied Partial LP Data	9:30 to 9:40
External Data Entry	Bounded by E2's – External data for 9:40 to 10:00
Power Up Marker	@ 10:10
Implied Partial LP Data	10:10 to 10:30
LP Data	10:30 to 11:00

5.3 Power Loss (case3)

Power down at 9:40, power recovery at 9:42 in the next day, external data entry (only when the meter is off across at least one demand boundary):-

Load Profile (LP) Data	8:45 to 9:15
LP Data	9:00 to 9:30
Power Down Marker	@ 9:40
Implied Partial LP Data	9:30 to 9:40
External Data Entry	Bounded by E2's – External data for 9:40 to 9:30 next day
New Day Entry	New Day stamp @ 9:42
Power Up Marker	@ 9:42
Implied Partial LP Data	9:42 to 10:00
LP Data	10:00 to 10:30

5.4 Time Change (case1)

Time change at 10:25 changing to 10:26 (i.e. same day – note that this applies to a time change - whether forwards or backwards - but within the same day):-

Load Profile (LP) Data	9:30 to 10:00
Implied Partial LP Data	10:00 to 10:25
Time Change Marker	@10:26 (new time)
Implied Partial LP Data	10:26 to 10:30
LP Data	10:30 to 11:00

5.5 Time Change (case2)

Time change at 10:25 changing to 10:26 of a different day:-

Load Profile (LP) Data	9:30 to 10:00
Implied Partial LP Data	10:00 to 10:25
New Day Marker	New Day stamp @10:26
Time Change Marker	Time change to 10:26 (new time/date)
Implied Partial LP Data	10:26 to 10:30
LP Data	10:30 to 11:00

5.6 Configuration Change

Configuration change at 10:25:-

Load Profile (LP) Data	9:30 to 10:00
Implied Partial LP Data	10:00 to 10:25
Config Change Marker	@10:25 indicating new configuration
Implied Partial LP Data	10:25 to 10:30
LP Data	10:30 to 11:00

5.7 Load Profile Cleared

Cleared at 11:34. This following data will be at the start of the Load Profile data:-

New Day Marker	New Day @ 11:34
LP Cleared Marker	@11:34
Implied Partial LP Data	11:34 to 12:00
LP Data	12:00 to 12:30