

DETAILS:	Real time bus stop sign: communication protocol.
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Communication Protocol

Review 2.5

Version 2.0

Bus Stop Sign

“Real Time”

DSPAGYYXXXNPRO

DSPAGYYXXXNPRS

DSPAGYYXXXAPRS

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Doc. Rev.	Protocol Version	Date	Update Description
2.0	1.7	13/Jan/09	English revision For past revision description please ask to specific document.
2.1	1.7	29/Jun/09	Terms adjustment
2.2	1.8	03/Aug/09	Added command CFS, CFV, POE, RPE.
2.3	1.8	27/Oct/09	<ul style="list-style-type: none"> - REVISION 2.2 HAS BEEN CANCELED; - Added commands CFV, POE, RPE; - Added management of German language in CFG; - Added management of compacted fonts with switch CTRLW-C; - Correct CFP field "Message waiting time threshold from 3 to 2", the time is in minutes and not in seconds as previous; - Added PIC version to RVE response
2.4	1.9	25/Sep/12	<ul style="list-style-type: none"> • Added dedicated command "CFP" for project DSPAGYYXXNPRS; • Added at chapter "Free text composition" the command sequence for define the sliding text area (only for DSPAGYYXXNPRS);
2.5	2.0	23/Mar/15	<ul style="list-style-type: none"> • Added commands for new photovoltaic system: BAT; CCS; EON. • Updated answer RPE. • Added to the CFC command the instruction to configure the wireless interface (only for firmware DSPAGYYXXAPRS);
2.6	2.0	10/Apr/15	<ul style="list-style-type: none"> • Added STATUS 804D = leds board fault; • Changed RPE description field "Battery Charging Current" to "Photovoltaics current"; • Changed RPE values field of "Environmental brightness" (added error status)

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Customer	AESYS
Order #	
Subject	Communication protocol for the management of "Real Time" bus stop electronic indicator with cpu 68000 and NIOS II. They are managed completely by the protocol without VFP configuration file.
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Protocol revision	1.9
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Made by	AESYS S.p.A.
RSW	Sergio Vismara
Team	Fabio Crovatto
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Annex:

2006_004SF001_1_0 Functional specifications

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1 Comment

Please read this document only after having viewed functional specifications document of the project. Otherwise some notations may be unclear or not exhaustive.

There are two different channels used to communicate with the *bus stop sign* (from now on **BSS**).

The main channel is used for long distance communication, and it works with several devices (such as GSM, GPRS, RADIO, SMS).

The other channel is used only with a "ShortRange" device, provided by Aesys, that allows the communication between the bus and the BSS. This protocol is used only to delete a *Estimated Arrival Time* (from now on **EAT**) when the bus stops.

The encoding font used is "ISO 8859-1".

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2 Main communication protocol

This product is designed to use different types of protocols: binary, SMS and TETRA radio. For this reason, all the commands and related data fields are composed exclusively of ASCII characters in order to simplify their coding.

It is possible to implement commands that provide information not ASCII displayable, but they will can not be sent through SMS.

2.1 General description

Regardless of the protocol type used, the message containing the BSS information is composed as follows:

<Command>;<data field 1>;<data field n>;

Where:

<Command>

indicates the message content exchanged between the two devices.

- *Length*: 3 bytes;
- *Values*: from 0x41 to 0x5A

<data fields>

are the information exchanged between the two devices. The content of these fields depends on the message type.

- *Length*: variable (possibly 0, maximum 250);
- *Values*: from 0x21 to 0x7E;

The fields of a command are separated by the character ';'. With the TXS and TXT commands if the text should contains the character ';' you must insert ';;'. The last field must contain a final ';'.

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2.2 Basic binary protocol description

This protocol is used with the following communication devices: MODEM; GSM; GPRS; WILRELESS; RADIO.

The messages exchanged between the devices that compose the system, have the following structure (fields between square brackets "[]" are optional):

STX <IndH> <IndL> [<MagicH> <MagicL>] <Command> <Data length> ; <Data field 1> ; <Data field n> ; ETX <Checksum>

Where:

<IndH> <IndL>

The slave device involved in the information exchange (the receiver for the call message, the sender for the reply message) is identified by a code **<Address>** on 14-bits. The 7-bits least significant of **<IndH>** are the 7-bits most significant of **<Address>**, while the 7-bits least significant of **<IndL>** are the 7-bit least significant **<Address>**. The most significant bit of **<IndH>** and **<IndL>** is always high. (set to one).

- *Length:* 1 byte **<IndH>** and 1 byte **<IndL>**;
- *Values:* 0x80 – 0xFF.

Reserved addresses:

- 0x3FFD = broadcast address (without BSS response);
- 0x3FFE = always valid address (with BSS response);

[<MagicH> <MagicL>]

These are optional fields. At server side, these fields are used in order to identify at which command refers the response.

In practice, the slave device includes these fields in the response.

The most significant bit of these fields is always high (set to one):

- *Length:* 1 byte **<MagicH>** ed 1 byte **<MagicL>**;
- *Values:* 0x80 – 0xFF.

<Command>

Displays the contents of the message exchanged between the two devices.

- *Length:* 3 bytes;
- *Values:* from 0x41 to 0x5A.

<Data length>

Indicates the length in bytes of the **<Data>** field codified in hexadecimal format.

- *Length:* 4 bytes;
- *Values:* from 0x30 to 0x39 otherwise between 0x41 and 0x46 otherwise "ZZZZ" to not carry out any verification;

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<Data fields>

These are the information exchanged between the two devices. The contents of the fields depends on the message type and each field is separate by the character ';'.

- *Length*: variable (possibly 0, maximum 4096 bytes – with DLE conversion the maximum number of characters is 8192);
- *Values*: from 0x00 to 0xFF;
- *Note*: to represent the bytes with ASCII values 02h (STX), 03h (ETX), 10h (DLE) is necessary used the DLE character (10h) followed by a character obtained by summing the ASCII code of the character to convert with 40h (ex. STX becomes: "DLE" + ("STX" + 40h) so "DLE" + "B").

<Checksum>

It is the sum, modulo 65536, for all the characters that compose the message. (STX, <IndH>, <IndL>, [<MagicH><MagicL>], <Commands>, <Length>, <Data>, ETX). The value is obtained thought the ASCII encoding of the hexadecimal value of this sum.

- *Length*: 4 byte;
- *Values*: from 0x30 to 0x39 otherwise between 0x41 and 0x46 otherwise "ZZZZ" to not carry out any verification;

In the following table you can see how are converted the three data types:

IDENTIFIER	CODE	CONVERSION
STX	0x02	0x10 + 0x42 (ASCII 'B')
ETX	0x03	0x10 + 0x43 (ASCII 'C')
DLE	0x10	0x10 + 0x50 (ASCII 'P')

There is a response to each command.

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2.2.1 Binary protocol variant

The basic binary protocol was developed with the intent to simplify the work at the application developers. For this reason it was introduced the fields separator (';') and ASCII format data. This is useful in order to control the BSS even from a normal terminal.

However, for some special commands this format is not possible, both for the amount of data that would generate and for compatibility reasons towards some additional devices.

In these particular cases, the transport protocol is similar, but the data field will no longer have the fields separator (';') and it will be in binary format (possibly the data must be masked with the DLE character).

STX <IndH> <IndL> [<MagicH><MagicL>] <Command> <Data length> <Data> ETX <Checksum>

<Data field>

These are the information exchanged between the two devices. The contents of the field depends on the message type.

- *Length*: variable (possibly 0, maximum 4096 bytes – with DLE conversion the maximum number of characters is 8192);
- *Values*: from 0x00 to 0xFF;
- *Note*: to represent the bytes with ASCII values 02h (STX), 03h (ETX), 10h (DLE) is necessary used the DLE character (10h) followed by a character obtained by summing the ASCII code of the character to convert with 40h (ex. STX becomes: "DLE" + ("STX" + 40h) so "DLE" + "B").

All binary commands receive binary responses. Also for the ACK is expected the equivalent binary ACB.

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2.3 SMS protocol description

If the BSS is configured to use a GSM modem on SMS mode, all commands can be sent through SMS (this is possible only for these messages that have a length less than maximum SMS size)

This modality allows you to send only ASCII data.

The exchanged messages have this structure:

999 ; <Command> ; <Data field> ;

where:

<Command>

indicates the message content exchanged between the two devices

- *Length*: 3 bytes;
- *Values*: from 0x41 to 0x5A;

<Data field>

are the information exchanged. The contents of the field depends on the type of message (the field separated character is ';'):

- *Length*: variable (possibly 0, maximum 160 bytes);
- *Values*: from 0x21 to 0x7D;

The BSS does not expect any response unless in case of DIA command.

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2.4 TETRA radio protocol description

The BSS can communicate with the operative center through a radios that use the TETRA standard. In particular is used the “SDS-FULL” mode, that is very similar to the SMS structure. The operative center inserts the command (that must be send to the BSS) in the data field of the “SDS-FULL” message and it does not expect any response unless in case of DIA command.

Depending on the type of TETRA radio mode chosen, the response to a DIA command can be:

- MODO_1: BSS sends a “STATUS” message as specified in the document “MOD-04-76” about the Sepura radio.
- MODO_2: BSS sends a “SDS-FULL” message composed by all the fields expected by PRO+RVE+RDO commands (queued together).

The exchanged messages have this structure:

<Command> ; <Data field> ;

where:

<Command>

indicates the message content exchanged between the two devices.

- *Length*: 3 bytes;
- *Values*: from 0x41 to 0x5A;

<Data field>

are the information exchanged. The content of the field depends on the type of message (the field separated character is ';'):

- *Length*: variable (possibly 0, maximum 160 bytes in MODO_1 mode or 140 bytes with MODO_2);
- *Values*: from 0x21 to 0x7D;

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3 COMMANDS

3.1 Call commands (Master -> Slave)

COMMAND	DESCRIPTION	RECIPIENTS
ATF	Phone number for voice call	BSS
BAT	Battery parameters	BSS
CCS	Calibration of current and voltage sensors	BSS
CDO	Date and time configuration	BSS
CFC	Communication device configuration	BSS
CFG	Basic parameters configuration	BSS
CFI	Communication address configuration	BSS
CFL	Layout configuration	BSS
CFP	EAT configuration	BSS
CFV	Photovoltaic system configuration	BSS
CLO	Logo configuration	BSS
DAF	End remotely firmware upgrade	BSS
DAT	Send firmware update data packets	BSS
DEF	Default settings	BSS
DFW	Begin remotely firmware upgrade	BSS
DIA	Diagnostics (only in SMS or Tetra radio mode)	BSS
DPP	EAT page header deletion	BSS
DPR	Single EAT deletion	BSS
DPA	All EATs deletion	BSS
DPI	Single EAT immediate deletion	BSS
DST	All spot texts deletion	BSS
DSP	Single spot text deletion	BSS
DTA	All free texts deletion	BSS
DTS	Single sliding text deletion	BSS
DSA	All sliding texts deletion	BSS
DTX	Single free text deletion	BSS
EON	Extend power up hours	BSS
GDO	Reading date and time from BSS	BSS
GGR	Reading graphic image	BSS
KAL	Keep-Alive	BSS
MPL	Map bus route	BSS
POE	Request Extended status (polling)	BSS
POL	Request status (polling)	BSS
PRV	EAT activation/update	BSS
PRA	Multiple EATs activation/update	BSS
PRW	Text to speech EAT activation/update	BSS
PRM	Multiple text to speech EATs activation/update	BSS
RES	BSS restart	BSS
TPP	EAT page header activation	BSS

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TSP	Spot text activation/update	BSS
TTS	Text to speech configuration	BSS
TXS	Sliding text activation/update	BSS
TXT	Free text activation/update	BSS
UCM	GPRS/GSM switch	UBGPRS/GMS
UCO	GPRS connection	UBGPRS
UDI	GPRS dial-up	UBGPRS
UPO	GPRS polling	UBGPRS
VER	Firmware version request	BSS
VEM	Wavecom modem version request	BSS
XRE	GPRS reset	UBGPRS
XVE	UBGPRS firmware version request	UBGPRS

3.2 Response commands (Slave -> Master)

COMMAND	DESCRIPTION	RECIPIENTS
ACK	Generic positive response	PC
NAK	Negative response due to checksum error	PC
RDA	DAT command response	PC
RDO	GDO command response	PC
RGR	GGR command response	PC
RPE	POE command response	PC
RPO	POL command response	PC
RRA	PRA and PRM commands response	PC
RVE	VER command response	PC
RVM	VEM command response	PC
URP	UPO command response	BSS
XRV	XVE command response	BSS

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4 EXCHANGE COMMANDS

If the slave receives a message with a wrong checksum, it must response to the master with the NAK and discard the received message.

For every commands where it is not required any response, the slave must send an ACK.

There are some functionalities that include a sequence of commands:

- Remotely firmware upgrade:
 - DFW = Begin -> BSS responses with ACK;
 - DAT = Send data packet n. 0 -> BSS responses with RDA;
 - DAT = Send data packet n. x -> BSS responses with RDA;
 - DAF = End -> BSS responses with ACK;

When the BSS must communicate something at the master (for example the request for a voice call), without having received any message it sends spontaneously a STATUS command, or a RPO (if, for instance, is connected via GPRS).

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5 Commands details sent by the central

5.1 ASCII commands

CFG (basic parameters configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
Pixels height	3 ASCII	From 16 to 80	16
Pixels width	3 ASCII	From 72 to 160	72
EATs display time (in seconds)	2 ASCII	0,2 ÷ 99 0 = disabled EATs	5
Display time for free text and spot messages (in seconds)	2 ASCII	0,2 ÷ 99 0 = disabled messages	5
Display time of the company page (in seconds)	2 ASCII	0,2 ÷ 99 0 = disabled business page	2
Receiver EATs deletion time-out (in seconds) ¹	3 ASCII	From 60 to 200 0 = not controlled	60
Receiver texts deletion time-out (in minutes) ²	2 ASCII	From 1 to 60 0 = uncontrolled	10
Brightness	3 ASCII	From 0 to 255 0 = automatic brightness	0
Text sliding speed (only from TXS commands)	1 ASCII	From 0 to 9 0 = fixed text	4
Spot page mode	1 ASCII	C = every <i>n</i> cycles mode T = every <i>n</i> minutes mode	C
N. of cycles / time (in minutes) spot page	2 ASCII	From 1 to 99 (cycles or minutes) 0 = disabled	0
Disables responses to commands (You can set either P or T or both of them)	2 ASCII	X = responses to all commands P = does not respond to PRV command T = does not respond to TXT, TSP, TXS	
Enable/Cycles solar panel mode ³	1 ASCII	From 1 to 9 (cycles) 0 = without solar panel	0
Enable request phone call with the operative center	1 ASCII	0 = disabled; 1 = enabled;	0
Enable/Cycles for voice announcement system of the BSS data.	1 ASCII	From 1 to 9 (cycles) 0 = disabled vocalization	0

¹ When this timeout expires the BSS no longer displays the estimated arrival time (**EAT**).

² When this timeout expires the BSS no longer displays text pages. Usually this timeout should be set higher than " *EATs deletion time-out* "; in this way, in case of no communication with the central, the BSS before deletes the EATs (that need to be updated more frequently and that are more important) and then it erases the free texts in order to display only the company logo.

³ If there is the solar panel, can not be there the phone and /or the voice announcement system.

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<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
Language	2 ASCII	Allows to select the language of the displayed months: IT = Italian EN = English FR = French ES = Spanish GE = German	IT

Pay attention. If you changes the number of pixels of the BSS, it will be restarted automatically.

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CFC (communication device configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
Number of device to be configured	1 ASCII	From 0 to 1	0
Device Type	1 ASCII	From 0 to 5 <ul style="list-style-type: none"> 0 = MODEM; 1 = GSM; 2 = GPRS; 3 = WIRELESS; 4 = RADIO; 5 = SHORT RANGE; 6 = TETRA RADIO MODO_1; 7 = TETRA RADIO MODO_2; 	0
Device options	3 ASCII	From 0 to 255 The global configuration value is the sum of all single options: <ul style="list-style-type: none"> 1 = RTS; 2 = CTS; 4 = DCD; 8 = RESET; 16 = ON; 32 = SMS; 64 = quotation marks command AT+CSCA; 128 = UBICOM; 	0
Device Baud Rate	5 ASCII	From 2400 to 38400 for 68000 From 2400 to 115200 for NIOS II	9600
Configuration string	200 ASCII	Every single initialization command is ended with "_" (0x5F). For example: AT&F_ATEO_ (The NULL value is accepted in absence of configuration string)	

With the "CFC" command, only a single communication device is configured at time. So, if there are two devices, it is necessary send two different command changing the value of "Device number" field. Obviously, if there is only a device, it must be configured as the device number 0.

Pay attention. If there is a ShortRange device (type number 5) , it is mandatory to set this gadget as first device.

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WIRELESS DEVICE CONFIGURATION NOTE

The wireless device require a custom configuration string with defined rules and the baud rate fixed to "115200" (only for firmware DSPAGYYXXXAPRS).

The configuration string is divided in many fields separated with the "#" character.

FIELD NAME	VALUES
#mode	C = infrastructure socket client L = infrastructure socket server A = access point socket server
#socket-ip	Server ip address for mode C
#socket-port	Server socket port for mode L and A
#ssid	Wifi SSID name
#protection	Wifi protection mode OFF = no protection W_O = wep open W_S = wep shared WPA = wpa
#key	Wep / wpa key (in case of wep key is mandatory to fill the field with 13 characters)
#ip	wifi ip (0.0.0.0 for dhcp when in mode C or L)
#subnet	Wifi subnet mask
#applicative password	password for web menu to enable remote connection

Example of configuration string:

```
#A#192.168.202.202#33333#SSID_WL02#W_O#00000000000000#192.168.202.202#255.255.255.255#1221
```

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CFI (communication address configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
Number of configured communication devices	1 ASCII	From 0 to 2	0
BSS Address	5 ASCII	from 0 to 16777215	0
Operative center' address/gateway	5 ASCII	From 0 to 16127	0
Operative center' SMS number	20 ASCII	ASCII string (NULL permitted)	NULL
Service center number	20 ASCII	ASCII string(NULL permitted)	NULL
Operative center' public IP	15 ASCII	From 0.0.0.0 to 255.255.255.255	
Operative center' TCP port	5 ASCII	From 0 to 65535	4000
Ubicom status check' polling time (in seconds)	3 ASCII	From 0 to 255	5
GPRS connection timeout - Tetra radio keep alive (in minutes)	2 ASCII	From 2 to 30	10
GPRS connection modality	1 ASCII	'C' (connect) o 'L' (listen)	C
GPRS APN connection	64 ASCII	ASCII string (NULL permitted)	NULL
GPRS ID connection (username)	64 ASCII	ASCII string (NULL permitted)	NULL
GPRS connection password	20 ASCII	ASCII string (NULL permitted)	NULL

If there is no value for a parameter, you must write "NULL" (where it is permitted).

Pay attention. All settings send with this command, become effective only after a BSS restart (also via RES command).

If you are using the TETRA radio and the KEEP-ALIVE timeout expires, the radio is reset and reconfigured.

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CFV (photovoltaic system configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
Activation system	1 ASCII	P = push button N = none, always activated	P
Half hours on/off duty cycle table 0	48 ASCII	One byte for every half hour 0 = panel off 1 = panel always on 2 – 9 = duty cycle 1/x	All 1
Half hours on/off duty cycle table 1	48 ASCII	One byte for every half hour 0 = panel off 1 = panel always on 2 – 9 = duty cycle 1/x	All 1
Default duty cycle table 0	1 ASCII	From 1 to 9	1
Default duty cycle table 1	1 ASCII	From 1 to 9	1
Maximum Daily Running Hour table 0	2 ASCII	From 1 to 24	24
Maximum Daily Running Hour table 1	2 ASCII	From 1 to 24	24
Month relationship table selection	12 ASCII	One character for each month 0 = table 0 1 = table 1	All 0

Attention, these parameters are specific for each type of panel and are communicated by Aesys, the customers can't change them.

If duty cycle equals 0 the power supply of the panel is off, not only the visualization! With values greater than zero, the panel is always powered and with values greater than 1 is only the visualization that is activated/deactivated.

If duty cycle equals 1 the visualization cycle is managed with standard parameters set in CFG.

Duty cycle represents the **ON** visualization period referred to one cycle period (visualization **ON** + visualization **OFF**).

Example with parameter set at 4: if the information is displayed for five seconds, the next visualization starts after $5 * (4 - 1) = 15$ seconds from previous visualization.

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TTS (Text to speech configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
Text to speech device type	1 ASCII	0 = with L&H 1 = with Aesys-Oki device	0
Baud Rate	5 ASCII	from 2400 to 19200	9600
Text to speech address	1 ASCII	"_" or "\"	–
Volume	3 ASCII	For type 0 = from 0 to 255 For type 1 = from 0 to 63	9
Rate	3 ASCII	From 0 to 255 (Used only with device type 0)	5
Voice	1 ASCII	"F" female "M" male (Used only with device type 0)	F
language	2 ASCII	"IT" Italian	IT
Restart time ⁴	2 ASCII	0 – 23 (99 = disabled)	2

MPL (Map bus routes)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
Status of 32 LEDs	8 ASCII Hex	Each bit: 0 = switch off 1 = switch on	0
Mode of 32 LEDs	8 ASCII Hex	Each bit: 0 = normal 1 = flashing	0

Each bit represents a single led. From the global 32-bit value you must derive the corresponding hexadecimal value and write it with ASCII characters.

For example, to switch on the leds number 0, 2, 7, and 10 (since the corresponding binary value is "10010000101") you must write the ASCII characters for the hexadecimal value "485".

⁴ Once a day, at the fixed time the text-to-speech device is restarted.

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CFL (layout configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
X coordinates of the EATs page header	3 ASCII	From 0 to 160	0
Y coordinates of the EATs page header	3 ASCII	From 0 to 80	1
EAT page header font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
EAT page header text	30 ASCII	ASCII string (NULL permitted)	NULL
Number of EATs per page	1 ASCII	From 1 to 10	1
X axis offset between the display of the next EAT	3 ASCII	From 0 to 160	0
Y axis offset between the display of the next EAT	3 ASCII	From 0 to 80	0
X coordinates of the bus route code	3 ASCII	From 0 to 160	0
Y coordinates of the bus route code	3 ASCII	From 0 to 80	1
Bus route code font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Bus route font mode	1 ASCII	N = Normal R = Reverse	N
Number of characters per bus route code	1 ASCII	From 1 to 9	6
X coordinates of the description	3 ASCII	From 0 to 160	0
Y coordinates of the description	3 ASCII	From 0 to 80	9
Description font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Number of characters of description	2 ASCII	From 0 to 40	12
X coordinates of the waiting time	3 ASCII	From 0 to 160	60
Y coordinates of the waiting time	3 ASCII	From 0 to 80	1
Waiting time font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Free text font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Date and time display flag	4 ASCII	P = date and time with EAT T = date and time with free text L = date and time with logo S = date and time with spot text I = date and time with EAT header (TPP command)	PTL

Real time bus stop sign

DETAILS: Real time bus stop sign: communication protocol.

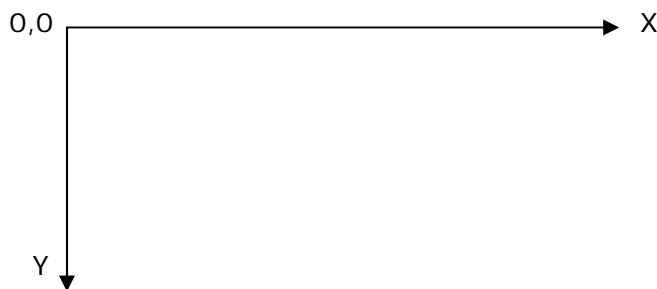
<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
		X=Date and time not displayed	
X coordinates of the date	3 ASCII	From 0 to 160	88
Y coordinates of the date	3 ASCII	From 0 to 80	65
X coordinates of the time	3 ASCII	From 0 to 160	131
Y coordinates of the time	3 ASCII	From 0 to 80	65
Data and time font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
X coordinates of the logo	3 ASCII	From 0 to 160	88
Y coordinates of the logo	3 ASCII	From 0 to 80	73
Logo font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Date format	15 ASCII	ASCII string with: \d = day of the month \m = month number \M = month abbr. \y = year (2 digit) \Y = year (4 digit) \D = day of the week abbr. \ = '\ ' character	\d \M
Time format	15 ASCII	ASCII string with: \h = time (24h) \H = time(12h) \m = minutes \s = seconds \: = flashing colon \A = show AM or PM \ = '\ ' character	\h\:\m

Real time bus stop sign

DETAILS:	Real time bus stop sign: communication protocol.
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Some notes on CFL command:

- Date and time must be displayed on the same line and they are permitted only in the first or in the last line of the panel. If the selected font is 14x7, two lines will be filled. In every case the lines used to show date and time can not be used for other information
- The sliding text is displayed in the last line, only with the EATs and always with a fixed font (7x5).
- The free text is always showed in a whole page. In case of date and time displayed on the first line, the free text will be automatically showed starting from the second line.
- Font and coordinate of free text and logo can be modified only if in their relative commands (TXT and CLO) are sent some CTRL-W sequence (for the font selection/position).
- The point of coordinate 0,0 is at the top and left of the BSS:



Real time bus stop sign		
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DETAILS: Real time bus stop sign: communication protocol.

CFP (EAT configuration) for DSPAGYYXXXNPRO

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
Maximum deviation between prediction and current time (in minutes)	2 ASCII	From 1 to 30 0 = not controlled	0
Maximal time that can be displayed (in minutes)	3 ASCII	From 0 to 240 0 = all	75
Max. number of EATs that can be displayed	3 ASCII	From 1 to 20 0 = all received EATs	10
Order	1 ASCII	L = by bus route O = by time	0
Number of EATs per bus route	1 ASCII	From 0 to 9 0 = all	0
Message waiting time threshold from 2 to 1 (in seconds)	3 ASCII	From 1 to 240	60
Message waiting time threshold from 3 to 2 (in minutes)	2 ASCII	From 1 to 120	60
Waiting time message 1 for a monitored EAT.	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
Waiting time message 2 for a monitored EAT	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
Waiting time message 3 for a monitored EAT	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
Waiting time message for a theoretical EAT	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
EAT alternation	1 ASCII	From 0 to 9 0 = no alternation	0
Free texts alternation	1 ASCII	From 0 to 9 0 = no alternation	0
Displayed time update threshold (in minutes)	1 ASCII	From 0 to 9	0
Waiting time TTS message 1 for a monitored EAT	30 ASCII	CTRL-W (0x17), NULL permitted and all visible ASCII characters	
Waiting time TTS message 2 for a monitored EAT	30 ASCII	CTRL-W (0x17), NULL permitted and all visible ASCII characters	
Waiting time TTS message 3 for a monitored EAT	30 ASCII	CTRL-W (0x17), NULL permitted and all visible ASCII characters	
Waiting time TTS message for a theoretical EAT	30 ASCII	CTRL-W (0x17), NULL permitted and all visible ASCII characters	

Real time bus stop sign

DETAILS: Real time bus stop sign: communication protocol.

CFP (EAT configuration) for DSPAGYYXXNPRS

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
Maximum deviation between prediction and current time (in minutes)	2 ASCII	From 1 to 30 0 = not controlled	0
Maximal time that can be displayed (in minutes)	3 ASCII	From 0 to 240 0 = all	75
Max. number of EATs pages that can be displayed	3 ASCII	From 1 to 10 0 = all received EATs pages	10
Order	1 ASCII	L = by bus route O = by time	0
Number of EATs per bus route	1 ASCII	From 0 to 9 0 = all	0
Message waiting time threshold from 2 to 1 (in seconds)	3 ASCII	From 1 to 240	60
Message waiting time threshold from 3 to 2 (in minutes)	2 ASCII	From 1 to 120	60
Waiting time message 1 for a monitored EAT.	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
Waiting time message 2 for a monitored EAT	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
Waiting time message 3 for a monitored EAT	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
Waiting time message for a theoretical EAT	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
EAT alternation	1 ASCII	From 0 to 9 0 = no alternation	0
Free texts alternation	1 ASCII	From 0 to 9 0 = no alternation	0
Displayed time update threshold (in minutes)	1 ASCII	From 0 to 9	0
Waiting time TTS message 1 for a monitored EAT	30 ASCII	CTRL-W (0x17), NULL permitted and all visible ASCII characters	
Waiting time TTS message 2 for a monitored EAT	30 ASCII	CTRL-W (0x17), NULL permitted and all visible ASCII characters	
Waiting time TTS message 3 for a monitored EAT	30 ASCII	CTRL-W (0x17), NULL permitted and all visible ASCII characters	
Waiting time TTS message for a theoretical EAT	30 ASCII	CTRL-W (0x17), NULL permitted and all visible ASCII characters	

Real time bus stop sign

DETAILS:	Real time bus stop sign: communication protocol.
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Some notes on CFP command:

- The difference between the two project **"DSPAGYYXXNPRO"** and **"DSPAGYYXXNPRS"** is only at the third parameter;
- The "Waiting time message" (1,2 and 3) fields contain the arrival time string to visualize. This string can be composed in two parts: the first one with a fixed text and the second one with the arrival time. All over the text it is possible to use the control sequence in order to create a flashing text: **CTRLW 'F'** "this is a flashing text" **CTRLW 'F'**.

Using the following keys you can select one of the different ways to view the arrival time:

- "\h" shows the absolute arrival time in the format HH:MM
- "\m" shows the missing minutes at the arrival time in the format MM;
- "\#" shows two squares that alternatively flashing (useful to indicate when the bus is coming)
- About the parameters "EATs alternation" and "Free texts alternation", you must know that, if you use the EATs-free texts alternation will not be displayed any sliding text sent through the TXS command (sliding text displayed with the EATs). Instead the sliding texts present in the free text pages (sent with the TXT command) still remain displayed;
- The "Threshold for updating the indicated time" parameter is used only when the new waiting time is greater than the current one. Otherwise (i.e. when it anticipates the estimation) the update is always displayed. We emphasize that this only affects the displayed data.

For example, assume that the threshold is set to 3 minutes and a EAT is 5 minutes. An update to 7 minutes keeps displayed "5 minutes" to 3 minutes before going to see 4 minutes, because the real time expectation is equal to 7 minutes.

CLO (Logo configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Logo	2048 ASCII	CTRL-W (0x17) and all visible ASCII characters

CDO (Date and time configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Date	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Time	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)

Real time bus stop sign

DETAILS: Real time bus stop sign: communication protocol.

CCS (Calibration of current and voltage sensors)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Photovoltaic current sensor	x ASCII	Floating point value -3.0 – 3.0 default 1.0
Photovoltaic current offset	x ASCII	Floating point value 0 – 2.0 default 1.0
Display current sensor	x ASCII	Floating point value -3.0 – 3.0 default 1.0
Display current offset	x ASCII	Floating point value 0 – 2.0 default 1.0
Pic power supply voltage	x ASCII	Floating point value 0 – 2.0 default 1.0
Pic AD1	x ASCII	Floating point value 0 – 2.0 default 1.0
Pic AD2	x ASCII	Floating point value 0 – 2.0 default 1.0
Pic AD3	x ASCII	Floating point value 0 – 2.0 default 1.0
Pic AD4	x ASCII	Floating point value 0 – 2.0 default 1.0

EON (Extend power up hours)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Hours	2 ASCII	1 – 23

Extend power up hours of the photovoltaic display to a maximum of 23 hours (overwrite, but not memorize, the programming hours defined with command CFV).

Real time bus stop sign

DETAILS: Real time bus stop sign: communication protocol.

BAT (Battery parameters)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
VA1	x ASCII	Floating point value -100.0 - +100.0
VA2	x ASCII	Floating point value -100.0 - +100.0
VA3	x ASCII	Floating point value -500.0 - +500.0
VA4	x ASCII	Floating point value 0.0 - +1.0
VA5	x ASCII	Floating point value 0.0 - +10.0
LUU	x ASCII	Integer value 16 – 2000
LUH	x ASCII	Integer value 16 – 2000
LUL	x ASCII	Integer value 16 – 2000
LX1	x ASCII	Integer value 16 – 2000
LX2	x ASCII	Integer value 16 – 2000
CBH	x ASCII	Floating point value 5.0 – 40.0
CBL	x ASCII	Floating point value 5.0 – 40.0
CNB	x ASCII	Integer value 50 - 250
GAM	x ASCII	Floating point value -1.0 - +5.0
BOH	x ASCII	Integer value 16 – 2000
BOL	x ASCII	Integer value 16 – 2000
FIH	x ASCII	Integer value 20 – 4000
FIL	x ASCII	Integer value 20 – 4000
WDH	x ASCII	Floating point value 1.0 – 30.0
WDL	x ASCII	Floating point value 1.0 – 30.0
WCO	x ASCII	Floating point value 3.0 – 20.0
WXL	x ASCII	Floating point value 0.001 – 0.1
CBR	x ASCII	Integer value 1000000 - 50000000

Real time bus stop sign

DETAILS: Real time bus stop sign: communication protocol.

CBD	x ASCII	Integer value 128 – 2048
DVB	x ASCII	Floating point value 0.2 – 2.0
BOF	x ASCII	Integer value 0 – 65535
MSA	x ASCII	Floating point value 0.0 – 1.0
MSO	x ASCII	Integer value 0 – 65535
MGA	x ASCII	Floating point value 0.0 – 100.0
PS1	x ASCII	Integer value 0 – 100
PS2	x ASCII	Integer value 0 – 100
PS3	x ASCII	Integer value 0 – 100
PS4	x ASCII	Integer value 0 – 100
NOT LX	x ASCII	Integer value 0 – 1
ADY THRESHOLD	x ASCII	Floating point value 0.0 – 1.0

Real time bus stop sign

DETAILS:	Real time bus stop sign: communication protocol.
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PRV (EAT activation/update) MAX 100

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Estimated Arrival Time ID	8 ASCII hex	
Validity time (in minutes)	4 ASCII	From 0 to 1439 (24 hours) If the value is set to 0, the BSS considers a EAT valid for 15 seconds.
Bus route code	X ASCII	As configured
Description	X ASCII	As configured and NULL
Estimated absolute time of vehicle arrival	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Waiting hours	2 ASCII	From 0 to 23
Waiting minutes	2 ASCII	From 0 to 59
Waiting seconds	2 ASCII	From 0 to 59
Estimation flag monitored / theoretical / cancel	1 ASCII	T = theoretical M = monitored C = cancel
Bus route code displayed flag	1 ASCII	S = yes N = no

Before accepting the insertion or update of a EAT the BSS performs a consistency check between the absolute arrival time predicted, the waiting time predicted and the message arrival time.

A EAT is discarded if the following test is true:

$$(\text{current_time} + \text{waiting_time_predicted} - \text{estimated_absolute_time_of_vehicle_arrival}) > \text{Maximum_deviation_parameter}$$

When the predicted bus arrival time expires, the deletion of a EAT can happen for two reasons:

- Based on the validity time set by the operative center;
- Through the "single EAT deletion" command (DPR).

DETAILS:	Real time bus stop sign: communication protocol.
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PRW (Text to speech EAT activation/update) MAX 100

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Estimated Arrival Time ID	8 ASCII hex	
Validity time (in minutes)	4 ASCII	From 0 to 1439 (24 hours) If the value is set to 0, the BSS considers a EAT valid for 15 seconds.
Bus route code	X ASCII	As configured
Description	X ASCII	As configured and NULL
Estimated absolute time of vehicle arrival	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Waiting hours	2 ASCII	From 0 to 23
Waiting minutes	2 ASCII	From 0 to 59
Waiting seconds	2 ASCII	From 0 to 59
Estimation flag monitored/theoretical/cancel	1 ASCII	T = theoretical M = monitored C = cancel
Bus route code displayed flag	1 ASCII	S = yes N = no
Text to be vocalize, instead of the description	100 ASCII	

For arrival times checking you can apply the same considerations already made for PRV command.

Real time bus stop sign

DETAILS: Real time bus stop sign: communication protocol.

PRA (Multiple EATs activation/update/deletion) MAX 100

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Number of EATs contained in this message	3 ASCII	From 1 to 100
Data buffer composed by n records, each of which composed by the following fields:	Variable up to 1300 Bytes	
Estimated Arrival Time ID	8 ASCII Hex	
Validity time (in minutes)	4 ASCII	From 0 to 1439 (24 hours) If the value is set to 0, the BSS considers a EAT valid for 15 seconds.
Bus route code	X ASCII	As configured
Description	X ASCII	As configured and NULL
Estimated absolute time of vehicle arrival	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Waiting hours	2 ASCII	From 0 to 23
Waiting minutes	2 ASCII	From 0 to 59
Waiting seconds	2 ASCII	From 0 to 59
Estimation flag monitored/theoretical/cancel	1 ASCII	T = theoretical M = monitored C = cancel
Bus route code displayed flag	1 ASCII	S = yes N = no

For arrival times checking you can apply the same considerations already made for PRV command.

Real time bus stop sign

DETAILS: Real time bus stop sign: communication protocol.

PRM (Multiple text to speech EATs activation/update/deletion) MAX 100

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Number of EATs contained in this message	3 ASCII	From 1 to 100
Data buffer composed by n records, each of which composed by the following fields:	Variable up to 1300 Bytes	
Estimated Arrival Time ID	8 ASCII Hex	
Validity time (in minutes)	4 ASCII	From 0 to 1439 (24 hours) If the value is set to 0, the BSS considers a EAT valid for 15 seconds.
Bus route code	X ASCII	As configured
Description	X ASCII	As configured and NULL
Estimated absolute time of vehicle arrival	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Waiting hours	2 ASCII	From 0 to 23
Waiting minutes	2 ASCII	From 0 to 59
Waiting seconds	2 ASCII	From 0 to 59
Estimation flag monitored/theoretical/cancel	1 ASCII	T = theoretical M = monitored C = cancel
Bus route code displayed flag	1 ASCII	S = yes N = no
Text to be vocalize, instead of the description	100 ASCII	

For arrival times checking you can apply the same considerations already made for PRV command.

Real time bus stop sign

DETAILS:	Real time bus stop sign: communication protocol.
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DPR (Single EAT deletion)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Estimated Arrival Time ID	8 ASCII hex	

This command deletes the EAT from the BSS memory. If the EATs page is displaying at this moment, the EAT continues to be showed. It will be completely removed only at the next display cycle.

DPI (Single EAT immediate deletion)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Estimated Arrival Time ID	8 ASCII hex	

This command deletes the EAT from the BSS memory (as the previous DPR command) and also from the display cycle if there are the following condition:

- Are not active any sliding texts with EAT (TXS command);
- The EAT in question is not present in the page currently displayed;
- If you're currently viewing the EAT page header and the EAT is not the only there;

DPA (All EATs deletion)

No data fields

DETAILS: Real time bus stop sign: communication protocol.

TXT (Free text activation/update) MAX 20

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII Hex	
Activation date ⁵	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Activation time	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Deactivation date	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Deactivation time	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Text ⁶	1650 ASCII	CTRL-W (0x17) and all visible ASCII characters
Concatenated message ID. (0 = none concatenated message) ⁷	8 ASCII Hex	

DTX (Single free text deletion)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII hex	

DTA (All free texts deletion)

No data fields

⁵ If the initial date is equal to the final date and the initial time is equal to the final time, the text is always valid.

⁶ If you need to compose the text with the control characters CTRLW (for example to insert a sliding line) is always required that the text start with the CTRLW even though the first part does not need any particular effects.

If the text begins with CTRLW, the formatting (next line alignment) must be done manually in the text itself (otherwise the automatic formatting only manage a single character, not whole words).

⁷ The concatenated message ID must be contiguous and in ascending order.

DETAILS: Real time bus stop sign: communication protocol.

TSP (Spot text activation/update) MAX 5

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII Hex	
Text ⁸	X ASCII	As configured
Concatenated message ID. (0 = none concatenated message) ⁹	8 ASCII Hex	

DSP (Single spot text deletion)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII hex	

DST (All spot texts deletion)

No data fields

TPP (EAT page header activation)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Text ⁸	1650 ASCII	As configured

DPP (EAT page header deletion)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII hex	

⁸ If you need to compose the text with the control characters CTRLW (for example to insert a sliding line) is always required that the text start with the CTRLW even though the first part does not need any particular effects.

If the text begins with CTRLW, the formatting (next line alignment) must be done manually in the text itself (otherwise the automatic formatting only manage a single characters, not whole words).

⁹ The concatenated message ID must be contiguous and in ascending order.

DETAILS:	Real time bus stop sign: communication protocol.
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TXS (Sliding text activation/update) MAX 50

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII hex	
Activation date ¹⁰	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Activation time	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Deactivation date	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Deactivation time	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Text	100 ASCII	

If, after the activation of a sliding message, the sliding speed is changed, the message remains at the speed defined at the time of its activation.

Pay attention. This command does not function if the alternation free text-EATs page is enabled (See parameters and notes of CFP command).

DTS (Single sliding text deletion)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII hex	

The TXS and DTS commands are available only if the layout provides the bottom line sliding and if it does not used the free text-EATs page alternation.

DSA (All sliding texts deletion)

No data fields

¹⁰ If the initial date is equal to the final date and the initial time is equal to the final time, the text is always valid.

DETAILS:	Real time bus stop sign: communication protocol.
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ATF (Phone number for voice call)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Phone number to call	20 ASCII	ASCII string

POL (Request status (polling))

No data fields. BSS polling.

POE (Request extended status (extended polling))

No data fields. BSS polling.

DIA (Diagnostics)

No data fields. Use this command only in SMS or TETRA radio mode. Otherwise, use the POL command.

KAL (Keep-alive)

No data fields. When this message is received, the "received message timeout" BSS side is reset.

RES (Reset)

No data fields. This message causes the BSS restart.

DEF (Default)

No data fields. The receiving of this command forces the default configuration data. It also deletes all data (EAT, sliding and free texts) and restart the CPU.

VER (Firmware version)

No data fields. It requests the firmware version.

VEM (Wavecom modem version)

No data fields. It requests the Wavecom modem version.

GDO (Reading date and time from BSS)

No data fields. It requests current date and current time.

GGR (Reading BSS graphic image)

No data fields. It requests the current image displayed on the BSS, in the format described in [chapter 10](#).

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DETAILS:	Real time bus stop sign: communication protocol.
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5.2 Binary commands

These are the commands that do not involving the “;” character as fields separator (See [section 2.2.1](#)).

DFW (Begin remotely firmware upgrade)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Flag	1 Binary	Bit = 0 forces the deletion of the RAM (with battery buffer);

DAT (Send firmware update data packets)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Packet number	1 Binary	0 – 255 circular
Data buffer	Variable Binary	0 - 255

DAF (End remotely firmware upgrade)

No data fields. After this command, the BSS restarts with the new firmware.

UCO (GPRS connection)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Mode	1 alphanumeric ASCII	C = connect L = listen
IP address	4 binary	Big-endian format (H-L)
TCP port	2 binary	Big-endian format (H-L)
TCP source port	2 binary	Big-endian format (H-L) 0 = the value is chosen by the device

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DETAILS: Real time bus stop sign: communication protocol.

UDI (GPRS dial-up)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
APN	Variable (max. 64) alphanumeric ASCII	With null terminator.
ID	Variable (max. 64) alphanumeric ASCII	With null terminator.
Password	Variable (max. 20) alphanumeric ASCII	With null terminator.

UCM (GPRS/GSM switch)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Device	1 Binary	0 = GPRS (UBICOM) 1 = GSM (MODEM)

UPO (GPRS polling)

No data fields.

XRE (GPRS reset)

No data fields.

XVE (UBGPRS firmware version request)

No data fields.

Real time bus stop sign

DETAILS: Real time bus stop sign: communication protocol.

6 Responses details sent by the BSS

6.1 ASCII responses

RPE (Extended Polling response)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
BSS address	5 ASCII	From 0 to 16127
Status	4 ASCII Hex	From 8049 to 804D
Temperature (°C)	3 ASCII	From -20 to 100 -99 = probe error
Battery Volts	4 ASCII	From 0 to 19.9
Leds Power Supply voltage (volts)	4 ASCII	From 0 to 19.9
Photovoltaics current (amperes)	4 ASCII	Form 0 to 99.9
Load current (amperes)	4 ASCII	From 0 to 99.9
Battery Charge %	3 ASCII	From 0 to 100
Environmental brightness	3 ASCII	From 0 to 99 255 = sensor error
Outdated operating hours (*)	1 ASCII	T = true F = false
Forced power down due to low battery level (*)	1 ASCII	T = true F = false
Photovoltaics System alarm	1 ASCII	T = true F = false
Programmed power down (*)	1 ASCII	T = true F = false
Day minutes power up	4 ASCII	From 0 to 1440
Day seconds leds on	5 ASCII	From 0 to 86400
Photovoltaics Volts (**)	4 ASCII	From 0 to 19.9
Battery Volts at startup (**)	4 ASCII	From 0 to 19.9
Days of autonomy (**)	3 ASCII	From 0 to 4.0

(*) When this flag is true, the display turns off within 5 minutes.

(**) fields added only in DSPAGYYXXXAPRS firmware

Real time bus stop sign

DETAILS: Real time bus stop sign: communication protocol.

RPO (Polling response)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
BSS address	5 ASCII	From 0 to 16127
Status	4 ASCII Hex	From 8049 to 804D
Temperature (°C)	3 ASCII Hex	From -20 to 100 -99 = probe error

RVE (VER command response)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Firmware code	6 alphanumeric ASCII	
Firmware description	variable alphanumeric ASCII	
PIC firmware+pld version	variable alphanumeric ASCII	Optional: this field is present only with PIC card installed.

RVM (VEM command response)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
ATI3	variable alphanumeric ASCII	
AT+WHWV	variable alphanumeric ASCII	
AT+WSSW	variable alphanumeric ASCII	

Real time bus stop sign

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ACK (Generic positive response)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Control	3 ASCII	0 = OK 1 = Unrecognized command 2 = Syntax error 3 = Data field not valid 4 = Length error 5 = Unexpected command 6 = Flash memory error 7 = EAT not deleted because it does not exist 8 = EAT does not added because it has been deleted by ShortRange 9 = maximum number of EATs/texts exceeded 10 = EAT does not added due to the failure of the time checking

NAK (Negative response due to checksum error)

No data fields.

RRA (PRA and PRM commands response) MAX 100

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Number of EATs	3 ASCII	From 1 to 100
Data buffer composed by n records, each of which composed by the following fields:	Variable up to 300 Byte	
Estimated Arrival Time ID	8 ASCII Hex	
Result (if this value is different from 0, the EAT is not added)	1 ASCII	See the ACK coding

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RDO (GDO command response)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Date	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Time	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)

RGR (GGR command response)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Data. The format is defined in chapter 10 .	4000 ASCII	All visible ASCII characters

Real time bus stop sign

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Tetra radio response at the DIA command (DIAGNOSTIC)

In TETRA radio mode, the BSS communicates with the operative center only through the DIA command. There are two possible BSS responses, based on the configured TETRA radio type:

- MODO_1: you must use the Status command (specified by Sepura radio). This command has only one data field with values between 32768 and 65535 (From 8000 up to FFFF Hex);
- MODO_2: you must use a SDS-FULL with the STS command. It is composed by all the fields expected by PRO+RVE+RDO (queued together).

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
BSS address	5 ASCII	From 0 to 16127
Status	4 ASCII Hex	From 8049 to 804D
Temperature (°C)	3 ASCII Hex	From –20 to 100 -99 = probe error
Firmware code	6 alphanumeric ASCII	
Firmware description	variable alphanumeric ASCII	
Date	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Time	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)

The command received by the operative central will be: (suppose BSS address equals to 1):

STS;1;8049;27;D8G02A;[220720080925];220708;140255;

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The STATUS message is sent to the operative center in the following cases:

- At BSS startup (or reboot by RES command);
- As consequence of a DIA command;
- As consequence of a “Keep-Alive timeout” expired followed by a correct radio re-initialization;

The possible values for the data field are the following (the values are represented in hexadecimal format):

- 8049 = everything OK;
- 804A = system reboot;
- 804B = default loaded (with the specific command, or in case of data loss);
- 804C = request for a voice call;
- 804D = leds board fault;

Every status change is communicated only at the next status request.

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6.2 Binary responses

These are the responses that do not involving the “;” character as fields separator (See [section 2.2.1](#)).

ACB (Generic positive binary response)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Control	1 Binary	0 = OK 1 = Unrecognized command 2 = Syntax error 3 = Data field not valid 4 = Length error

RDA (DAT command response)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Packet number	1 Binary	0 – 255 circular
Control	1 Binary	0 = OK 1 = Numbering error 2 = Data error 3 = Memory error

URP (UPO command response)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Connection status	1 Binary	0 = link not present 1 = dial-up 2 = available link 3 = listening 4 = connecting 5 = connected 128 = no carrier bit 6 = ring

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XRV (XVE command response)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Firmware code	6 alphanumeric ASCII	
Firmware description	variable alphanumeric ASCII	

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7 Example of data exchange with TETRA radio (at BSS side)

In the following examples, the data contained in square brackets [] are hexadecimal values.

7.1 BSS: commands received

When the operative central send a "Data and time configuration" command (suppose that today is June 15th 2005 and now is 16:00:00), it sent this string: **CDO;150605;160000;**

A BSS, configured with MODO_1, will receive the following string:

**[OD][OA]+CTSDSR:12,222000100000101,1,222000100000109,1,160[OD][OA]8204FF0
143444F3B3135303630353B3136303030303B[OD][OA]**

The underlined characters represent the 4 bytes that identify an SDS-FULL message (but they may change).

Otherwise, if the BSS is configured with MODO_2, it will receive the following string:

+CMT:_101,1,144[OD][OA]43444F3B3135303630353B3136303030303B[OD][OA]
101 represents the source address.

7.2 BSS: sending STATUS message to the operative center: MODO_1

The BSS, in order to send the STATUS at the operative center, must compose the following command (in this example we send the data 33000 at the gateway 821):

AT+CMGS=821,16[OD][OA]80E8[1A]

As confirmation of the correct sending, the BSS will receive the following string:

[OD][OA]+CMGS:0,2,0[OD][OA][OD][OA]OK[OD][OA][OD][OA]+CMGS:0,2,0[OD][OA][OD][OA]+CTSDSR:13,222000116777213,1,222000100000109,1,16[OD][OA]FE00[OD][OA]

The underlined characters are the confirmation of the correct transmission of the STATUS message.

7.3 BSS: sending STATUS message to the operative center: MODO_2

The BSS, in order to send the STATUS at the operative center, must compose a SDS-FULL (in this example we send a message at the gateway 101):

**AT+CMGS=101,1,0,864[OD]8200005354533B313B383034393B2D39393B4438473032
413B5B3232303732303038313634305D3B3135303630353B3136303534383B[1A]**

Using the MODO_2 mode, you do not have any suggestion about the correctness of the transmission.

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8 Secondary protocol: ShortRange

If the bus is equipped with a ShortRange device, it can communicate directly with the BSS (obviously only if it is near the bus stop) in order to delete the information about its arrival.

There are two different modes to delete that information:

- 1) If the bus does not stop in front of the BSS, the information will be deleted after 10 seconds from the receiving of the last delete command.
- 2) if the bus stops and opens its doors, the information is immediately erased;

The configuration string for the ShortRange device is the following:

"SerialCode=1_BusNode=1_BSSNode=2_".

The parameters *BusNode* and *BSSNode* can be changed but they must be all equal in the same bus fleet.

8.1 Aesys protocol

The Aesys protocol is composed in this way:

<EAT-id >;<opened-doors>;\$

where:

',' (ASCII hex 3B)

is the fields separator character;

<EAT-id>

is the EAT ID to be deleted (8 ASCII characters Hex)

< opened-doors >

is a flag that indicates if the bus doors are opened (ASCII 1) or closed (ASCII 0)

\$ (ASCII hex 24)

is the character that ends the command.

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8.2 Short Range transport protocol

The ShortRange device requires that the data buffer to be transmitted is encoded as follows:

<STX><destination node><data field>

where:

<STX> (ASCII hex 2)

the initial sync;

<destination node>

These two bytes are used to identify the destination node of the packet;

<data field>

Data packet to be sent. It represents the delete command written with the Aesys protocol ([section 8.1](#)). Its length is variable.

<destination node> and **<data field>** contain bytes in hexadecimal ASCII format; according to this notation each byte is replaced by two bytes representing the hexadecimal form with printable ASCII characters.

For example:

- BSS node = 2 (decimal);
- EAT ID = 35 (decimal);
- Doors state = closed;
 - o Data field: "35;0;\$";
 - o Complete command: "[02] 02 33 35 3B 30 3B 24" ([02] is the binary 2);

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9 Free text composition

The free text buffer is composed by all the characters that can be visualized on the BSS.

Some display effects can be applied to the text by inserting the sequences described in the table below:

SEQUENCE	EFFECT
CTRL_W + 'N' + F + C	<u>Selects the F font and uses C as inter-column space</u> F = '0' ⇒ Font 7x5 F = '1' ⇒ Font 6x5 F = '2' ⇒ Font 7x7 F = '3' ⇒ Font 14x7 F = '4' ⇒ Font 8x5 F = '5' ⇒ Font 8x7 C should be between '0' and '9'
CTRL_W + 0 + XX + YY	Sets the text position XX – X coordinate (2 hexadecimal characters) YY – Y coordinate (2 hexadecimal characters)
CTRL_W + 'E'	<u>Begin/end expanded text</u>
CTRL_W + 'F'	<u>Begin/end flashing text</u>
CTRL_W + 'C'	<u>Begin/end compacted (proportional) text</u>
CTRL_W + 'V' + 00 + 00	<u>Begin sliding text</u> V = sliding speed (0=min / 9=max) Pay attention: the sliding text is displayed only in the last line of 8 pixels in height, then you can not use the font 14x7
CTRL_W + 'S' + V + XX + YY + WW	<u>Begin sliding text area</u> ONLY FOR DSPAGYYXXXNPRS V = sliding speed (1=min / 9=max) XX – X coordinate (2 hexadecimal characters) YY – Y coordinate (2 hexadecimal characters) WW – W width sliding area Pay attention: <ul style="list-style-type: none"> - the sliding speed are required but is ignored, the speed used id defined in CFG;

CTRL_W = 17 hexadecimal

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In the following table there are some examples of how the decimal coordinates are converted into hexadecimal ASCII format (upper case letters)

X and Y (decimal)	X and Y (hexadecimal)	X and Y (hexadecimal ASCII)
0, 0	0x00, 0x00	0x30 0x30 0x30 0x30
5, 3	0x05, 0x03	0x30 0x35 0x30 0x33
25, 19	0x13, 0x0D	0x31 0x33 0x30 0x44

10 Graphical page composition

Inside a graphical area, each pixel can be either switched on or off. The display can be described as composed by several line each of which is 8 pixels in height. The status of these 8 pixels is controlled by a single byte (the MSB is the higher pixel and the LSB is the lowest one). This byte is then encoded with 2 hexadecimal byte. For example:

1	2	3	4	5

The first column is controlled with the sequence 11101010 (1=on, 0=off). The relative hexadecimal value is EA, that is the correct encoding for this column.

Column 1 → 1110 1010 → "EA"

Column 2 → 0011 0111 → "37"

Column 3 → 1000 1000 → "88"

Column 4 → 0000 0000 → "00"

Column 5 → 1111 1111 → "FF"

To display the example image, the complete buffer to send is

CTRL_W 'G' 'E' 'A' '3' '7' '8' '8' '0' '0' 'F' 'F' CTRL_W 'G'

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