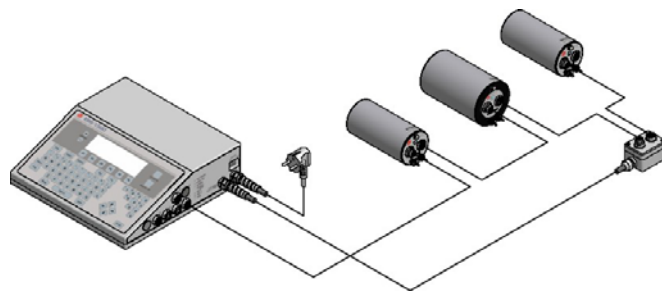


EBS-1500 MULTIHEAD SYSTEMS

OPERATING INSTRUCTIONS



WERSJA: 20060915#3.0

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Dear User,

This Manual contains very useful information on how to operate your Ink-Jet Printer. Please read this Manual carefully.

This version (3.0) of the document applies to multi-head printing systems which are based on the EBS-1500 printer controller and is the continuation of the operating instructions (version 20.8), which applied to EBS-1500 printers with all head types, including multi-head systems.

As the machine and options can be customised, the product delivered to you depends on your specific order. Therefore some descriptions or illustrations may differ slightly from your equipment. As we need to keep pace with new technological advancement, we reserve the right to introduce changes in the design and technical solutions adopted. In view of the above, no data, illustrations or description shall make grounds for any claims. Should your printer be equipped with options that are not described or illustrated in the Manual or should you have additional queries after having read the Manual, please contact any EBS representative for more information.

1. General Information

NOTE:

There are warning and information signs on the right or left hand-side margins of some pages to attract user's attention to messages that are provided next to them. They are the following signs:



Information signs indicating:

- that the actions described should be taken carefully,
- additional, printer-specific option and features,
- untypical behaviour of the unit,
- other hints.



A warning not to take the action that might have a critical impact on the proper operation of the unit. It requires the user to follow closely instructions given therein.



An indication that the description concerns a 1500/00 electromagnetic head only.



An indication that the description concerns a 1500/20 series piezoceramic head only.

**The Manufacturer reserves the right to introduce changes whose description may not be provided in this manual.
The Manufacturer shall not bear any responsibility for damages resulting from the failure to follow the instructions or consequences of editorial or publishing errors within the instructions.**

2. Environmental protection

On withdrawing **EBS-1500** printing systems from use do not take system elements out together with other waste. Pursuant to Directive No. **2002/96/EC** of the Council of the European Community on waste electrical or electronic equipment, the elements of the **EBS-1500** printing systems must be separated from other waste after they have been withdrawn from use and processed in an environmentally friendly way.



3. Application and Description of the Multi-Head Printing System (EBS-1500)

Considering label creation methods and materials to be labelled, the multi-head **INK-JET** printers have the same applications as single-head printers have. In terms of complexity, we should talk about a printing system instead of a simple printer.

The multi-head systems are based on the series of **EBS-1500** single-head printers. Each print-head can print a label independently from the other on an object (or a few objects) moving on a factory conveyor. This document is an extension of *The **EBS-1500** Series Printer Operating Instructions* and therefore it does not describe all options but only those that concern multi-head systems.

The multi-head systems are characterized by the following qualities:

- The entire printing system is equipped with print-heads of the same type - which can be either electromagnetic or piezoceramic. The electromagnetic print-heads can have 5, 7, 12, 16, 25, 32 or 64 nozzles and print-heads of various numbers of nozzles can be mixed. The piezoceramic print-heads are

32 or 64 dot (pixel) print-heads. Each of the 32-dot print-heads can contain 192 or 352 nozzles, and each of the 64-dot print-heads can contain 64 or 128 nozzles.

NOTE:

The only exception is a printing system with “mixed”, piezoceramic and electromagnetic print-heads, that is described in section **4.6 A printing system with “mixed” (piezoceramic and electromagnetic) print-heads**.



- The print-head system contains one controller for all print-heads.
- Each print-head can be installed at any place and position in relation to object labelled except for piezoceramic print-heads, which always need to work in the horizontal position.
- All heads are activated by one photo-detector and printing is timed by one internal generator or one external speed indicator (shaft-encoder). The location of labels produced by individual print-heads after a release signal has been generated by the photo-detector is defined with the print parameter **initial distance** for each print-head separately.
- The printing system can contain from 1 up to 6 print-heads which can print different labels. In the case of electromagnetic 25, 32 and 64-dot print-heads and piezoceramic print-heads, the number of print-heads can be restricted.

Special configurations of print-heads are available on request. For example, a system has been designed containing eight 7-nozzle electromagnetic print-heads for printing the same labels. The system contains a big common ink pot equipped with a low level detector. Certain constraints may be applied for complex printing systems; therefore details concerning the printing system’s specifications should be agreed with the dealer before any order is placed.

- All print-heads are connected in series within the printing system. Piezoceramic print-heads have Ink Monitoring Systems (**IMS** in short) built in and are connected one to another with a common interface cable. If a compressor system is used, electromagnetic print-heads are connected one to another with one interface cable, while the **IMS** systems, which are independent from the print-heads, are connected (also in series) via another interface cable. Electromagnetic print-heads should be connected in a slightly different way if the printing system is based on an ink system with an ink pump (such systems are shown in **Fig. 4.2.3 - Fig. 4.2.6**). The **IMSs** are integrated with ink systems. Each print-head has a specific ink system, whose ink bottle is controlled by a specific **IMS**. Both the heads and the corresponding **IMS** systems need to be connected in ascending order by their numbers.

NOTE:

The printing system where one ink system with an ink pump serves more than one electromagnetic print-head is an exception.



4. Installing the Printing System

Before starting the installation, one should become familiar with the following sections of the Operating Manual:

- ☞ **Safety Requirements,**
- ☞ **Power and Air Supply Requirements,**
- ☞ **Preparatory Steps,**
- ☞ **Removing Transport Protections,**
- ☞ **Connections.**

4.1. Restrictions on Printing System Configuration

Certain restrictions need to be followed while installing multi-head systems in order to ensure the proper operation of such systems.

They are the restrictions on:

- Software – a maximum of 6 print-heads can be connected (even if the other restrictions would enable a user to connect a greater number of print-heads),
- Current input for the heads and current efficiency of the printer controller,
- The number of bits transmitted to heads per one clock cycle.

4.1.1. The number of bits transmitted

In the controller of EBS-1500 series printers, the maximum number of bits transmitted to print-heads in one data transmission cycle is **256**.

The following number of bits is required by different print-head types in multi-head systems:

Print-head type	Required number of bits
7, 12 and 16-dot electromagnetic heads	32
25 and 32-dot electromagnetic heads	64
64-dot electromagnetic heads	80
96/32, 192/32, 352/32 piezoceramic heads	32
64/64, 128/64 piezoceramic heads	64

While configuring a printing system make sure that the sum of bits transmitted to all heads does not exceed **256**.



4.1.2. Current input for electromagnetic heads

The current input for electromagnetic heads depends on the following factors:

- intensity,
- product of resolution, **R**, and shift, **P**, (**R*P** defines the number of rows printed during a unit of time),
- number of nozzles used for printing at the same time.

The total current input for the head is calculated with the following formula:

$$I_h = 0.065 + 0.167 * 10^{-6} * (20 + INTENS/2) * R * P * D * WW$$

NOTE:

For the intensity smaller than **63** an adjustment of **(63-INTENS)/2**% should be added.

where:

INTENS – a setting of the **Intensity** parameter made in the print parameter menu,

R – print resolution, a setting of the **Resol.dot/dcm** parameter made in the print parameter menu,

P – shift, a setting of the **Cnv spd m/min** parameter made in the print parameter menu,

D – the number of nozzles in an electromagnetic head,

WW – tuning factor, it defines the number of nozzles used to print one vertical row of text. If all of the nozzles (e.g. 32 for a 32-dot head) are used to print a vertical row, then WW=1. If only a half of the nozzles is used, then WW is 0.5. In typical applications the WW factor does not exceed 0.5, however WW=1 has been taken to estimate the maximum current input for a given head.

The above formula has been used to draw up charts of the maximum current input vs. intensity for 16, 25, 32 and 64-dot print-heads if all nozzles are used to print a vertical row (WW=1).

Electromagnetic 16-nozzle head

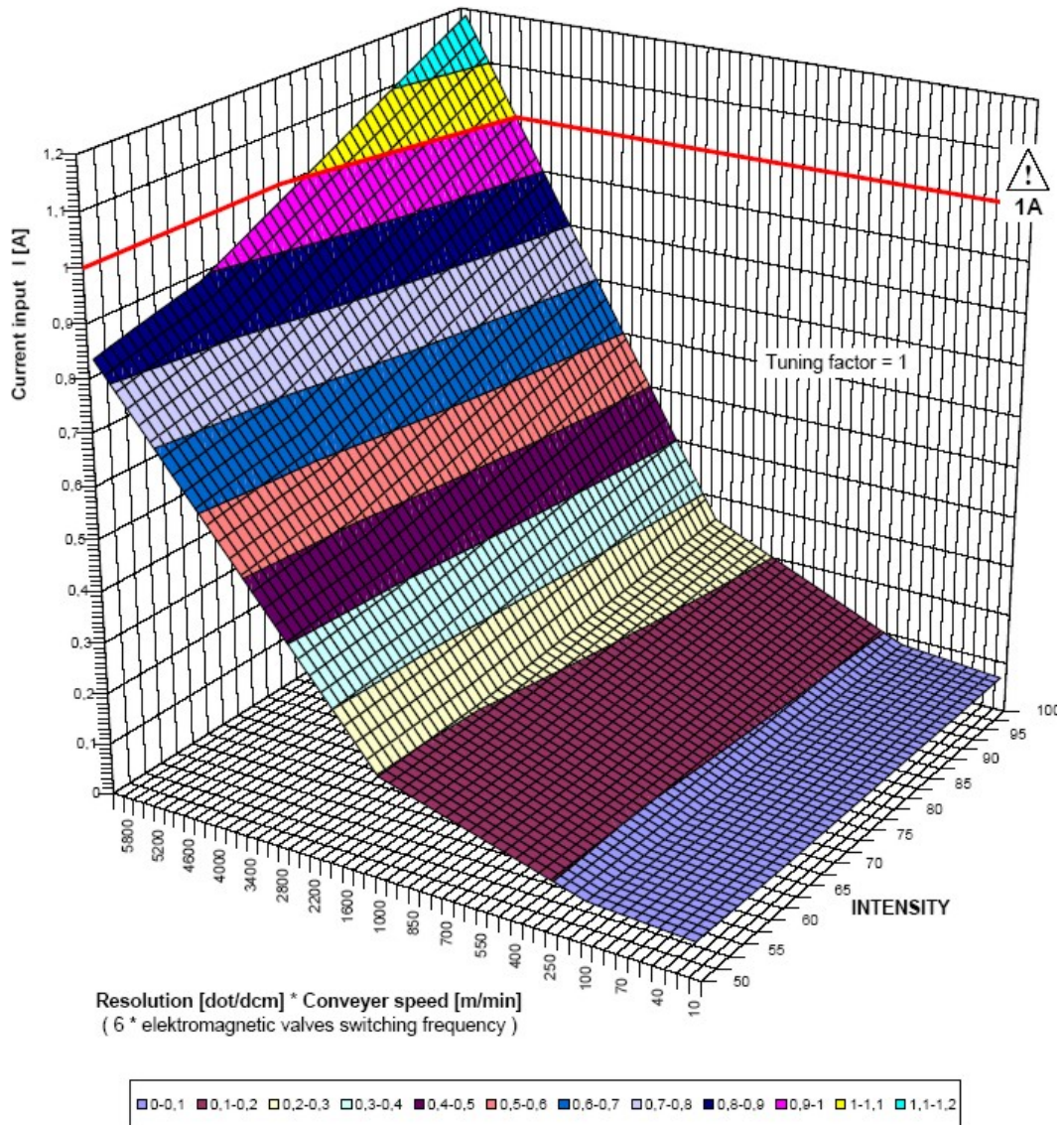


Fig. 4.1.2.1. Maximum current input vs. print parameters for an electromagnetic 16-dot head

Electromagnetic 25-nozzle head

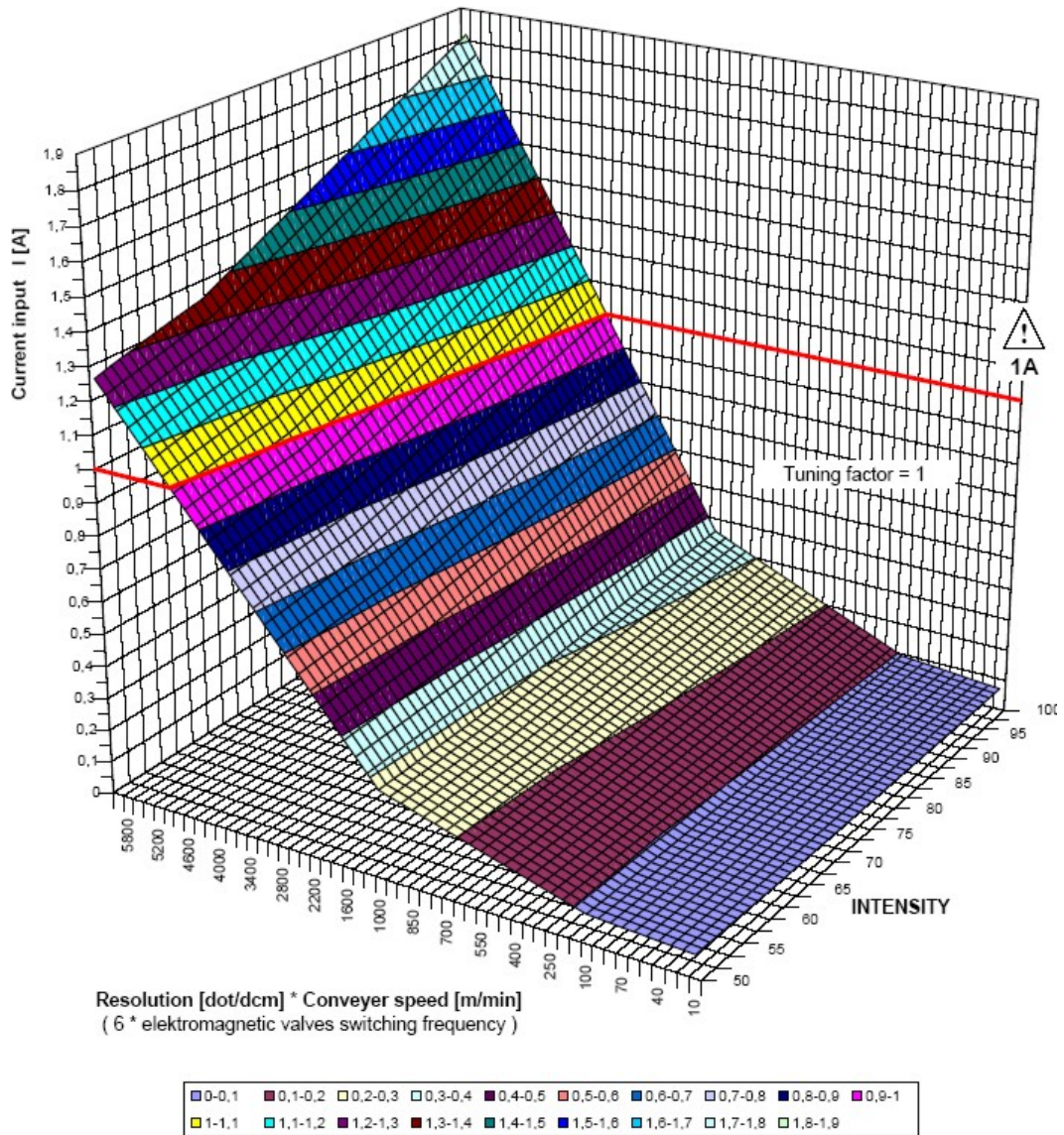


Fig. 4.1.2.2. Maximum current input vs. print parameters for an electromagnetic 25-dot head

Electromagnetic 32-nozzle head

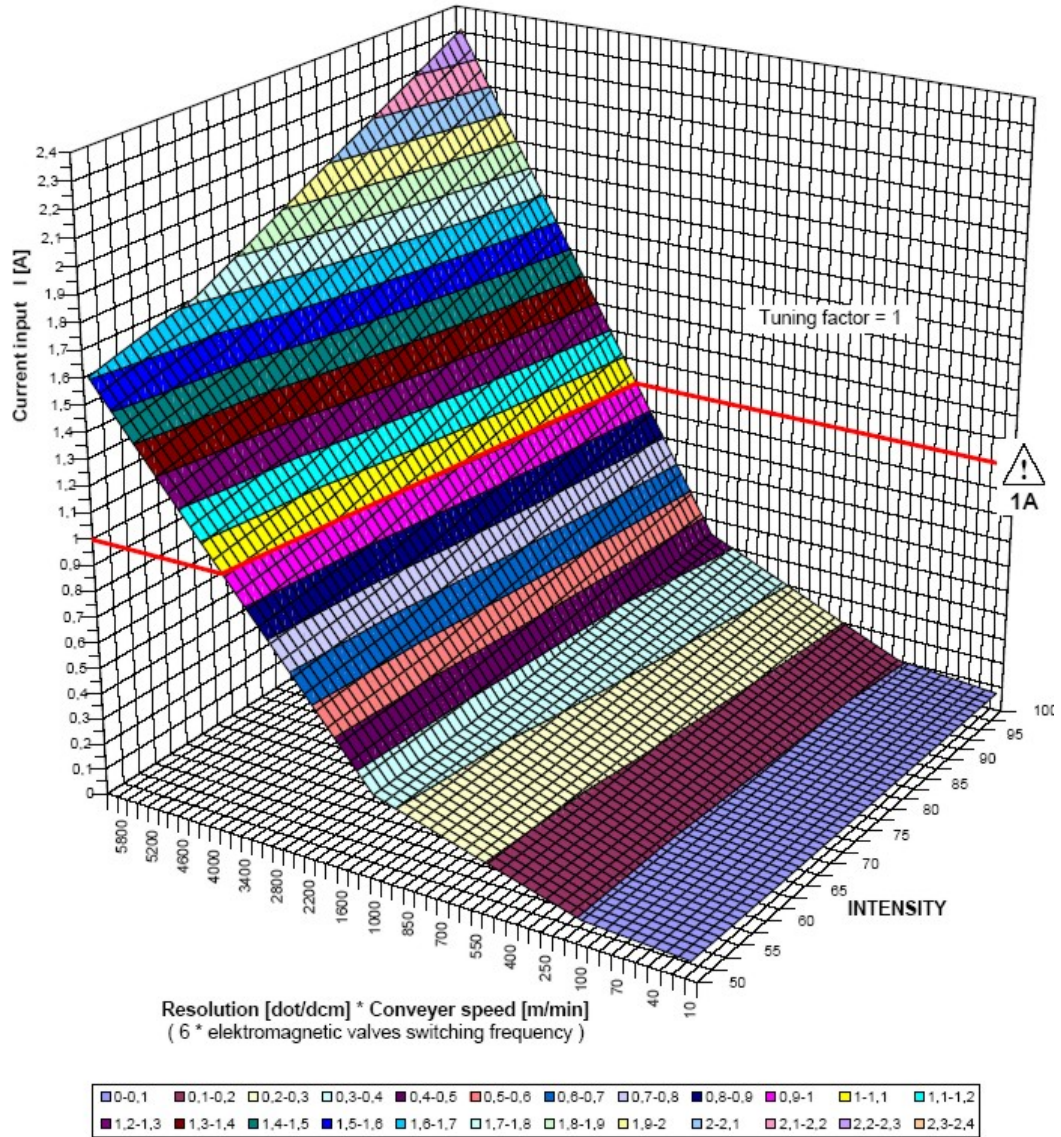


Fig. 4.1.2.3. Maximum current input vs. print parameters for an electromagnetic 32-dot head

Electromagnetic 64-nozzle head

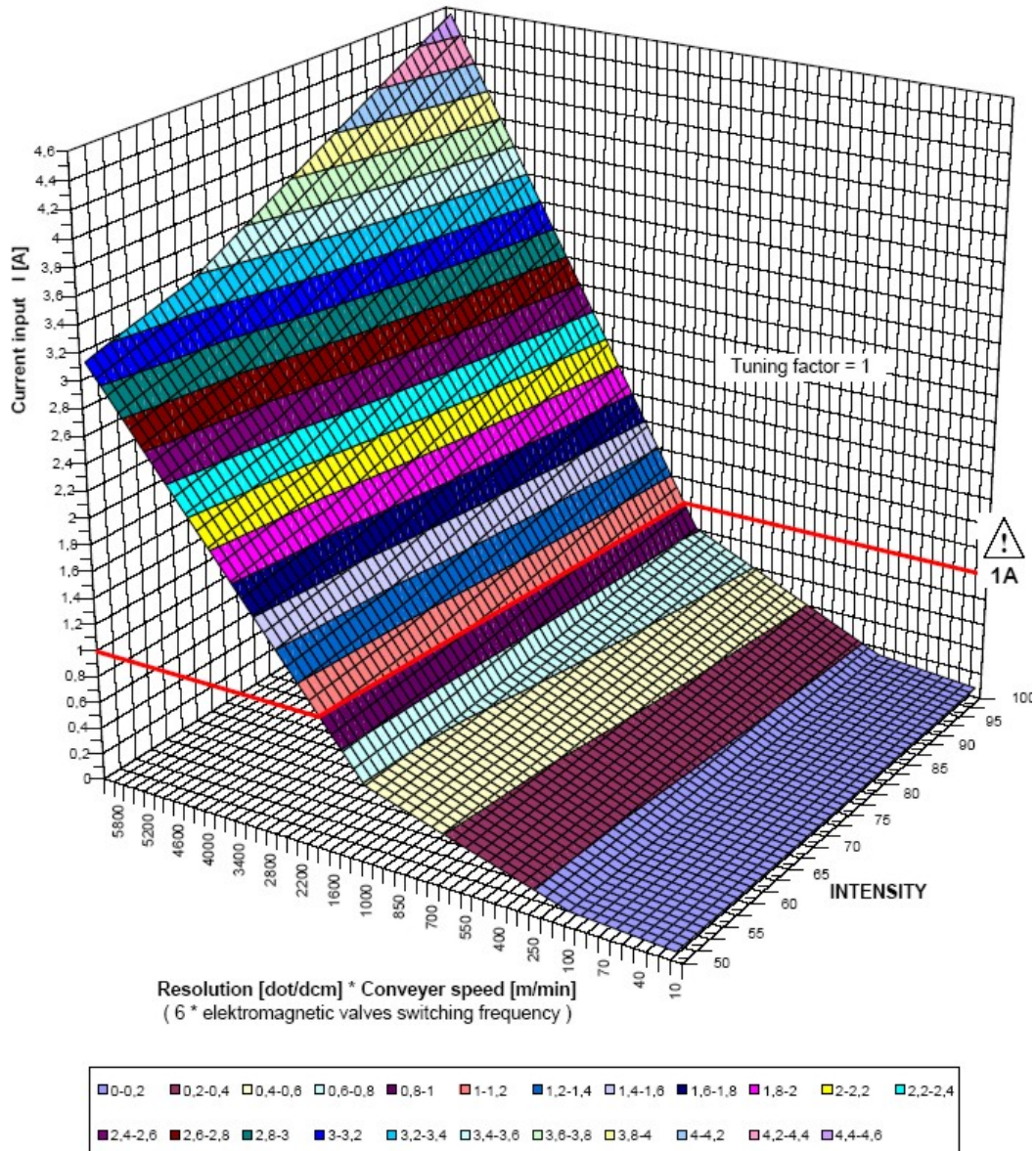


Fig. 4.1.2.4. Maximum current input vs. print parameters for an electromagnetic 64-dot head

An additional restriction that needs to be taken into account on the above charts is the maximum timing frequency which is 1 kHz (1000 vertical rows per second) for electromagnetic heads. The timing frequency of 1 kHz corresponds to the product of $R \cdot P = 6000$ and this is the maximum value on the above charts.

NOTE:

When a shaft-encoder is used, no maximum print rate can be predicted and therefore special attention is required not to exceed the maximum timing frequency.



4.1.3. Current input to piezoceramic heads

Piezoceramic heads work properly when they are heated up to the appropriate temperature of about 60°-70°. That is why they are equipped with heaters. Current input to piezoceramic heads depends to a significant extent on the heater power and can reach a maximum of **0.92 A**. In order to calculate the total current input for a multi-head system this value should be taken as the most extreme case. In fact, the maximum current will flow to the head at certain time intervals.

4.1.4. Current efficiency of the controller for EBS-1500 series printers

A multi-head printing system can be built with the application of one out of two controllers that are available for EBS-1500 series printers.

- **EBS-1501(2)** – a printer controller equipped with a standard power pack with the current efficiency of **1.5 A**. As much as two print-heads can be connected to it;
- **EBS-1506** – a printer controller equipped with a “multi-head” power pack with the current efficiency of **5 A**. As much as six print-heads can be connected to it.

The current efficiency of the power pack of a given controller is not the only restriction on the number of heads that can be connected. There are components which limit the maximum current input to the heads directly from socket No 7 on the controller housing. They are installed inside the unit on the **PGDU** card together with connection sockets.

NOTE:

- In the **EBS-1501(2)** controllers which are equipped with either a **PGDU3** card, or a **PGDU4** card (all controllers numbered from 61114), the maximum current input from the unit is restricted by the current efficiency of the power pack and is **1.5 A**.
- If the controller of the **EBS-1506** printer is equipped with a **PGDU3** card, then the maximum current input to the heads that are connected directly to socket No 7 on this controller is **1.5 A**. The other print-heads of the printing system need to be powered via branch-joints (examples of such an application are given in section 4.2), however the user should bear in mind that the current input to all connected heads must not exceed **5 A**. If the units are equipped with **PGDU4** cards (all controllers numbered from 61114), the maximum current input to heads connected directly to socket No 7 on the controller is **3 A**. The other print-heads of the printing system must be powered via branch-joints (examples of such an application are shown in section 4.2), however the user should bear in mind that the current input to all connected print-heads must not exceed **5 A**.
- If the above restrictions are not followed during designing of a multi-head printing system, the printer controller may get damaged !!!



4.2. Connection diagrams for multi-head printing systems with print-heads of one type

The installation of every printing system depends on the number of print-heads and the type of each print-head. Below, there are few connection diagrams of printing systems. They cover most applications of **EBS-1500** series-based multi-head systems. Printers with two print-heads are described separately as they are used most frequently, although they are a subset of a set of systems with 6 print-heads.

Table 1. A list of subassemblies (products) to be used as part of the printing system. The numbers correspond to those on the figures¹. The numbers apply to all diagrams shown in this document.

Number on the figures	Specifications
①	EBS-1501(2) General Purpose Controller for a printer with up to 2 E-M ² or PIEZO ³ print-heads EBS-1506 General Purpose Controller for a printer with up to 6 E-M or PIEZO print-heads
②	Photo-detector with a cable and connector. The standard cable is 5 m long. *)
③	Shaft-encoder with a cable and connector. The standard cable is 4 m long. *)
④	n-nozzle electromagnetic (dot, pixel) print-heads; n=5, 7, 12, 16, 25, 32, 64. n-pixel (n=32, 64) m-nozzle (m=96, 128, 192, 352) piezoceramic print-heads.
⑤	A 3, 5 or 7 m long 16-core interface cable for the print-head, the first of a series , terminated with male and female connectors. *)

¹ The list may differ for more technologically advanced devices or customised printing systems.

² **E-M** – stands for the 1500/00 series electromagnetic print head.

³ **PIEZO** – stands for the 1500/20 series piezoceramic print-head.

Number on the figures	Specifications
⑥	1, 2 or 3 m long interface cables for the print-heads, the second and following of the series , terminated with male and female connectors. *)
⑦	A first in a series 12-24V, RS-485 Ink Monitoring System (IMS) for the multi-head printing system with electromagnetic print-heads, a cable (of a standard length of 3 m), a male connector and a female connector. *)
⑧	The second and following in the series IMSs - see above. *)
⑨	RS-485 Line Termination for IMS .
⑩	RS-232(RS-485) printer ⇔ PC cable, a D-sub 25 pin connector or RS-232(RS-485) printer ⇔ PC cable, a D-sub 9 pin connector.
⑪	A branch-joint to distribute power supply to more than 2 print-heads within an EBS-150n multi-head printing system.
⑫	A 3-m long cable for the first branch-joint. *)
⑬	A cable from the first to the second branch-joint, its length depends on the location of the branch-joints within the system. *)
⑭	A 16-core 1, 2 or 3 m long interface cable between a print-head and the branch-joint , terminated with a male connector and a female connector. *)
⑮	An ink system with an ink pump. This device is described more precisely in the document entitled <i>Ink System with an Ink Pump</i> .

*) – Cables of various lengths can be supplied.

An **EBS-1502 E-M** Printing System with two electromagnetic print-heads⁴ (and a compressor system).



EBS-1502 Printing System with up to two n-nozzle (pixel) electromagnetic print-heads

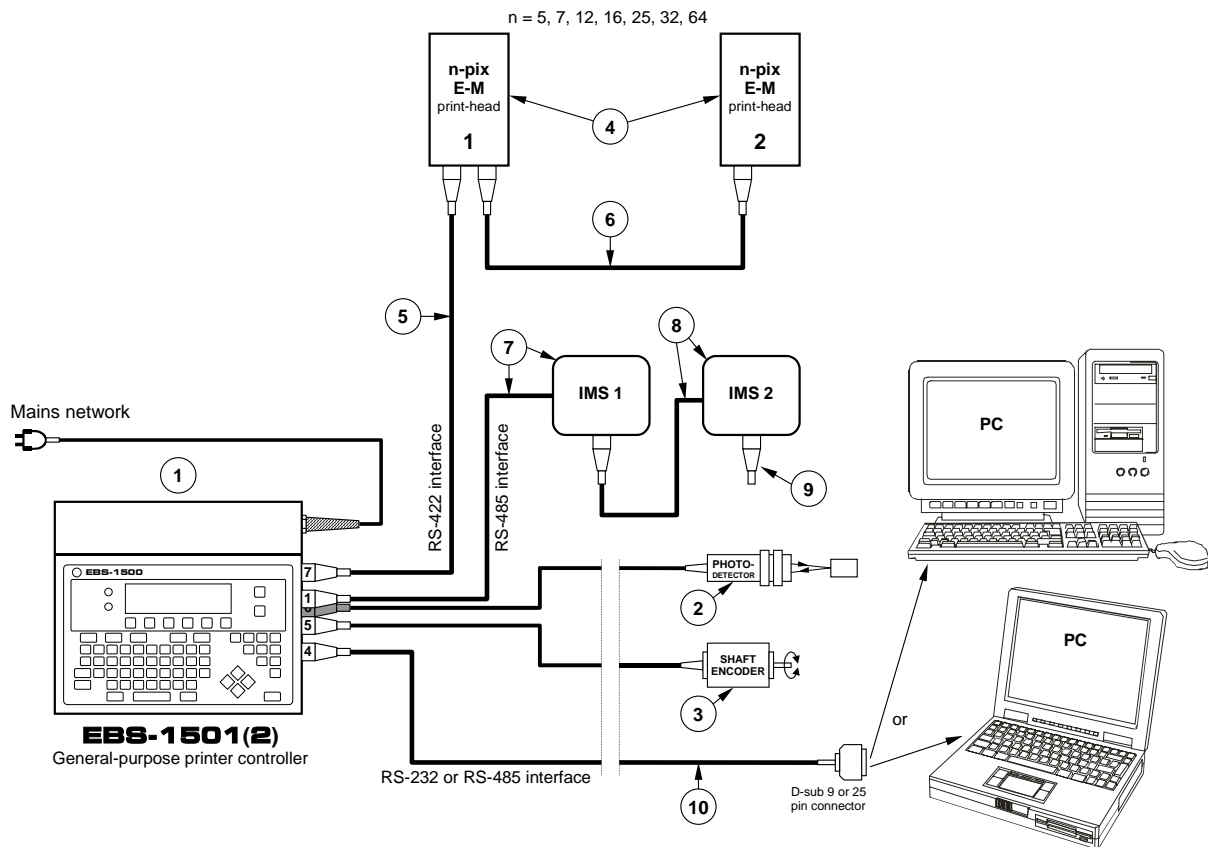


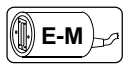
Fig. 4.2.1. Connection diagram for a printing system with two electromagnetic print-heads and a compressor system

NOTE:

- The two-head printing system shown in **Fig. 4.2.1** is an illustration of how to connect the system elements. The system will work properly only when the requirements presented in section **4.1 Restrictions on Printing System Configuration** are satisfied and when it is designed in compliance with the guidelines given in section **4.7 Rules for designing a multi-head printing system**.
- No printing system elements must be connected in the way shown in the above drawing unless the restrictions are applied to the system design or otherwise the system elements may get damaged!!!



⁴ E-M – stands for the electromagnetic print-head.



An **EBS-1506 E-M** Printing System with six electromagnetic print-heads⁵ (and a compressor system).

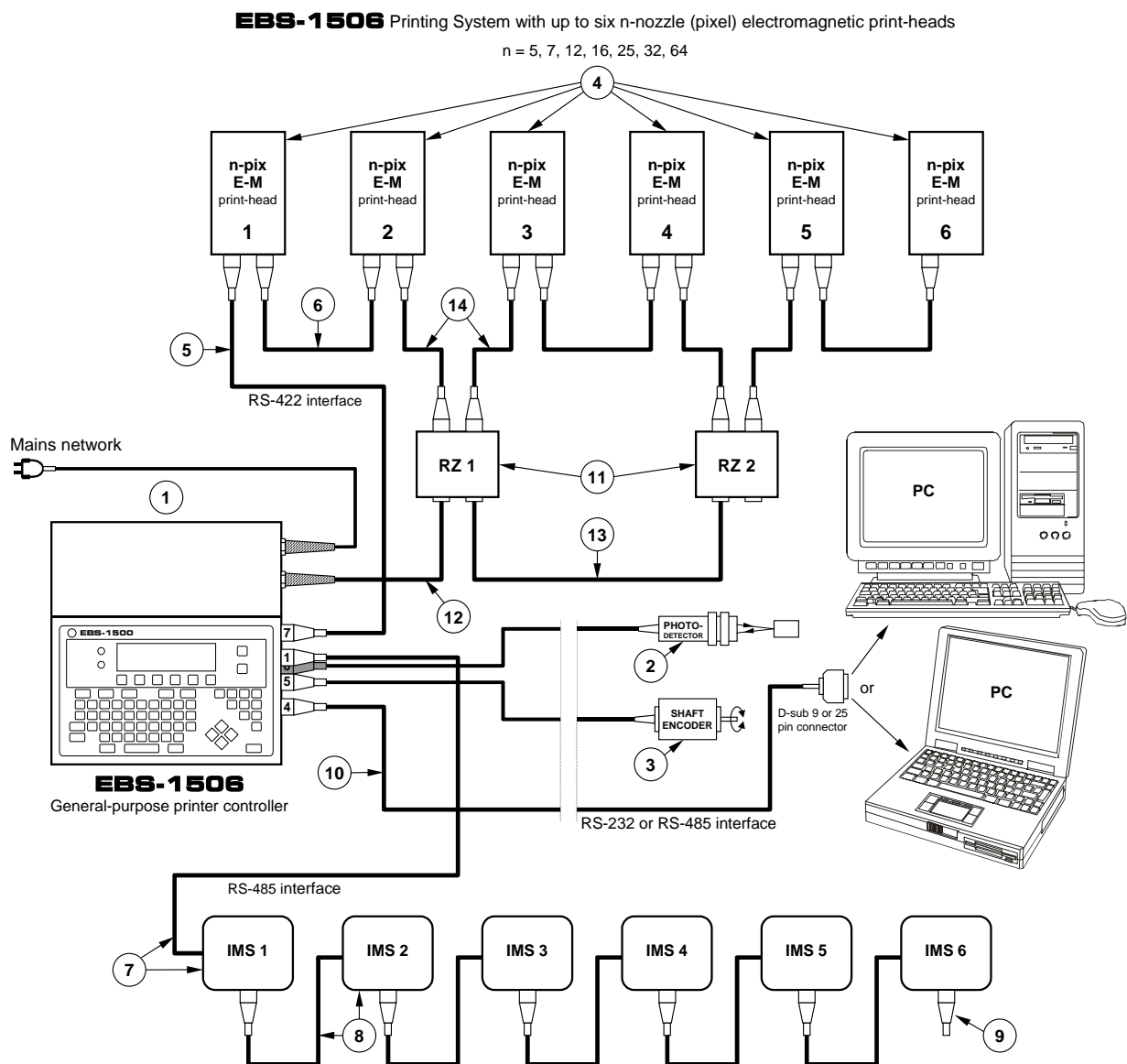


Fig. 4.2.2. Connection diagram for a printing system with six electromagnetic print-heads and a compressor system

NOTE:

- The six-head printing system shown in **Fig. 4.2.2** is an illustration of how to connect the system elements. The system will work properly only when the requirements presented in section **4.1 Restrictions on Printing System Configuration** are satisfied and when it is designed in compliance with the guidelines given in section **4.7 Rules for designing a multi-head printing system**.
- No printing system elements must be connected in the way shown in the above drawing unless the restrictions are applied to the system design or otherwise the system elements may get damaged!!!
- Ensure free circulation of air around the **EBS-1506** controller to cool the device properly.

⁵ E-M – stands for the electromagnetic print-head.



An **EBS-1502 E-M⁶** Printing System with two electromagnetic heads and one (common) pump-based ink system.

EBS-1502: Printing System with up to two n-nozzle (pixel) electromagnetic print-heads and one pump-based ink system
 n = 5, 7, 12, 16, 25, 32, 64

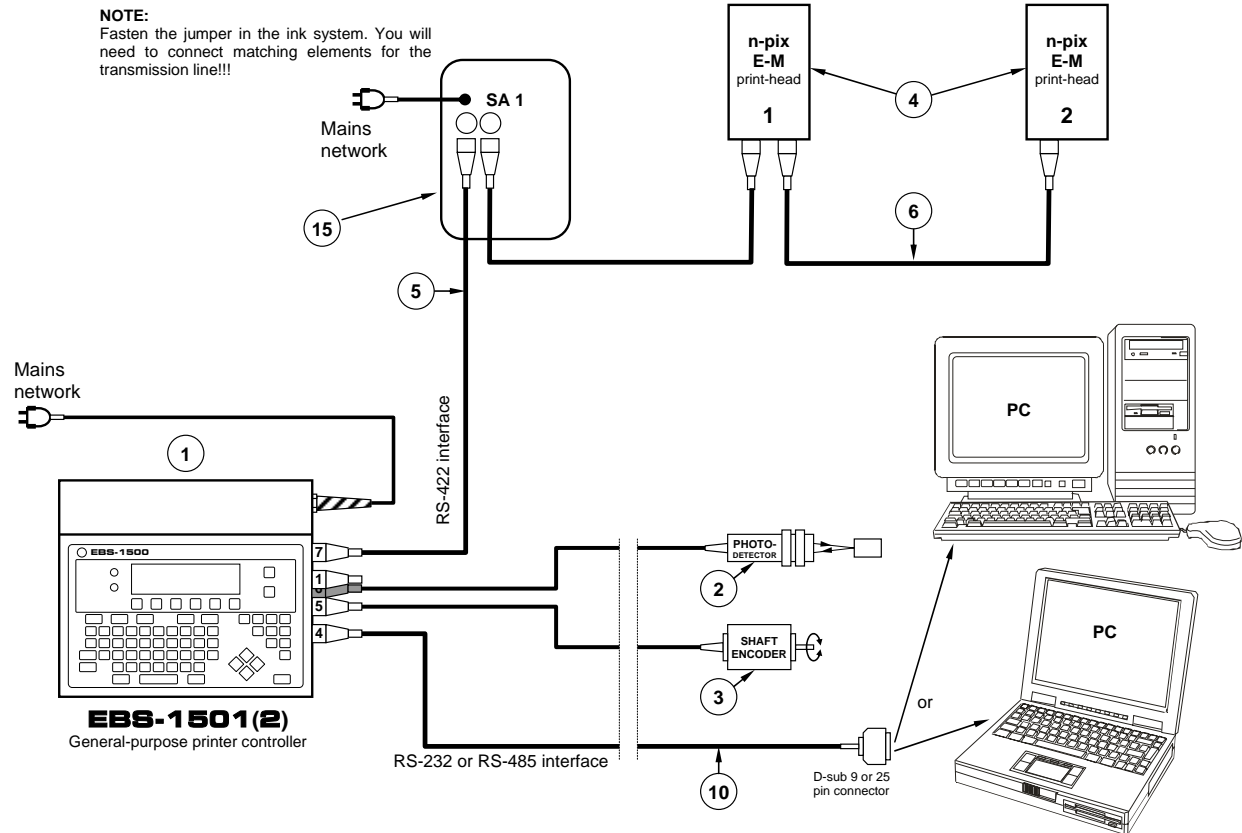


Fig. 4.2.3. Connection diagram for a printing system with two electromagnetic print-heads and one ink system with an ink pump

NOTE:

- The two-head printing system shown in **Fig. 4.2.3** is an illustration of how to connect the system elements. The system will work properly only when the requirements presented in section **4.1 Restrictions on Printing System Configuration** are satisfied and when it is designed in compliance with the guidelines given in section **4.7 Rules for designing a multi-head printing system**.
- No printing system elements must be connected in the way shown in the above drawing unless the restrictions are applied to the system design or otherwise the system elements may get damaged!!!
- The ink system with an ink pump is equipped with its own power pack and therefore it does not impose any additional restrictions on the design of the printing system.



⁶ E-M – stands for the electromagnetic print-head.



An **EBS-1502 E-M**⁷ Printing System with two electromagnetic heads and two ink systems with ink pumps, for example, for different ink colours.

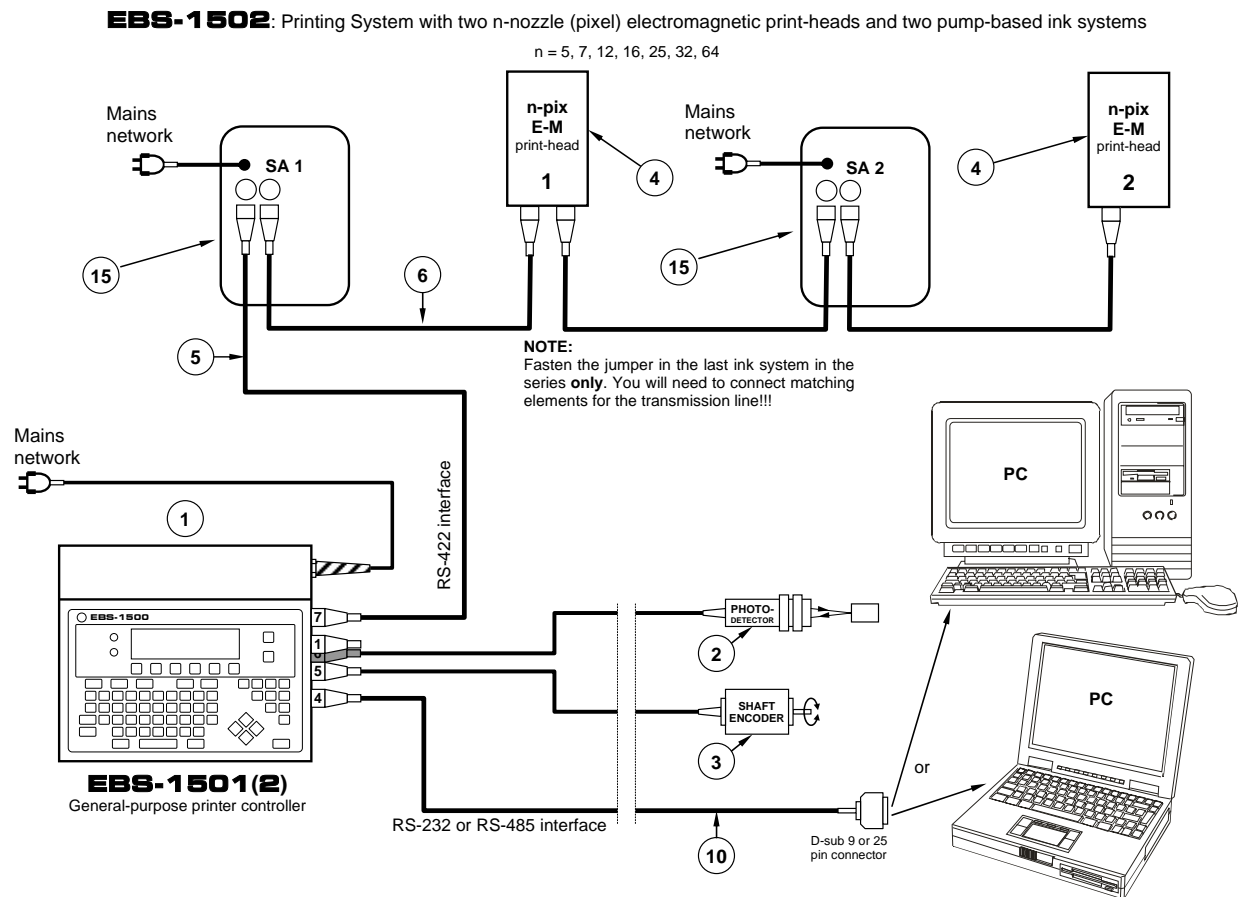


Fig. 4.2.4. Connection diagram for a printing system with two electromagnetic print-heads and two ink systems with ink pumps.

NOTE:

- The two-head printing system shown in **Fig. 4.2.4** is an illustration of how to connect the system elements. The system will work properly only when the requirements presented in section **4.1 Restrictions on Printing System Configuration** are satisfied and when it is designed in compliance with the guidelines given in section **4.7 Rules for designing a multi-head printing system**.
- No printing system elements must be connected in the way shown in the above drawing unless the restrictions are applied to the system design or otherwise the system elements may get damaged!!!
- The ink system with an ink pump is equipped with its own power pack and therefore it does not impose any additional restrictions on the design of the printing system.

⁷ E-M – stands for the electromagnetic print-head.



An **EBS-1506 E-M**⁸ Printing System with three electromagnetic heads and three ink systems with ink pumps (for example, for different ink colours).

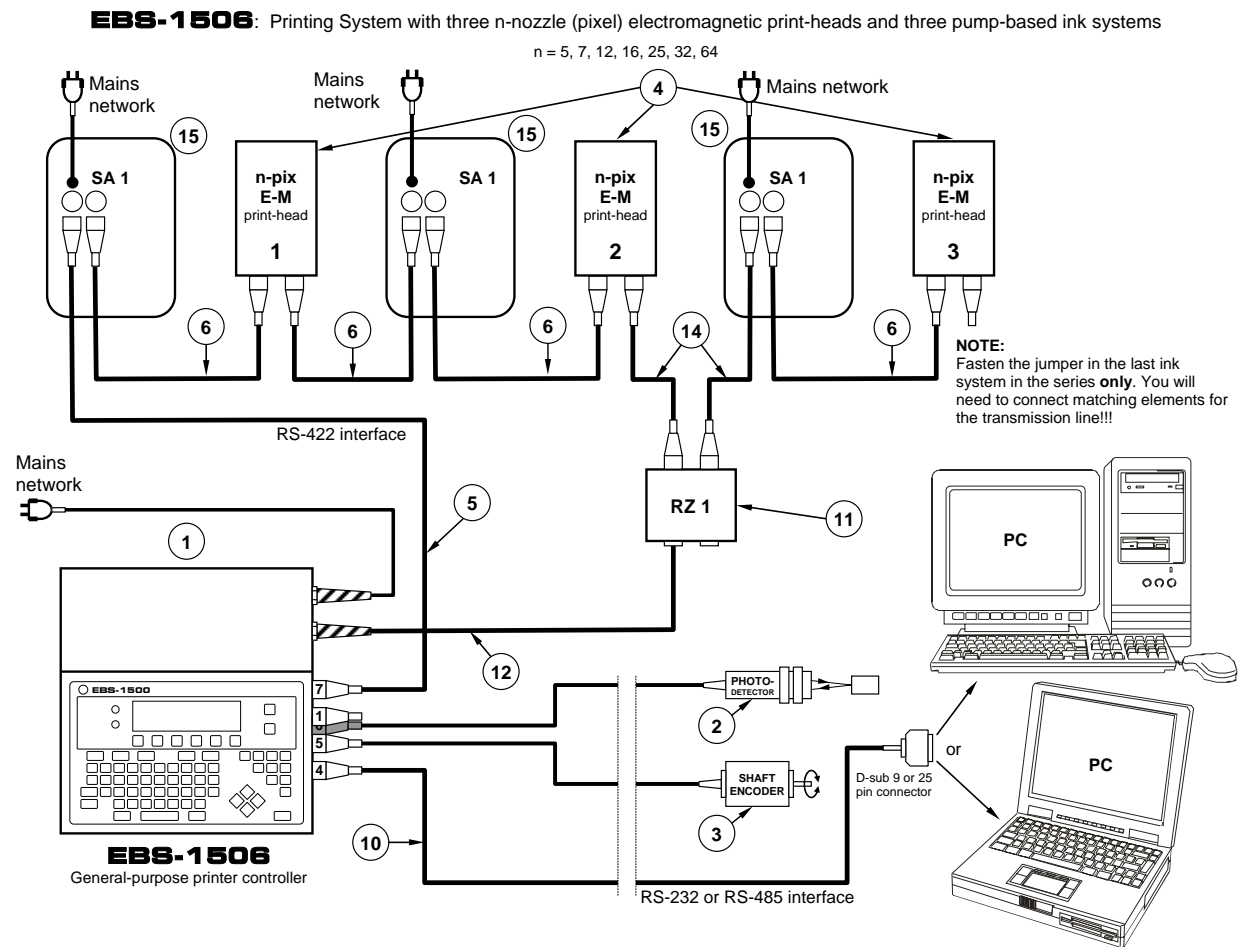


Fig. 4.2.5. Connection diagram for a printing system with three electromagnetic print-heads and three ink systems with ink pumps.

NOTE:

- The printing system shown in **Fig. 4.2.5** is an illustration of how to connect the system elements. The system will work properly only when the requirements presented in section **4.1 Restrictions on Printing System Configuration** are satisfied and when it is designed in compliance with the guidelines given in section **4.7 Rules for designing a multi-head printing system**.
- No printing system elements must be connected in the way shown in the above drawing unless the restrictions are applied to the system design or otherwise the system elements may get damaged!!!
- The ink system with an ink pump is equipped with its own power pack and therefore it does not impose any additional restrictions on the design of the printing system.
- Ensure free circulation of air around the **EBS-1506** controller to cool the device properly.



⁸ E-M - stands for the electromagnetic print-head.



An **EBS-1506 E-M**⁹ Printing System with six electromagnetic heads and one (common) ink system with an ink pump.

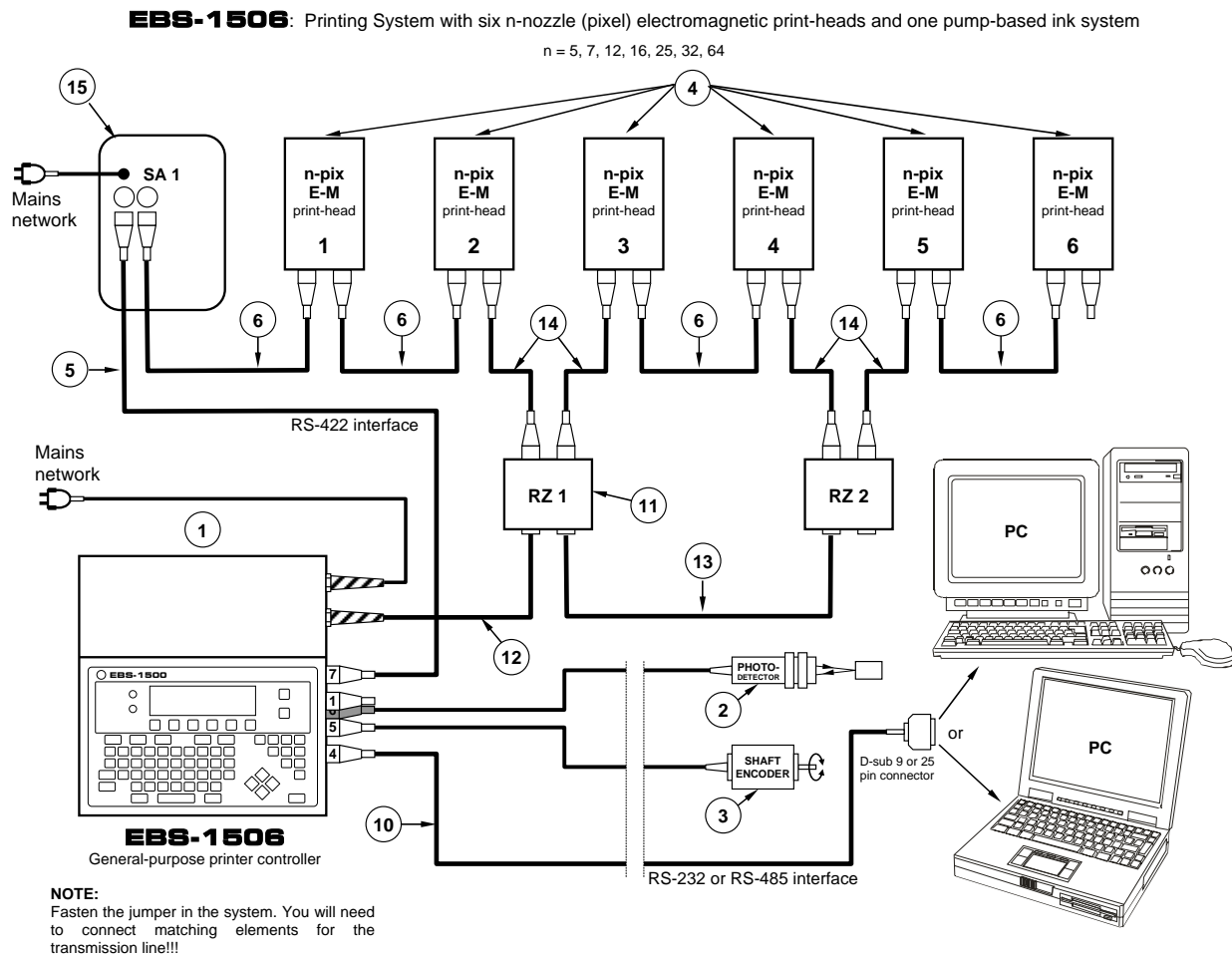


Fig. 4.2.6. Connection diagram for a printing system with six electromagnetic print-heads and one ink system with an ink pump.

NOTE:

- The six-head printing system shown in **Fig. 4.2.6** is an illustration of how to connect the system elements. The system will work properly only when the requirements presented in section **4.1 Restrictions on Printing System Configuration** are satisfied and when it is designed in compliance with the guidelines given in section **4.7 Rules for designing a multi-head printing system**.
- No printing system elements must be connected in the way shown in the above drawing unless the restrictions are applied to the system design or otherwise the system elements may get damaged!!!
- The ink system with an ink pump is equipped with its own power pack and therefore it does not impose any additional restrictions on the design of the printing system.
- Ensure free circulation of air around the **EBS-1506** controller to cool the device properly.

⁹ E-M – stands for the electromagnetic print-head.



The **EBS-1502 PIEZO**¹⁰ Printing System with two piezoceramic print-heads. The ink systems and IMS modules, which monitor transponders on ink bottles, are built into the print-heads.

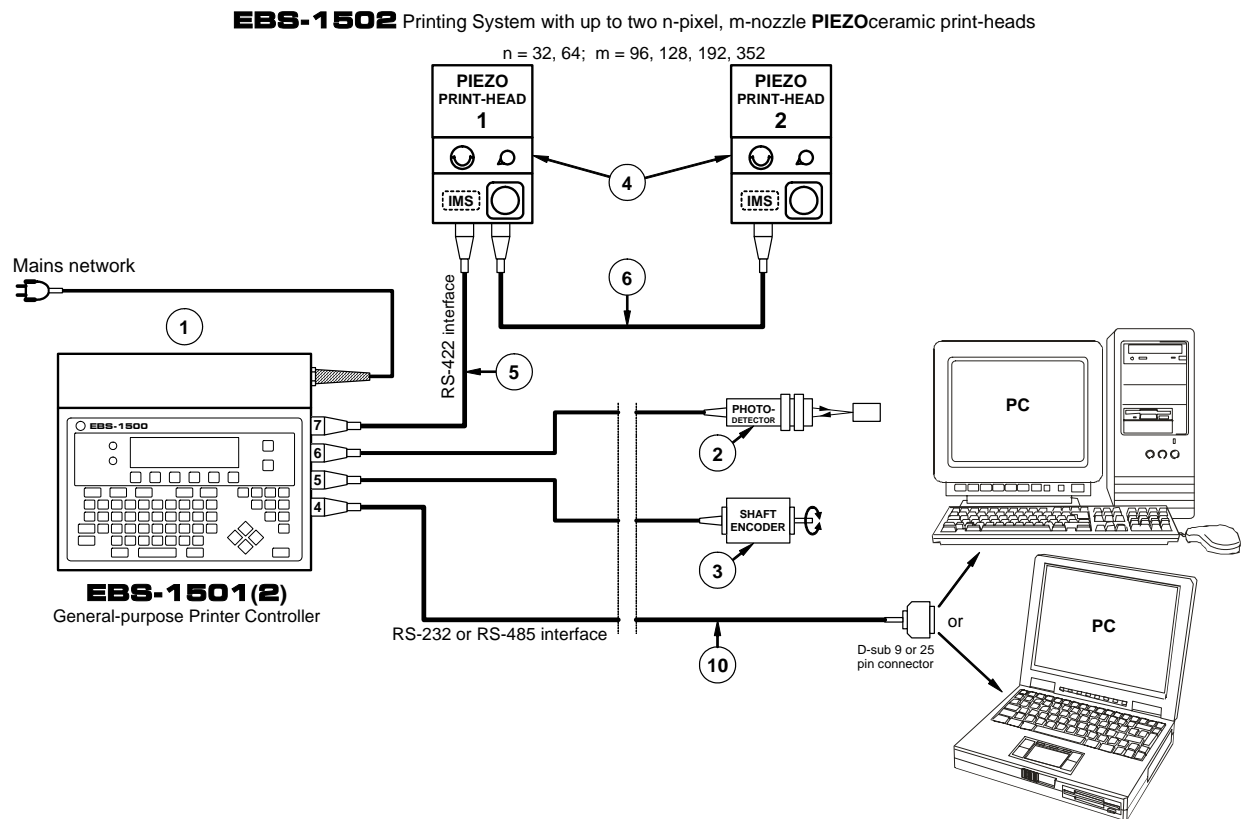


Fig. 4.2.7. Connection diagram for a printing system with two piezoceramic print-heads

NOTE:

- The two-head printing system shown in **Fig. 4.2.7** is an illustration of how to connect the system elements. The system will work properly only when the requirements presented in section **4.1 Restrictions on Printing System Configuration** are satisfied and when it is designed in compliance with the guidelines given in section **4.7 Rules for designing a multi-head printing system**.
- No printing system elements must be connected in the way shown in the above drawing unless the restrictions are applied to the system design or otherwise the system elements may get damaged!!!
- The system shown in **Fig. 4.2.7** can work properly only with an **EBS-1506** or **EBS-1501(2)** controller equipped with a **PGDU4** card (for more details refer to section **4.1.4**)!!! Otherwise the controller may get damaged !!!



¹⁰ **PIEZO** – stands for the 1500/20 series piezoceramic print-head.

The **EBS-1506 PIEZO**¹¹ Printing System with six piezoceramic print-heads containing built-in ink systems and **IMS** modules for monitoring transponders on ink bottles.

EBS-1506 Printing System with up to six n-pixel, m-nozzle **PIEZO**ceramic print-heads

n = 32, 64; m = 96, 128, 192, 352

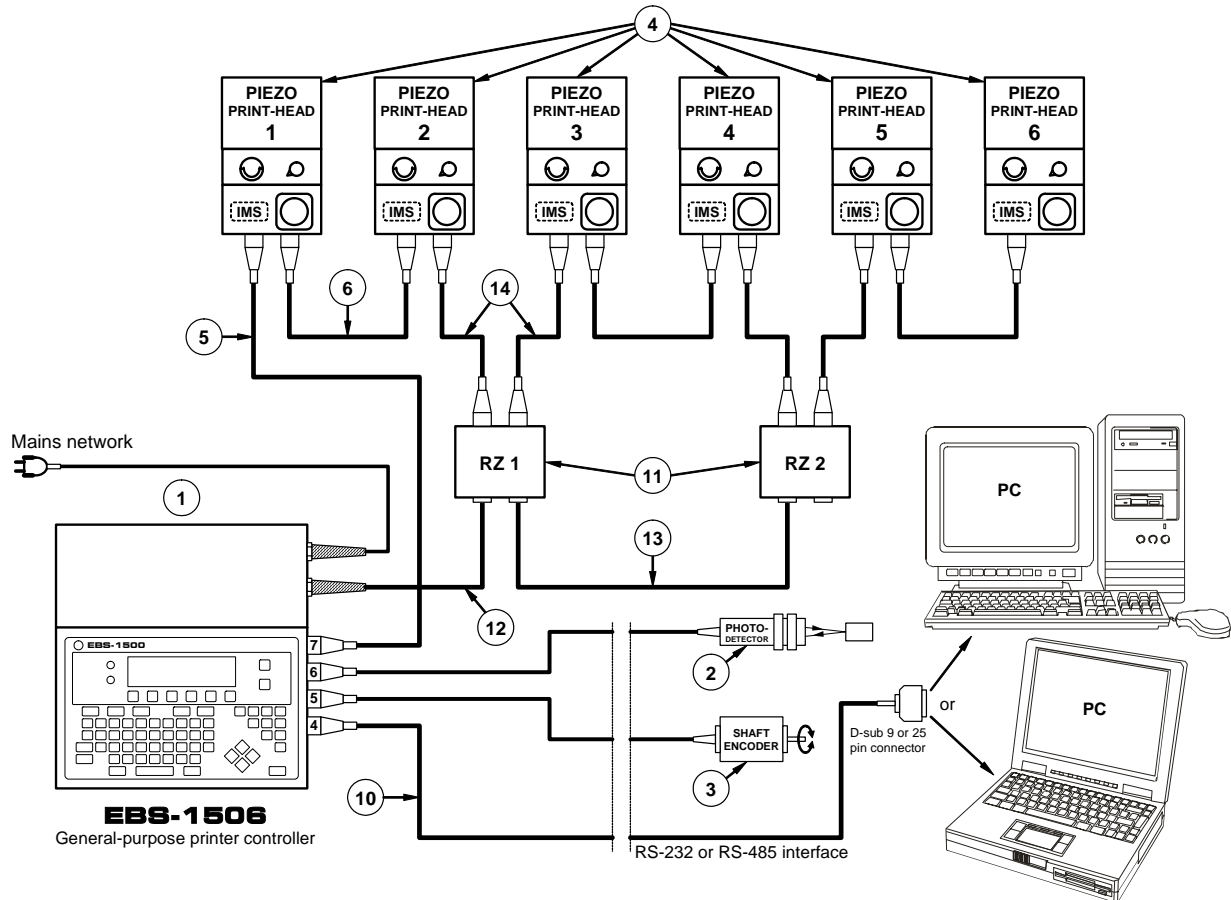


Fig. 4.2.8. Connection diagram for a printing system with six piezoceramic print-heads

NOTE:

- The six-head printing system shown in **Fig. 4.2.8** is an illustration of how to connect the system elements. The system will work properly only when the requirements presented in section **4.1 Restrictions on Printing System Configuration** are satisfied and when it is designed in compliance with the guidelines given in section **4.7 Rules for designing a multi-head printing system**.
- No printing system elements must be connected in the way shown in the above drawing unless the restrictions are applied to the system design or otherwise the system elements may get damaged!!!
- The system shown in **Fig. 4.2.8** can work properly only with an **EBS-1506** controller equipped with a **PGDU4** card (for more details refer to section **4.1.4**)!!! Otherwise the controller may get damaged!!!
- Ensure free circulation of air around the **EBS-1506** controller to cool the device properly.

¹¹ **PIEZO** - stands for the 1500/20 series piezoceramic print-heads.

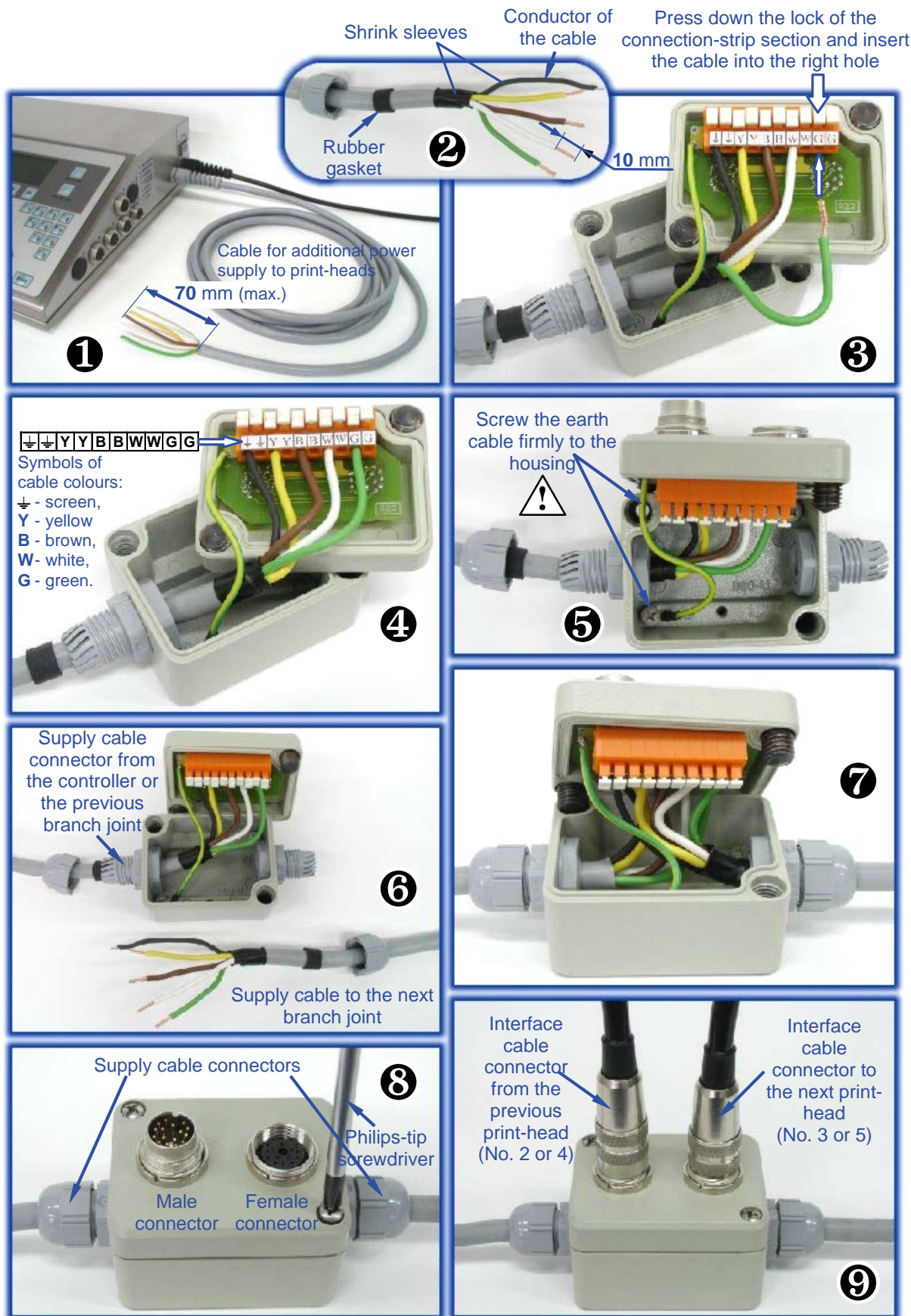
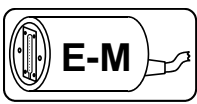



Fig. 4.3.2.1. Installing a power cable in an RZ branch-joints

4.3.3. Configuring the printing system

The following steps need to be followed during installation in order to ensure the proper operation of the print-heads and the corresponding **IMS** modules within the multi-head system:

	A printing system with electromagnetic print-heads	A printing system with piezoceramic print-heads																	
<ol style="list-style-type: none"> 1. Set the order of print-heads and assign numbers to them starting from 1 – see section 4.3.1. 2. Assign an ink system to the corresponding IMS module or an ink system with an ink pump to each print-head (if each print-head uses its intrinsic ink system). 3. Connect only one print-head and one IMS module (or one ink system with an ink pump) to the controller. Plug the termination of the transmission line into the socket on the IMS module. If an ink system with an ink pump is used, then a terminating resistor may be installed for proper operation – see NOTES on page 25. 4. Switch the controller on and go to the submenu BOTTLE INFORMATION/ALL HEADS. Select the command CHANGE HEAD No. and after the service password has been typed input the number of the IMS module (or the system with an ink pump) in compliance with the previous assignment referred to in step 1. Then confirm the selection. 	<ol style="list-style-type: none"> 1. Set the order of print-heads and assign numbers to them starting from 1 – see section 4.3.1. 2. For piezoceramic print-heads, IMS modules are built into the print-heads and therefore the modules are automatically assigned to the corresponding ink systems. 3. Connect only one piezoceramic print-head to the controller. It may be required to connect a termination resistor for the proper operation of the system - see NOTES on page 25. 4. Switch the controller on and go to the submenu BOTTLE INFORMATION/ ALL HEADS. Select the command CHANGE HEAD No. and after the service password has been typed input the print-head (IMS module) number in compliance with the previous assignment referred to in step 1. Then confirm the selection. 																		
<table border="1"> <thead> <tr> <th colspan="2">CAPS</th> </tr> </thead> <tbody> <tr> <td>Head No.(1hex): 3</td> <td>000527</td> </tr> <tr> <td>PLEASE WAIT</td> <td>p=32 S</td> </tr> <tr> <td></td> <td>U - -</td> </tr> <tr> <td></td> <td>- - -</td> </tr> </tbody> </table>	CAPS		Head No.(1hex): 3	000527	PLEASE WAIT	p=32 S		U - -		- - -	<table border="1"> <thead> <tr> <th colspan="2">CAPS</th> </tr> </thead> <tbody> <tr> <td>BOTTLES:A</td> <td>ERROR</td> </tr> <tr> <td>4 CHANGE HEAD No.</td> <td></td> </tr> <tr> <td>6 DIAGNOSTICS</td> <td></td> </tr> </tbody> </table>	CAPS		BOTTLES:A	ERROR	4 CHANGE HEAD No.		6 DIAGNOSTICS	
CAPS																			
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CAPS																			
BOTTLES:A	ERROR																		
4 CHANGE HEAD No.																			
6 DIAGNOSTICS																			
<p>When the number has been properly input into the IMS module, the MENU re-appears on the terminal. Otherwise the following message is displayed:</p>																			
<table border="1"> <thead> <tr> <th colspan="2">CAPS</th> </tr> </thead> <tbody> <tr> <td>CHANNEL ERROR</td> <td>WRONG</td> </tr> <tr> <td>Press ENTER...</td> <td>HEADs</td> </tr> <tr> <td></td> <td>CONFIG</td> </tr> <tr> <td></td> <td>URATION</td> </tr> <tr> <td></td> <td>N</td> </tr> </tbody> </table>				CAPS		CHANNEL ERROR	WRONG	Press ENTER...	HEADs		CONFIG		URATION		N				
CAPS																			
CHANNEL ERROR	WRONG																		
Press ENTER...	HEADs																		
	CONFIG																		
	URATION																		
	N																		
<p>A message ERROR or WRONG HEADs CONFIGURATION is inconsequential at the moment, as either of them appears whenever the numbers of print-heads and IMS modules do not equal. Other alarms and messages concerning bottles of ink may appear, but they should simply be cleared.</p> <ol style="list-style-type: none"> 5. Switch the controller off and disconnect the programmed IMS module or the system with an ink pump (the print-head may be left). 6. Follow the assignment procedure in order to assign unique numbers to successive IMS modules or ink systems with ink pumps; see steps 3, 4, 5 above. 7. Connect to the controller all print-heads in series, in pre-set (ascending) order of the numbers. Use serial interface cables to do this (also connect branch-joints, if required). Connect all programmed IMS modules or ink systems 	<ol style="list-style-type: none"> 5. Switch the controller off and disconnect the print-head along with the programmed IMS module. 6. Follow the assignment procedure in order to assign unique numbers to successive IMS modules; see steps 3, 4, 5 above. 7. Connect in series, all print-heads containing the programmed IMS modules in the pre-set (ascending) order of the numbers, to the controller. Use serial interface cables to do this (also connect branch-joints, if required). Install a transmission-line matching element in the last 																		



A printing system with electromagnetic print-heads

with ink pumps in series to the controller in pre-set (ascending) order of the numbers. Plug the transmission-line termination to the socket on the last **IMS** module in the series. If the systems are equipped with ink pumps, matching elements need to be connected to the transmission line on the last system in series - see **NOTES** on page 25. For the other systems (from the 1st to the next to the last) such elements must not be connected.

8. Switch on the controller to which the print-heads and **IMS** modules or systems with ink pumps are connected. If all elements of the printing system are properly connected and the **IMS** modules (or the systems with ink pumps) have their individual numbers properly programmed, then the proper status of each print-head should be displayed in the terminal status window after a short while.

CAPS	
PLEASE WAIT +++++	WRONG HEADS CONFIG URATIO N

MENU		CAPS	
1 TEXT SERVICE		000527	
2 PARAMETERS SERVICE		p=32 S	
3 PRINTING		U U U	
4 SERVICE		U U U	
5 AUX. COMMANDS			

Otherwise the message **WRONG HEADS CONFIGURATION** is displayed after a longer while.

CAPS	
PLEASE WAIT +++++	WRONG HEADS CONFIG URATIO N

MENU		CAPS	
1 TEXT SERVICE		WRONG	
2 PARAMETERS SERVICE		HEADS	
3 PRINTING		CONFIG	
4 SERVICE		URATIO	
5 AUX. COMMANDS		N	

Check once again all connections and possibly the numbers of **IMS** modules (or ink systems with ink pumps) - see notes below.

9. Insert a bottle of ink to the basket inside the ink system for print-head No. 1 (that contains the **IMS** module with its number programmed to 1). The new bottle is accepted after its transponder has been validated (within about 10 seconds) with the message **BOTTLE ACCEPTED**. A description of how to install a new ink bottle in the system with an ink pump is given in the document entitled *Ink System with an Ink Pump*.
10. Follow the instructions indicated in step 9 above for ink system numbers 2, 3, 4, etc.
11. After all bottles of ink have been validated, connect each ink system to the corresponding print-head with ink tube. Set the rating pressure in each ink system; see also **Connecting the head to the ink and compressed air systems** in sections **Connections** and **Installing a new Bottle of Ink (or Replacing an Empty One)** in the EBS-1500 Operating Instructions.
9. Insert the transponder of a bottle of ink into the socket on print-head No. 1 (containing the **IMS** module with its number programmed to 1). The new transponder is accepted after it has been validated (within about 10 seconds) with the message **BOTTLE ACCEPTED**.
10. Follow the instructions indicated in step 9 above for piezoceramic print-head numbers 2, 3, 4, etc.
11. After all transponders have been validated, screw in the bottles to supply ink to the ink system for each print-head. In order to do this, remove protective aluminium sticker from the plug of the new bottle. Holding it upside down place the bottle into the socket and screw in (no ink should pour out as the integrated bottle plug is equipped with a protection valve); see also section **Installing a new Bottle of Ink (or Replacing an Empty One)** in the EBS-1500 Operating Instructions.



A printing system with piezoceramic print-heads

piezoceramic print-head - see **NOTES** on page 25. Matching elements must not be installed in any other print-heads (from the first to last but one).



NOTES:

- When the specific numbers are programmed, no more than one **IMS** module or one ink system with an ink pump must be connected at a given point of time.
- No more than one **IMS** module or one system with an ink pump with a given number must be connected during normal operation of the printing system. Otherwise a malfunction in the system may occur.
- If a wrong-print-head-configuration message occurs, the printing system needs to be tested. In submenu **BOTTLE INFORMATION/ ALL HEADS**, select the **DIAGNOSTICS** command. The command initiates tests of all connected print-heads and **IMS** modules (or ink systems with ink pumps) and displays data received in response. The data contain the status of each print-head in the order in which the print-heads are connected in series and numbers are assigned to the **IMS** modules (antenna numbers are not displayed in the order the antennas occur in the series). If the number of **IMS** modules detected complies with the number of print-heads detected, then the status for all print-heads is displayed in the terminal status window. For example, if two electromagnetic print-heads and two **IMS** modules are connected to a 6-print-head controller, the following test results are displayed (no **WRONG HEADS CONFIGURATION** message is displayed, as the numbers of print-heads and **IMS** modules detected are the same):

CAPS	
Antenna: 1 2	000527
Status :	p=32 S
25 3939 FF FF FF FF	U U -
	- - -

The value of **FF** indicates that there is no print-head attached or that the cables are connected improperly and therefore the status cannot be transmitted (in the above example this relates to print-head numbers 3, 4, 5, 6 in the series). A two-digit status describes 5, 7, 12, 16, 64-dot print-heads, while a four-digit status 25 and 32 dot ones.

- In order to reduce the number of errors and facilitate fault location, elements of the printing system need to be connected one by one and tested with the **DIAGNOSTICS** command.
- In order to connect transmission-line matching elements to the circuits in a piezoceramic print-head, pins 1-2 of the **J3** connector should be connected with a jumper on the **IT2** card (for earlier versions of the head) (see [Fig. 4.3.3.1](#)) or a jumper should be fastened on the **Z4** connector on the **T132** card (for later versions) (see [Fig. 4.3.3.2](#)). If there is no jumper, the matching elements are not added.
- In order to connect transmission-line matching elements in the pump based ink system working with electromagnetic heads fasten a **Z4** jumper on the **IDT3** card (see [Fig. 4.3.3.3](#)).

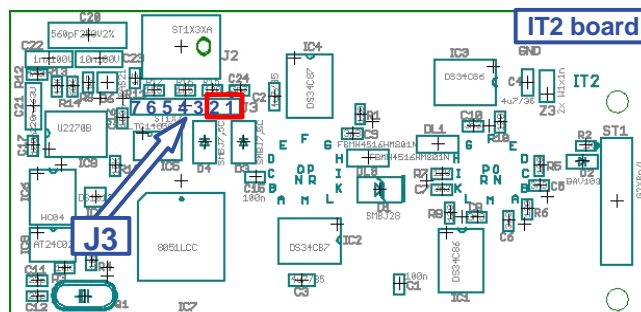


Fig. 4.3.3.1. Location of a jumper for connecting transmission-line matching elements in the piezoceramic head of an earlier type

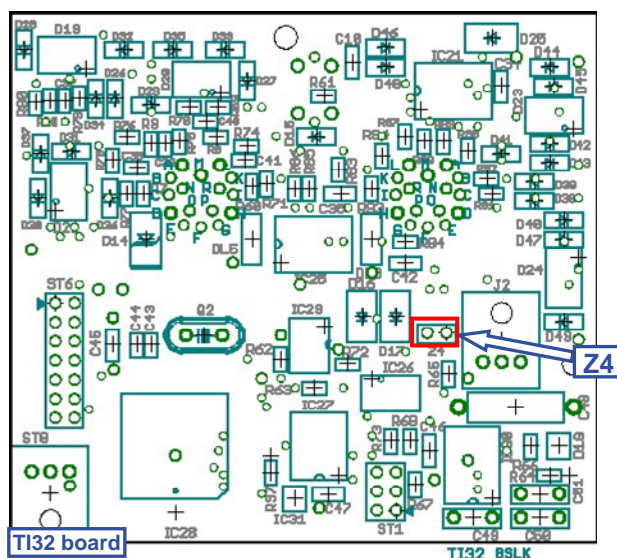


Fig. 4.3.3.2. Location of a jumper for connecting transmission-line matching elements in the piezoceramic head of a later type

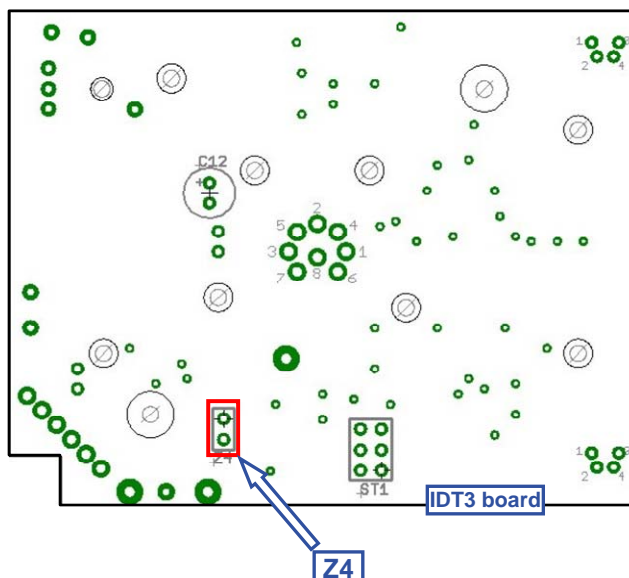


Fig. 4.3.3.3. Location of a jumper for connecting transmission-line matching elements in the ink system with an ink pump

Below there is a list of proper status data displayed for electromagnetic print-heads by the **DIAGNOSTICS** command.

State of the print-head	Number of nozzles (pixels) in the electromagnetic print-head					
	7	12	16	25	32	64
STOP/PRINTING	29	25	3D	3535	3939	31
RINSING	2B	27	3F	3737	3B3B	33
POWER SUPPLY – voltage lower than +24V	69	65	7D	7575 3575 7535	7979 3979 7939	71



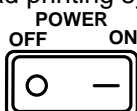
A list of proper status data displayed for piezoceramic print-heads by the **DIAGNOSTICS** command:

State of the print-head	Type of print-head						
	P64	128	352	32	96	192	256
STOP/PRINTING	35	55	75	17	37	57	77
	3D	5D	7D	1F	3F	5F	7F
	31	51	71	13	33	53	73
	39	59	79	1B	3B	5B	7B



4.4. Starting the Machine

The multi-head printing system is started (or turned off) by switching on (or off) the controller with the



power switch in the same way as the single-head printers are. The start-up procedure is extended only by the detection and testing of print-heads and ink monitoring systems (**IMs**), which is indicated by + (plus) signs displayed in the main terminal window.

CAPS	
PLEASE WAIT +++++	WRONG HEADs CONFIG URATIO N

After the printing system has been switched off, all print-heads need to be protected appropriately; see section **Switching the Printer Off** in the EBS-1500 Operating Instructions.

4.5. Operating the Machine

4.5.1. Control menu in the printing system controller

The **PRINTING**, **SERVICE** and **BOTTLE INFORMATION** menus contain submenus such as **ALL HEADS**, **HEAD NO 1**, ..., **HEAD NO 6**. The contents of the submenus vary according to the selection of one or all print-heads. The structure of the entire controller's operation MENU is given in figures **Fig. 4.5.1.1** through **Fig. 4.5.1.3**.

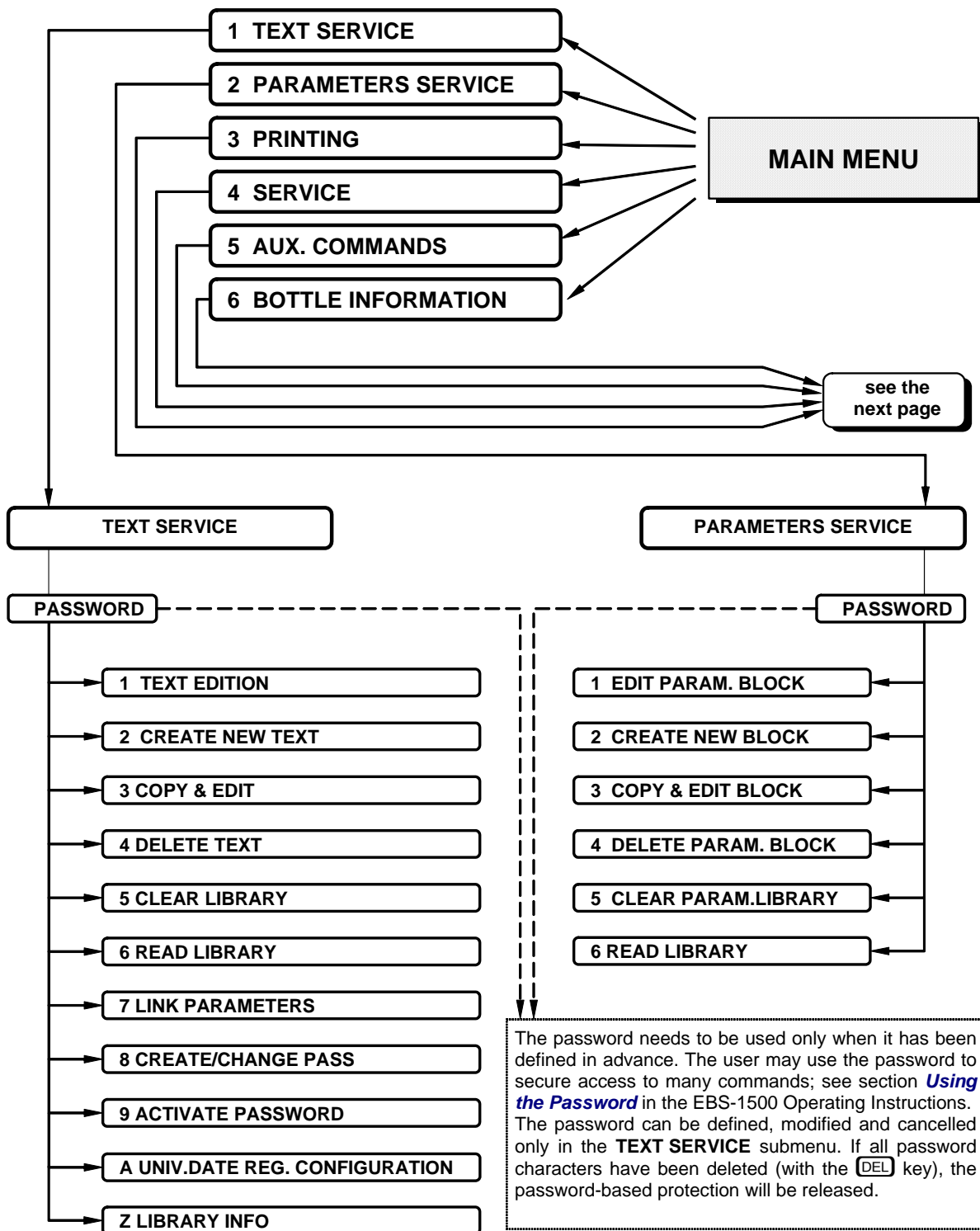


Fig. 4.5.1.1.

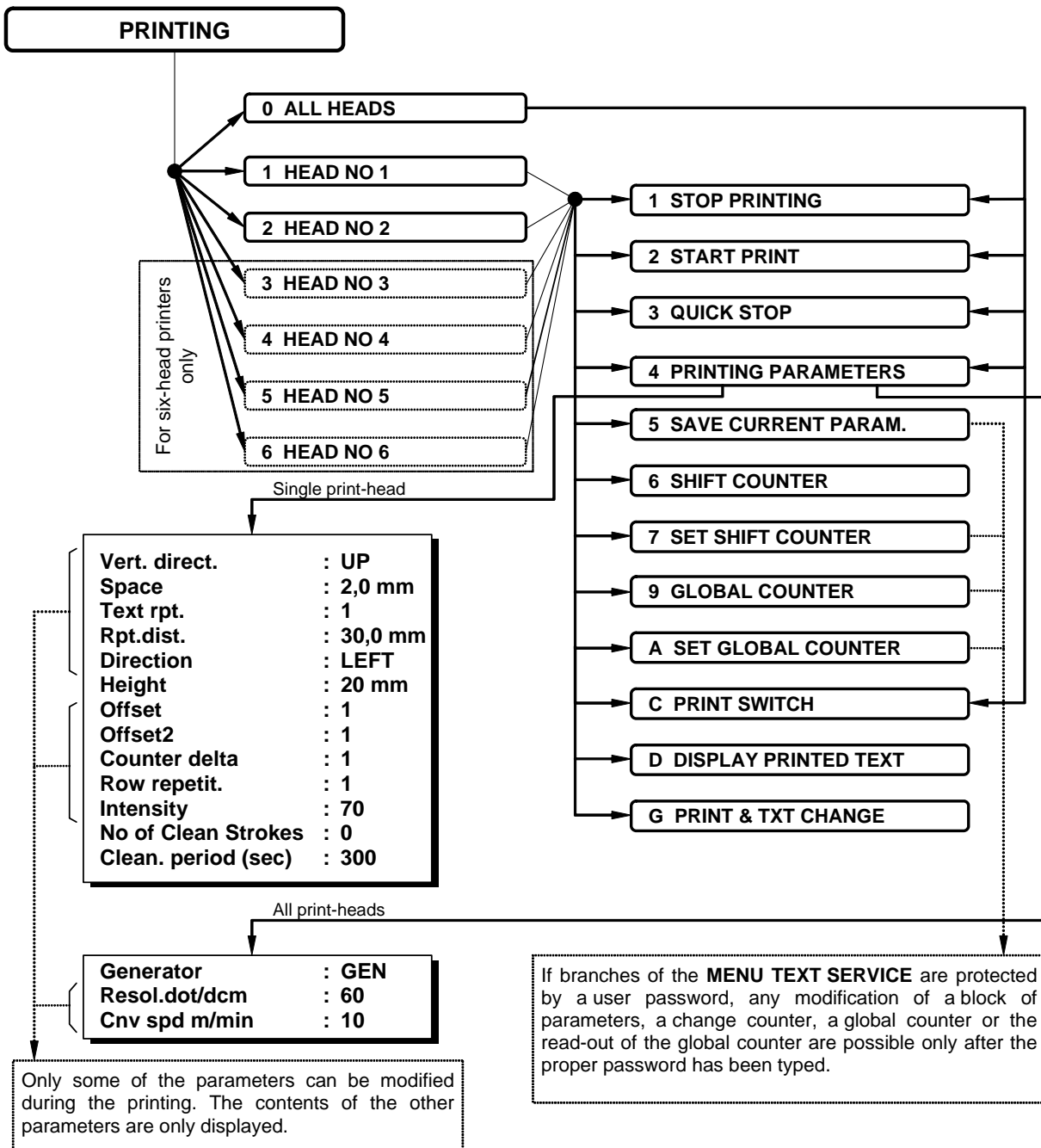


Fig. 4.5.1.2.

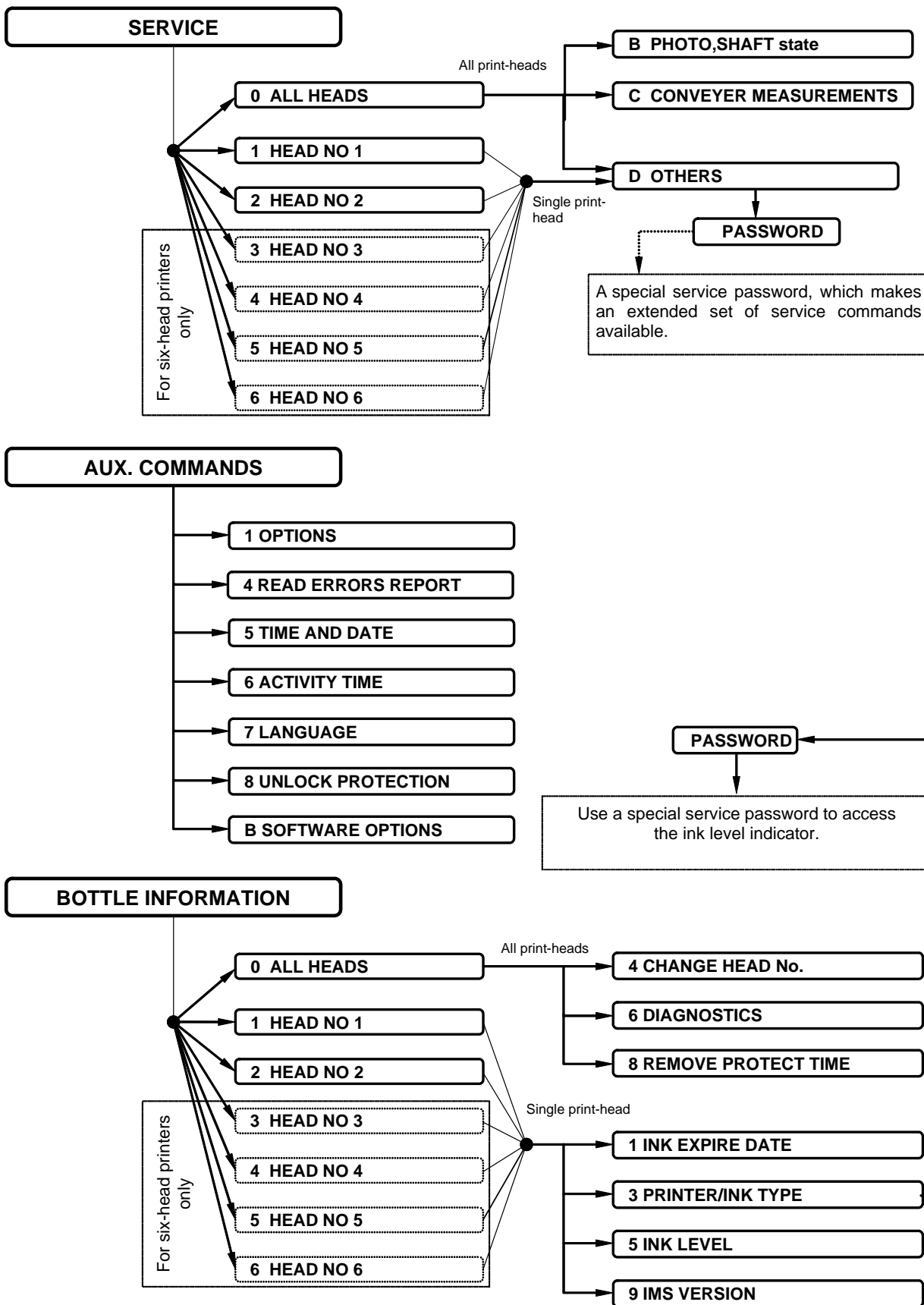
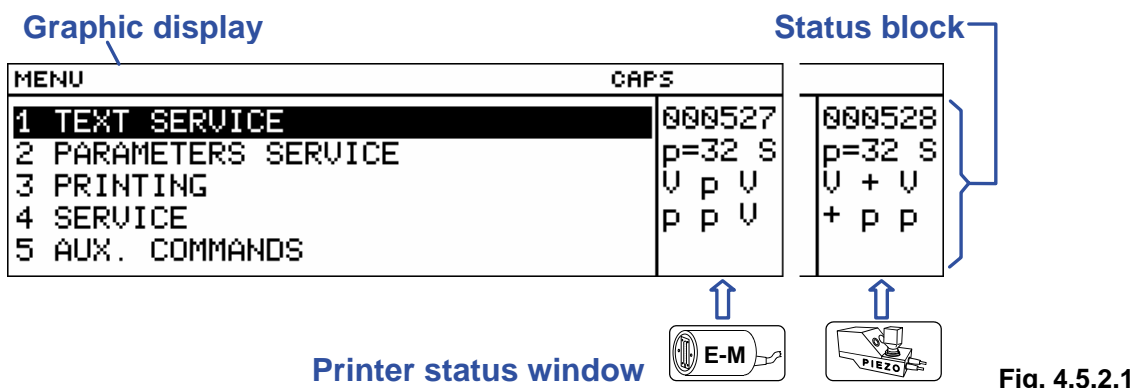


Fig. 4.5.1.3.

4.5.2. The print-head status

The status is a set of parameters describing the condition of the print-head. It is displayed in the status window on the terminal display. The status of the print-head is updated on an on-going basis and displayed as a block of characters. The meaning of the characters is described further on. A sample print-head status is given below.



1. The status of each of the print-heads connected or the joint status can be displayed in the printer status window. A simplified status is displayed until the real configuration is set up automatically (that is at least one print-head is detected and the corresponding number of **IMS** modules is identified).
2. If the **DATE IS SET BACKWARD !!** error has been detected, it is displayed in the printer status window until it is cleared (no matter whether the **F1** and **F2** keys have been used).
3. When the **F1** key is pressed, the status of the following print-head is displayed, the **F2** key moves to the status of the previous print-head.
4. **The joint status** contains the following pieces of information:
 - On the first line there is the printer number.
 - On the second line there is **p**=<the maximum height of the text (expressed as a number of dots> and the letter **S** when the printer is not in the print mode or the letter **P** when it is in the print mode.
 - The following lines contain 1-character indications of the state of each of the print-heads (from 1 to **CHN_NR**¹³). The following characters can appear:
 - means that no print-head of a given number has been detected,
 - + means that the print-head has been detected but it is not ready for printing (e.g. the temperature of the print-head is too low),
 - V** means that the print-head is fully operational,
 - p** means that the print-head has been activated (see section [4.5.4. Starting and finishing printing](#)).
 - The last line may indicate a special-register-update error.

However, if an error (for example, an ink error) occurs in one of the connected print-heads, then the joint status is replaced with the message **ERROR**. The type of error can be confirmed by viewing the status for each of the print-heads (with the **F1** and **F2** keys).

5. **The print-head status** contains information on a given print-head (the status is available only for the print-heads that are detected by the printer). However, if an ink error occurs in a given print-head, the print-head status is replaced with the print-head number followed by a complete message. The print-head status contains the following data:
 - The first line consists of a 1-character print-head number, followed by a colon (:), small letters **s** or **p**, a slash (/) and capital letters **S** or **P**, for example **1:s/P**. The small letter **S** means that the print-head is not active (see section [4.5.4. Starting and finishing printing](#)), the small letter **p** means that the print-head is active. The capital letter **S** means that the

¹³ **CHN_NR** - the maximum number of print-heads connectable, it is defined by software installed in the controller of the printing system.

printer is not in the print mode, while the capital letter **P** means that the printer is in the print mode.

- On the second line (with the acronym “*pix*” at the end), the **START PRINT** command is followed by a number that is the maximum height of the vertical row of the print (in other words, the number of independently controlled nozzles (canals) within the print-head). Alternatively, after the **F4** function key has been pressed, the name (the first 6 characters of the name) of the text currently being printed is displayed for a while. If the **F4** key is pressed a few times, the name is displayed for a longer while.
- The following lines contain additional status data on the print-head and the condition of some of its inner subassemblies.

For the piezoceramic print-head, the successive characters have the following meaning:

- a). The first three characters are the number of all nozzles within the print-head (e.g. 96, 192, 352).
- b). The fourth character means the status of high voltage (**HV**) applied to the print-head.
 - V** HV applied (proper state).
 - no **HV** applied (improper state); the message ****HV-ERROR**** is displayed on the terminal.
- c). The fifth character describes the level of the temperature in the print-head.
 - T** means that the temperature of the print-head and ink is of the rated value (about. 70°C); and the green **TMP** lamp inside the print-head shines continuously (proper state).
 - The temperature of the ink in the print head is too low; the green lamp **TMP** inside the print-head does not light (improper state) and the message **HEAD TEMPERATURE TOO LOW !!** is displayed on the terminal.
- d). The sixth character describes the status of the ink in the print-head.
 - I** the level of ink in the ink pot within the print-head is sufficient (proper state).
 - the level of ink in the ink pot is insufficient (improper state) and the message **INK LACK** is displayed on the terminal.

4.5.3. The maximum length of a print

The maximum length of a text printed by each of the print-heads depends on the maximum number of connectable print-heads, that is defined by the software installed in the controller and described by option **CHN_NR**¹⁴ (CHN_NR = 2 through 6). It does not depend on the number of connected or running print-heads. For example, for a 6-print-head, 4 Mbit RAM printer, a text containing the maximum of about 190 Latin T32x39 characters can be printed. Longer texts exceed the capacity of the buffer. Generally, the maximum number of characters in a text printed with the above font is 1140/CHN_NR and this is an approximate value.

4.5.4. Starting and finishing printing

1. Using the control MENU.

NOTE: The submenu **PRINTING** appears on the terminal screen after one or all relevant print-heads have been selected.

PRINTING	CAPS
0 ALL HEADS	000527
1 HEAD NO 1	p=32 S
2 HEAD NO 2	U U U
3 HEAD NO 3	U U U
4 HEAD NO 4	

- a). The **START PRINT** command from the submenu **HEAD NO 1**, ..., **HEAD NO 6** (a so called print-head activation) only assigns a text to one print-head and generates appropriate system data but it does not initiate the process of printing.

¹⁴ **CHN_NR** - the maximum number of print-heads connectable, it is defined by the software installed in the controller of the printing system.

- b). The **START PRINT** command from the submenu **ALL HEADS** starts the process of printing, i.e., a release signal from the photo-detector initiates the operation of these print-heads that have been activated before (see above).
 - c). The next release of the photo-detector cannot take place until all activated print-heads finish the printing.
 - d). The termination of the printing with the **STOP PRINTING** command from the submenu **ALL HEADS** is effective after all print-heads have finished their printing operations.
 - e). The printing is terminated immediately for all print-heads after the **QUICK STOP** command has been selected in the submenu **ALL HEADS**.
2. Using the **PRINT ON/OFF** key on the main operator's panel.
 - a). The application of the **PRINT ON/OFF** key depends on the state indicated in the printer status window (see section **4.5.2. The print-head status**).
 - b). If a joint status is displayed in the printer status window, the **PRINT ON/OFF** key triggers the whole printer from the **print** mode to the **stop** mode or from the **stop** mode to the **print** mode. Switching to the **print** mode, firstly, activates all the print-heads that are in the proper state and that have proper parameters set up and proper texts assigned, and secondly, initiates the printing each time a photo-detector has been activated.
Switching to the **stop** mode deactivates all print-heads and stops the printer responding to the photo-detector after the printing that was being performed at the time of switching has been finished.
 - c). If the status of a single print-head is displayed in the printer status window, then the **PRINT ON/OFF** key switches this particular print-head from the stop mode to the print mode or vice versa.

4.5.5. Print parameters and blocks of parameters

1. Print parameters
 - a). Print parameters of undetected print-heads are not available.
 - b). Print parameters such as **Generator**, **Resol.dot/dcm (Resol. dot/cm** for piezoceramic print-heads), **Cnv spd m/min** and **Enc const p/m** are common for all print-heads and therefore they appear separately and in the submenu **PRINTING/ALL HEADS/PRINTING PARAMETERS** only (see also section **4.5.1. Control menu in the printing system controller**).
 - c). As all print-heads need to print with the same resolution, care should be taken that the resolution-related parameters (for example, print height, row multiplicity, etc.) are properly set for each print-head. If the resolution changes, the parameters need to be adjusted accordingly !!!
2. Blocks of print parameters

The blocks of parameters, which are stored in the library of blocks in the printer's memory and are available in the submenu **PARAMETERS SERVICE**, do not contain print parameters such as: **Generator**, **Resol.dot/dcm (Resol. dot/cm** for piezoceramic 1500/20 series print-heads), **Cnv spd m/min** and **Enc const p/m** because these parameters are common for all print-heads. The reason is that if the above mentioned parameters are added to blocks and if the blocks of parameters of different values are associated with texts that are assigned to different print-heads, a contradiction of values and problems during the printing might occur.

4.5.6. The maximum print rate

1. For slow print-heads (e.g. electromagnetic ones) there are generally no constraints on the maximum print rate, that would differ from those for single-head printers (because the minimum time of printing a vertical row of the minimum intensity of 50 is 500 microseconds [µs]).
2. For fast print-heads (e.g. piezoceramic ones) the maximum frequency of printing rows of text is 10 kHz (that is, the minimum time of printing a vertical row is 100 µs) and it is available when the below specified configurations are used.

The maximum print rate depends on the following factors:

- The number of print-heads attached to the interface,
- The number of print-heads active,
- The number of special registers. When special registers are used, the print rate is also affected by other parameters described in **d)** below.



- a). The transmission of a row to every print-head connected takes 20 microseconds [μs]. With 6 print-heads it takes 120 μs . Some spare time of 25 μs is also needed, which makes a total of 145 μs . There are two other constraints, the time for preparing another row - see **b)** below and the number of special registers - see **d)** below.
- b). The time for preparing one row for an inactive print-head is 13 μs , while for an active print-head 33 μs . If 6 print-heads are connected but the user wishes to print with two print-heads only, then the time for preparing one row is:
 $2 \cdot 33 + (6-2) \cdot 13 + 25 (\text{spare}) \mu\text{s} = 66 + 52 + 25 = 143 \mu\text{s}$
 As the constraint described in **a)** is stronger, the printer takes the minimum of 145 μs or the maximum of 6.896 kHz to print one row. **However, if only two print-heads are connected to the printer and both of them are to be used, then the time for preparing a row is $2 \cdot 33 + (2-2) \cdot 13 + 25 \mu\text{s} = 91 \mu\text{s}$ {in **a)** it is $2 \cdot 20 + 25 \mu\text{s} = 65 \mu\text{s}$. The printer chooses 100 μs which is the maximum print rate!!! Therefore care should be taken not to attach to the interface too many print-heads unnecessarily, in order not to reduce the maximum print rate.** If all six print-heads are used for printing, the time for preparing a row is:
 $6 \cdot 33 + (6-6) \cdot 13 + 25 \mu\text{s} = 223 \mu\text{s}$ (that is 4.484 kHz) - the rate achieved is below one half of the print-heads' capacity (or twice as slowly as for a single-head printer).
- c). The exact value of the maximum print rate (when no special registers are used) is defined by the printer automatically after all parameters have been set and a successive print-head is activated, as is the case with single-head **EBS-1500** printers. As the activation of every successive print-head reduces the maximum print rate, it may happen that no other (for example, the fifth in turn) print-head can be activated. The recommended solution is then to reduce print resolution or the conveyor's travel speed.
- d). The use of special registers consumes some considerable amount of the processor's time. The higher the print rate, the less time the processor can spend on processing special registers. The preparation of updated values of special registers starts as soon as the distance to a text to be printed (front distance) is covered and can last over the time that the text is printed and until the distance to the next text is covered. If the processor fails to prepare the updated values of the special registers during this time interval, a special-register-update error occurs and a relevant message is displayed in the lowest line of the joint status:

SRg:n where n is the number of errors expressed in the modulo 8 notation (0-7).

If the total number of errors is 0, no message occurs. The total number of errors is always cleared when the printer is not in the print mode.

It is not possible for the system to estimate the maximum print rate for a situation when special registers are used, because too many parameters would need to be considered, such as:

- The number and types of special registers,
- The current value of each special register (the value changes with every print),
- The type of font,
- The number of lines of text,
- The length of the special register,
- The total length of text,
- The distance between successive texts.

Generally, it is better when:

- The special register is a small part of the total length of text,
- The number of special registers is as small as possible,
- The distance between prints is longer,
- The size of font used in the special register is as small as possible.

The maximum rate of printing when special registers are used can be confirmed manually during the installation of the printer. The steps given below should be followed for that purpose:

- Set real print parameters for the most adverse configuration (that is, for the highest anticipated conveyor speed, the highest anticipated resolution, etc),
- Prepare all text files in the most complicated way,
- Start printing with all print-heads using the highest anticipated repetition frequency,
- Observe (the lowest line of) the joint status in the status window to see whether the special-register-update error message **SRg:n** appears on the terminal. The observations should be made for the minimum of 30 minutes. Note that any use of the terminal (keypad) at this time may also be a source of errors. If error messages appear only

when the terminal is used, re-install the software choosing the **FAST_REJSP** option. If error messages appear when the terminal is not used, modify some of the parameters following the above instructions and also choose the **FAST_REJSP** option just in case.

4.5.7. Setting resolution

The setting of resolution is subject to certain constraints that are automatically enforced by the printer software. The constraints are prioritized below, that is, the printer always checks them for compliance in the order they are specified below. The printer only proceeds to move to the next constraint when the given one is met:

1. For piezoceramic print-heads: the resolution must not be changed while the machine is printing. If at least one of the print-heads is of 256 or 352 types, any changes in resolution need to be made in a way that is applicable for these types of print-heads (although the other print-heads may be of different types).
2. For electromagnetic print-heads: if all active print-heads are positioned vertically (that is, the print-heads are not tilted), the resolution can be changed during the printing.
3. If neither of the above mentioned constraints needs to be applied, the resolution is set on the basis of the capacity offered by the first print-head attached to the printer.



4.5.8. Indicating errors in the main and status windows

Error messages displayed in the main window are preceded by the number of the print-head involved, for example:

MENU	CAPS
2: NO BOTTLE Press ENTER...	ERROR

If an error occurs in one of the print-heads attached (for example, **NO BOTTLE** in print-head No. 2), then the joint status is replaced with the message **ERROR**. After error data have been cleared from the main window with the **ENTER** key, the user can still identify the type of error by viewing the status for each print-head (with the **F1** and **F2** keys). Error data are available in the printer status window for the print-head where the error occurred.

MENU	CAPS
1 TEXT SERVICE	2:NO B OTTLE
2 PARAMETERS SERVICE	
3 PRINTING	
4 SERVICE	
5 AUX. COMMANDS	

4.5.9. Servicing - adjusting ink jets at the nozzles of electromagnetic print-heads

Nozzles or rather the electromagnets of valves within an electromagnetic print-head can be adjusted only when the given print-head performs the operation of printing. The adjustment cannot be made in any other state, including a state when the print-head is waiting for a release signal from the photo-detector. Therefore continuously repeated printing should be set (the print parameter **Text rpt.=CONTIN.**) for the adjusted print-head, the printing of any text started, the photo-detector released and then the nozzles adjusted with the parameter **Set Nozzle no** available in **SERVICE/ OTHERS/ ADJUSTMENTS** - see also *Adjusting valve electromagnets (in electromagnetic heads)* in the EBS-1500 Operating Instructions.



4.6. A printing system with “mixed” (piezoceramic and electromagnetic) print-heads

Multi-head printing systems with “mixed”, piezoceramic or electromagnetic print-heads are based on the single-head **EBS-1500** series printers. The systems can print different texts with each print-head on one or many objects moving on the same conveyor. Applications and characteristics of the multi-head printing system with “mixed” print-heads are similar for systems with print-heads of one type.



Multi-head systems with “mixed” print-heads can additionally be characterized by the following properties:

- An important quality of the printing system is number **CHN_NR**¹⁵. **The first few print-heads defined by CHN_NR/2** (after the fractional part has been truncated) **are reserved for piezoceramic print-heads, while the other print-heads are electromagnetic ones**. The maximum value of **CHN_NR** is currently **6**. This means that the multi-head systems available contain from 2 up to 6 print-heads. **CHN_NR/2** can be equal to 1, 2 or 3.

Examples:

- ☞ For **CHN_NR=4** (**CHN_NR/2=2**) print-head numbers 1 and 2 are reserved for piezoceramic print-heads, while numbers 3 and 4 for electromagnetic ones.
- ☞ For **CHN_NR=3** (**CHN_NR/2=1** after the fractional part has been truncated) number 1 is reserved for a piezoceramic print-head, while numbers 2 and 3 for electromagnetic print-heads.
- Electromagnetic print-heads can contain 5, 7, 12, 16, 25, 32 or 64 nozzles and print-heads with different numbers of nozzles can work together. Piezoceramic print-heads can produce 32 or 64 dots (pixels) and the 32 and 64 dot print-heads can contain 64, 96, 128, 192 or 352 nozzles. Only 32-dot piezoceramic heads have been used in “mixed” head systems so far.
- Every piezoceramic print-head has a built-in Ink Control System (**IMS**). Electromagnetic print-heads need to be equipped with external ink systems with **IMS** modules at the bottles (or work with an ink system with an ink pump, which is also equipped with an **IMS** system). The external **IMS** modules are connected in series to socket **1 - INK SYSTEM** on the printing system controller. In terms of the operation of the ink control systems, the **IMS** modules of piezoceramic print-heads and the external **IMS** modules for electromagnetic print-heads **are connected to the same interface**, and therefore they constitute one system in which each **IMS** module (also when it is built into the ink system with an ink pump) needs to have its individual number.
- Not each of the print-heads need to be linked to the system. Only one condition needs to be met - the number of print-heads should equal the number of **IMS** modules, including modules built into the piezoceramic print-heads.

NOTE:

A printing system in which one ink system with an ink pump serves more than one electromagnetic head is an exception.



¹⁵ **CHN_NR** - the maximum number of print-heads connectable, it is defined by software installed in the controller of the printing system.

4.6.1. Connection diagrams for “mixed” multi-head printing systems

The simplest printing system with “mixed” print-heads is known as **EBS-1502 E-M / PIEZO**¹⁶. Here there is only one piezoceramic print-head and only one electromagnetic print-head.



EBS-1502 Printing System: 1 PIEZOceramic n-pixel, m-nozzle print-head, n = 32, 64; m = 64, 96, 128, 192, 352,
1 electromagnetic n-nozzle (pixel) print-head; n = 5, 7, 12, 16, 25, 32, 64

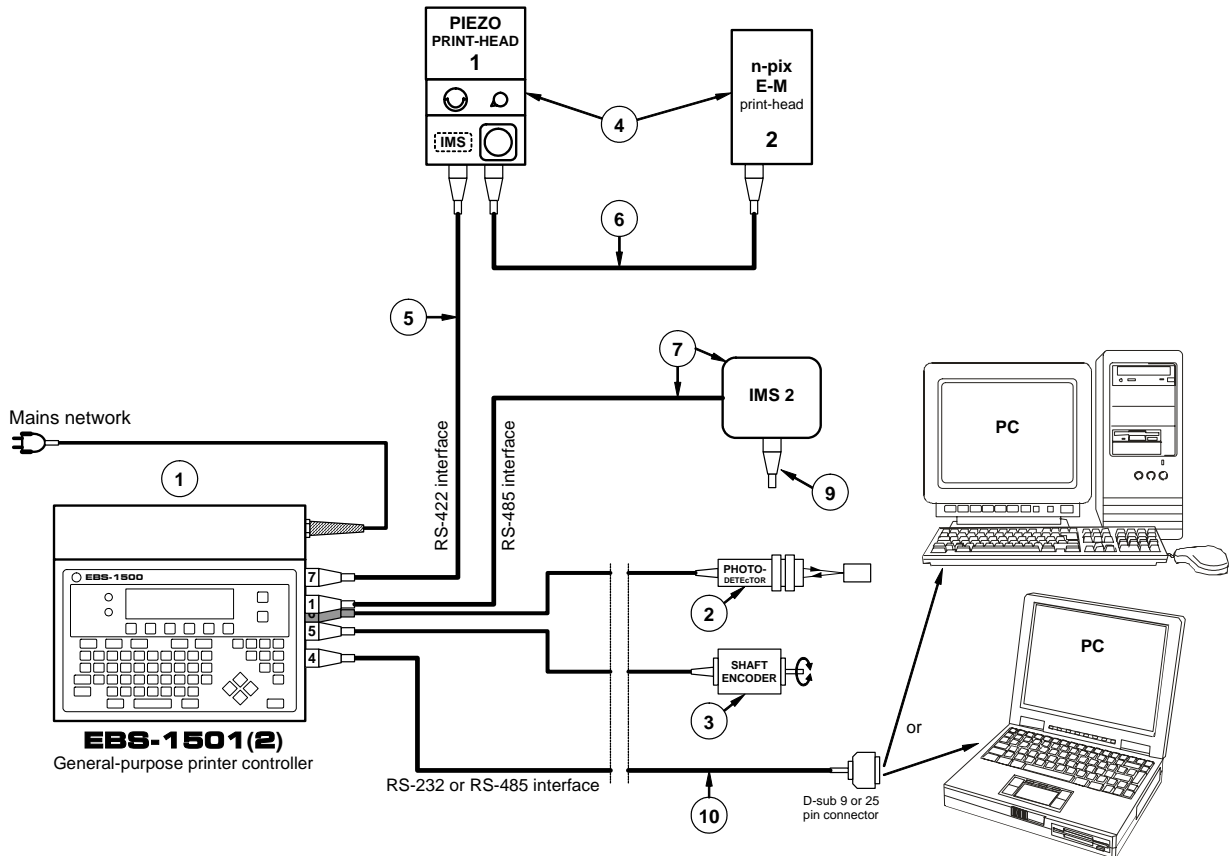


Fig. 4.6.1.1. Connection diagram for a printing system with one piezoceramic print-head and one electromagnetic print-head

NOTE:

- The two-head printing system shown in **Fig. 4.6.1.1** is an illustration of how to connect the system elements. The system will work properly only when the requirements presented in section **4.1 Restrictions on Printing System Configuration** are satisfied and when it is designed in compliance with the guidelines given in section **4.7 Rules for designing a multi-head printing system**.
- No printing system elements must be connected in the way shown in the above drawing unless the restrictions are applied to the system design or otherwise the system elements may get damaged!!!



¹⁶ E-M – stands for the electromagnetic print-head, PIEZO – stands for the piezoceramic print-head.



The most developed printing system with „mixed” print-heads is **EBS-1506 E-M / PIEZO**¹⁷, where there are up to three piezoceramic print-heads and up to three electromagnetic print-heads.

EBS-1506 Printing System: up to 3 PIEZOceramic n-pixel, m-nozzle print-heads; n = 32, 64; m = 64, 96, 128, 192, 352,
up to 3 electromagnetic n-nozzle (pixel) print-heads; n = 5, 7, 12, 16, 25, 32, 64

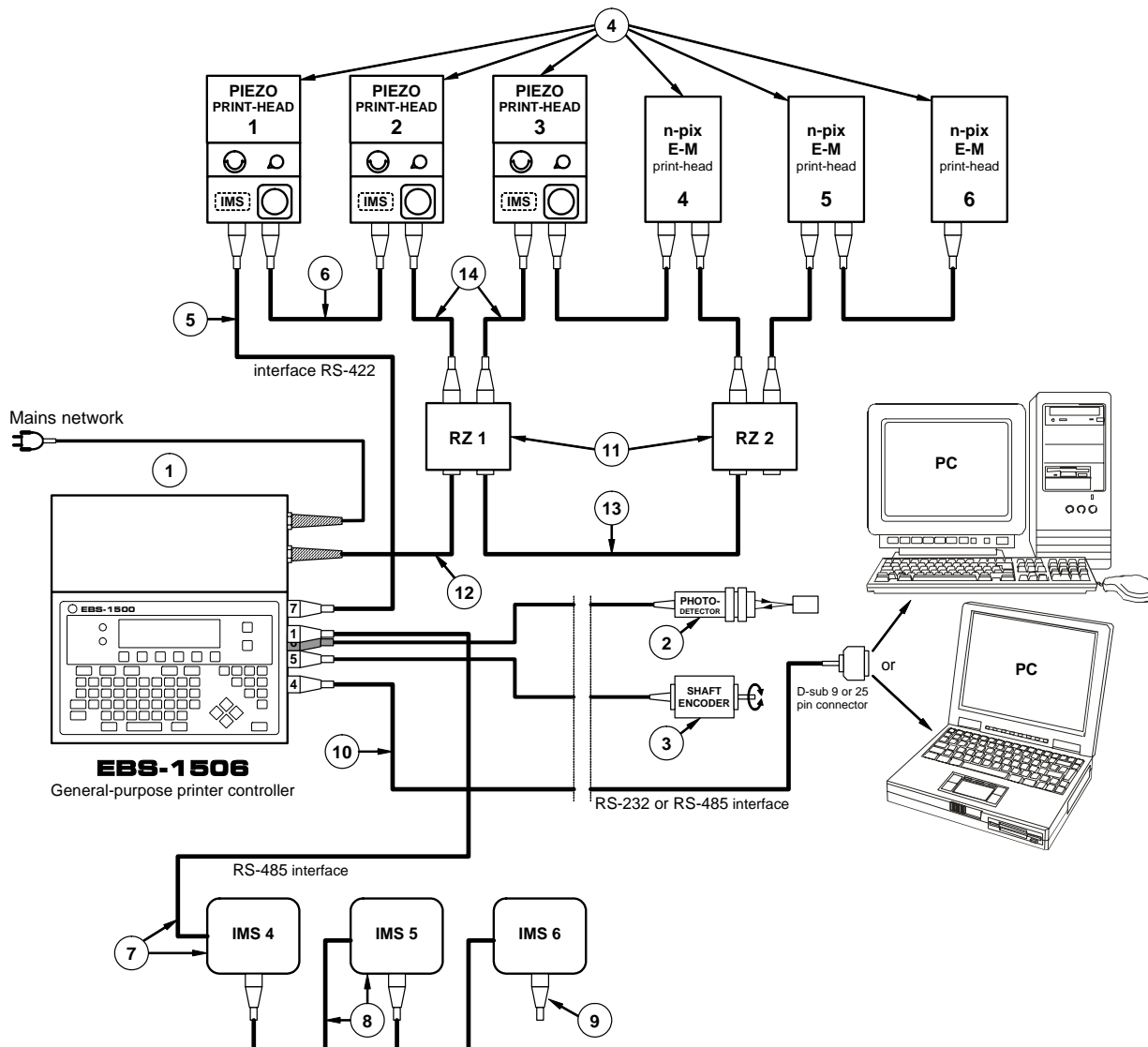


Fig. 4.6.1.2. Connection diagram for a printing system with three piezoceramic print-heads and three electromagnetic print-heads

¹⁷ **E-M** - stands for the electromagnetic print-head, **PIEZO** – stands for the piezoceramic print-head.




NOTE:


- The six-head printing system shown in **Fig. 4.6.1.2** is an illustration of how to connect the system elements. The system will work properly only when the requirements presented in section **4.1 Restrictions on Printing System Configuration** are satisfied and when it is designed in compliance with the guidelines given in section **4.7 Rules for designing a multi-head printing system**.
- No printing system elements must be connected in the way shown in the above drawing unless the restrictions are applied to the system design or otherwise the system elements may get damaged!!!
- The system shown in **Fig. 4.6.1.2** can work properly only with an **EBS-1506** controller equipped with a **PGDU4** card (for more details refer to section **4.1.4**)!!! Otherwise the controller may get damaged !!!
- Ensure free circulation of air around the **EBS-1506** controller to cool the device properly.

If the printing system contains more than two print-heads, an **EBS-1506** controller with a power supply of higher current efficiency should be used. In addition, branch-joints **RZ** should be connected between two consecutive pairs of print-heads (that is between print-heads 2 and 3 and between 4 and 5). The joints energize the consecutive heads via a cable of higher current efficiency and are "transparent" for interface signals at the same time. The installation of the power cable in the branch-joints is shown in **Fig. 4.3.2.1** on page **22**.

4.6.2. Configuring a "mixed" printing system

The below steps should be followed during the installation in order to ensure proper operation of "mixed" print-heads and the corresponding **IMS** modules (also when they are built into the ink system with an ink pump) in a multi-head printing system:





Printing system with piezoceramic and electromagnetic print-heads

1. Define the order in which all types of print-heads should be installed and assign numbers to them starting from number 1.
2. Assign an ink system with an **IMS** module (or possibly an ink system with an ink pump if each head uses a separate system) to each electromagnetic print-head. The **IMS** modules are built into the piezoceramic print-heads and therefore they are automatically assigned to the corresponding ink systems.
3. It has been mentioned before that **in the printing system, the first CHN_NR/2¹⁸** (after the fractional part has been truncated) **are piezoceramic print-heads and the other print-heads are electromagnetic ones**.
4. Attach only one piezoceramic print-head to the controller. A termination resistor may need to be installed in order to ensure proper operation - see **NOTES** on page **25**.
5. Switch the controller on and go to the submenu **BOTTLE INFORMATION/ ALL HEADS**. Choose the **CHANGE HEAD No.** command and on typing the service password input the **IMS** number that was assigned to the module in point **1** above. Then press the **(ENTER)** key.

CAPS	
Head No.(1hex): 3	000527
PLEASE WAIT	p=32 S
	U - -
	- - -

⇒

BOTTLES:A		CAPS
4 CHANGE HEAD No.		ERROR
6 DIAGNOSTICS		

If the number has been programmed properly in the **IMS** module, the MENU screen is displayed on the terminal. Otherwise the following message is displayed:

¹⁸ **CHN_NR** - the maximum number of print-heads connectable, it is defined by software installed in the controller of the printing system.



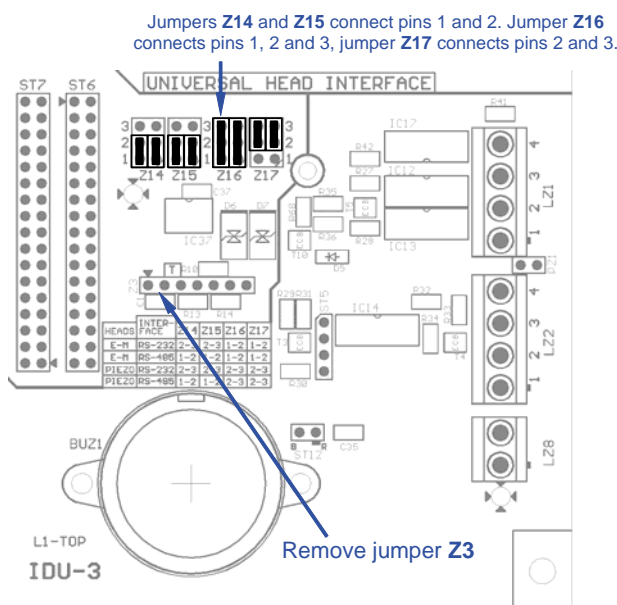
Printing system with piezoceramic and electromagnetic print-heads


CAFS	
CHANNEL ERROR Press ENTER...	WRONG HEADS CONFIGURATION

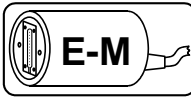
The message **ERROR** or **WRONG HEADS CONFIGURATION** in the printer status window is inconsequential at the moment, as it is displayed each time the number of print-heads and the number of **IMS** modules are different. Other alarms or messages concerning the bottles of ink may also occur but these should be cleared.

6. Switch the controller off and detach the print-head for which the **IMS** module has been programmed.
7. Follow steps **4, 5, 6** above in order to assign individual numbers to the other **IMS** modules of piezoceramic print-heads.
8. Attach only one electromagnetic print-head and the corresponding **IMS** module (or the ink system with an ink pump) to the controller. Install the transmission line termination to the socket on the **IMS** module. For the pump-based ink system connect a jumper shown in **Fig. 4.3.3.3**.
9. Follow steps **5, 6** above in order to assign individual numbers to the **IMS** modules (or the pump-based ink systems) that correspond to the electromagnetic print-heads.
10. Attach to the controller all print-heads in series and in pre-defined (ascending) order. Make the connections using series interface cables (connect also branch joints, if required). Attach to the controller all programmed **IMS** modules (or ink system with ink pumps) corresponding to the electromagnetic print-heads in series and in pre-defined (ascending) order. For proper operation of the print-head system, ensure that the transmission line of an RS-485 interface is matched:
 - a). Connect the termination of the transmission line to the socket on the last **IMS** module in the series.
 - b). In the last pump-based ink system connect transmission-line matching elements. For this end fasten a **Z4** jumper shown in **Fig. 4.3.3.3**. In all other systems except the last one the above mentioned jumper must be unfastened !!!
 - c). Install transmission-line matching elements in the last piezoceramic print-head. For this end fasten a jumper to pins 1-2 of the **J3** connector on the **IT2** card (for earlier head types – see **Fig. 4.3.3.1**) or to the **Z4** connector on the **TI32** card (for later head types - see **Fig. 4.3.3.2**). If there is no jumper, the matching elements are not added. Matching elements must not be installed in any other print-heads (from the first to last but one).
 - d). Remove jumper **Z3** on the **IDU-3** card of the controller.

Position of jumpers **Z3, Z14, Z15, Z16** and **Z17** on the **IDU-3** card of the controller







Printing system with piezoceramic and electromagnetic print-heads

Fig. 4.6.2.1.

11. If all print-heads and the corresponding **IMS** modules are attached, switch the controller on. After a short while, the proper status should be displayed for each print-head in the status window of the terminal, provided that all elements of the printing system are connected properly and the **IMS** modules (also those built into pump-based ink systems) have their individual numbers programmed properly.

CAPS	
PLEASE WAIT +++++	WRONG HEADS CONFIGURATION

MENU		CAPS	
1 TEXT SERVICE		000527	
2 PARAMETERS SERVICE		p=32 S	
3 PRINTING		V V V	
4 SERVICE		V V V	
5 AUX. COMMANDS			

Otherwise the message **WRONG HEADS CONFIGURATION** is displayed after a longer while.

CAPS	
PLEASE WAIT +++++	WRONG HEADS CONFIGURATION

MENU		CAPS	
1 TEXT SERVICE		WRONG HEADS CONFIGURATION	
2 PARAMETERS SERVICE			
3 PRINTING			
4 SERVICE			
5 AUX. COMMANDS			

In such a case check all connections and possibly the **IMS** module numbers once again - see the notes below.

12. For piezoceramic print-heads, place the transponder of the ink bottle into the transponder socket on print-head 1 (that comprises a **IMS** module with number 1 programmed for it). The new transponder is validated with the message **BOTTLE ACCEPTED** after it has been reviewed (within about 10 seconds).

13. Follow step **12** for piezoceramic print-heads. After the bottle transponders have been validated, screw the bottles into the ink systems within the individual print-heads. The operation requires protective aluminum foil to be removed from the plug of a new bottle. Screw the bottle into the bottle seat (no ink leakage should occur when the bottle is put up side down as the integrated bottle plug contains a protection valve) - see also section **Installing a new Bottle of Ink (or Replacing an Empty One)** in the EBS-1500 Operating Instructions.

14. For electromagnetic print-heads, put the bottle of ink into the ink container for print-head 1 (that comprises a **IMS** module with number 1 programmed for it). The new bottle is validated with the message **BOTTLE ACCEPTED** after it has been reviewed (within about 10 seconds). If a pump-based ink system is used, connect the bottle following the instruction given in the document entitled *Ink System with an Ink Pump*.

15. Follow step **14** for the other ink systems of electromagnetic print-heads. After all bottles have been validated, connect the ink systems to the corresponding print-heads with ink tubes. Set the rated pressure in all ink systems - see also **Connecting the head to the ink and compressed air systems** in section **Connections** and section **Installing a new Bottle of Ink (or Replacing an Empty One)** in the EBS-1500 Operating Instructions.

16. See also **NOTES** on page **25**.

4.6.3. Print parameters

All information on print parameters for multi-head systems that is contained in section **4.5.5. Print parameters and blocks of parameters**, is also valid for systems where “mixed” print-heads are used. Only the parameter **Resol. dot/cm** describing the resolution of characters printed, is common for both piezoceramic and electromagnetic print-heads. For electromagnetic print-heads there is an additional parameter, **Speed divider** - see further below. The parameters **Speed divider** and **Intensity** are not available for piezoceramic print-heads.

4.6.4. Setting resolution for a “mixed” head system

All print-heads of the **EBS-1500** series-based multi-head systems are released by one photo-detector and the printing is timed by one internal generator or one shaft-encoder.



As the print rate for piezoceramic print-heads is several times higher than that for electromagnetic print-heads, a timing problem occurs in systems where “mixed” print-heads are used.

Changes in and restrictions on “mixed” systems are specified below:

1. Timing signals are generally generated as if only faster (that is piezoceramic series) print-heads are used.
2. The print parameter **Resol. dot/cm** is given and calculated as if piezoceramic print-heads are used.
3. In view of the above, there is an additional parameter, the speed divider, within the set of parameters for electromagnetic print-heads. It is used to adjust the print-rate of the electromagnetic print-heads to that of the piezoceramic print-heads:

	Speed divider
Range of values	1,2, ... , 50
Default value	1
Can it be modified during the printing?	NO

The parameter **Speed divider** can only be modified, when the print-head is not active and the printer is not in the print mode. The parameter defines how many times the resolution for a given electromagnetic print-head should be smaller than that for a piezoceramic print-head.

Resolution of an electromagnetic print-head = **(Resol. dot/cm) / (Speed divider)**

Please note that resolution is expressed as a number of dots per cm (whereas for printers with electromagnetic print-heads it has so far been given as a number of dots per decimeter; 10 dots/dcm = 1 dot/cm).

4. The setting of the resolution should be started for piezoceramic print-heads first. When each piezoceramic print-head is able to print properly, move on to the adjustment of the setting for electromagnetic print-heads, leaving the common parameter **Resol. dot/cm** unchanged. The resolution of each electromagnetic print-head should be adjusted with the parameter **Speed divider** only. The resolution obtained for an electromagnetic print-head is equal to the value of the common parameter **Resol. dot/cm** divided by the value of the parameter **Speed divider** for this print-head.

Example:

Resol. dot/cm=63 implies that all piezoceramic print-heads print with this resolution For electromagnetic print-head No. 3, **Speed divider=10** and the resolution is 63/10 dot/cm=6,3 dot/cm=63 dot/dcm. For electromagnetic print-head No. 4, **Speed divider=9** and the resolution is 63/9 dot/cm=7 dot/cm=70 dot/dcm.

5. In the case of **electromagnetic print-heads of reduced print height** (that is achieved by setting the print parameter **Height** to a value different from the maximum and by tilting the print-head downwards) note that only certain values of the resolution may bring a positive result. In systems where “mixed” print-heads are used, the printer controller "proposes" resolutions that are appropriate for piezoceramic print-heads, therefore for electromagnetic print-heads of reduced print-height the value of the parameter **Speed divider** needs to be estimated by experience. The table below gives the minimum resolution that can be achieved for a given type of print-head and a given print-height. Resolutions of the values that are a whole number (that is 2, 3, 4, 5...) times greater than the minimum are allowable. The resolution should not differ more than 10% from that given in the table, otherwise the user may find it difficult to obtain straight prints or prints of a required height.

Table 2. Print heights (mm) for various types of electromagnetic print-head (the height is measured between the centers of outermost dots).

No.	7pix print-head (max. height of 11 mm)	12pix print-head (max. height of 20 mm)	16pix print-head (max. height of 27 mm)	25pix print-head (max. height of 44 mm)	32pix print-head (max. height of 56 mm)	64pix print-head (max. height of 115 mm)	Min. resolution (dot/cm)
1	9	16	22	35	45	92	9.167
2	8	14	19	31	39	80	7.702
3	6	11	15	24	31	63	6.586
4	5	9	12	20	25	52	6.159
5	4	7	9	15	20	40	5.871
6	3	5	7	11	14	29	5.680

Example:

For piezoceramic print-heads the parameter **Resol. dot/cm** is set to **63**. A 16-pix (16-dot) electromagnetic print-head is to print 22 mm high labels. The above table shows that the minimum resolution for this kind of print is 9.167 dots/cm. If you choose **Speed divider=7**, the resolution equals 9 dots/cm (which is too small by about 2%). The inaccuracy of the resolution can be compensated by tilting the print-head a little in order to get vertical (straight) prints, however the print will be a little lower than the intended 22 mm. The doubled value of the resolution (i.e. $2 \cdot 9.167 = 18.334$) cannot be set as $63/3 = 21$ dots/cm and $63/4 = 15.75$ dots/cm and the two values differ significantly from the value set (for such resolution, the print height would be too big compared with the character width anyway).

If you choose **Speed divider=8** to get the resolution of 7.875 dots/cm, then you can tilt the print-head in such a way that straight prints can be produced but the prints will be about 20 mm high.

Important note: the real resolution differs from the required one (!) for the following reasons:

- All hardware dividers operate on whole numbers only,
- The encoder constant (print parameter **Enc const p/m**) is limited,
- The program makes calculations taking fractional parts into account but the result is rounded to a whole number.

Should difficulties in determining the resolution occur (normally, the resolution is determined precisely enough), take **the real resolution** into consideration. In order to determine **the real resolution** follow the steps below:

- a) Divide the value of **Enc const p/m** by the value of **Resol. dot/cm** and divide the result of the division by 100. Round the final result to the nearest whole number - this is how a hardware divider (**hdv**) operates.

Example: **Enc const p/m**=120850, **Resol. dot/cm**=63, $\Rightarrow 120850/63/100 = 19.18254$.

For this set of parameters **hdv**=19.

- b) Divide the value of **Enc const p/m** by **hdv** and by 100 - this is **the real resolution**. (Example: $120850/19/100 = 63.6053$, **the real resolution** is **63.6053 dots/cm**). In the case referred to, **the real resolution** applies to piezoceramic print-heads.
- c) For electromagnetic print-heads, **the real resolution** needs to be divided by the value of **Speed divider** - this is **the real resolution** for every electromagnetic print-head. (Example: **Speed divider**=9, **the real resolution** for every electromagnetic print-head is $63.6053/9 \text{ dots/cm} = 7.0673 \text{ dots/cm}$).
- d) The bias may be even greater, if the value of the encoder constant is smaller. (Example: **Enc const p/m**=12085, **Resol. dot/cm**=63 $\Rightarrow 10125/63/100 = 1.60714$. The rounded **hdv** is 2 for this set of parameters. **The real resolution** is $10125/2/100 = 50.625 \text{ dots/cm}$!!!).

4.6.5. The maximum print rate in a system with “mixed” heads

The maximum print rate can be constrained for two reasons:

1. The maximum print rate is exceeded for piezoceramic print-heads - for the print-heads of this type the restriction is the same as for the printers where only piezoceramic print-heads are used - see section 4.5.6. **The maximum print rate**.
2. The maximum print rate is exceeded for one of the electromagnetic print-heads (for every electromagnetic print-head there can be different values of the parameters **Speed divider** and **Intensity**, either of which affect the maximum allowable print rate).



If the message **PRINT SPEED TOO HIGH** is displayed, make sample prints with each of the print-heads separately in order to find which of them reduces the print rate. If no error occurs when each print-head is used separately from the other but it occurs when all of them are used, this means that no time is left for the machine to transfer data to the print-heads or to prepare the data. The recommended solution is then to reduce the print rate or the resolution of a text printed.

4.7. Rules for designing a multi-head printing system

Before starting installing a multi-head printing system make sure that the system meets the restrictions described in section [4.1 Restrictions on Printing System Configuration](#).

1. Number of heads in the system.

The number of heads in the system must not exceed **6**. Printing systems consisting of a greater number of heads can be made to order. In such a case the other restrictions need to be followed.

2. Number of bits transmitted to the heads.

The number of bits transmitted to all heads during one data transmission cycle should not exceed **256**. The number of bits transmitted to a given head type is specified in section [4.1.1 The number of bits transmitted](#).

Example:

The multi-head printing system consists of the following heads (for CHN_NR=3):

- One 96/32 (32-dot, 96-printing nozzle) piezoceramic head,
- One 16-dot electromagnetic head,
- One 25-dot electromagnetic head.

(If CHN_NR=3, the integer part of CHN_NR/2 is 1. This is the maximum number of piezoceramic heads in the system.)

Using the table given in section [4.1.1](#) define the number of bits that is required for a given head type. The 16-dot electromagnetic head requires 32 bits per cycle, the 25-dot head requires 64 bits per cycle, while the 96/32 piezoceramic head requires 32 bits per cycle. Thus the total number of bits is **128** (32+64+32). This number is smaller than 256, so the requirement is met. Otherwise, you should limit the number of heads in the system to meet the requirement.

3. Current input for heads.

Depending on the number of heads to be used in a printing system and the current to be used by the heads, you can apply one out of two controllers specified in section [4.1.4](#). If you use the configuration presented in the example at point [2](#), you will need to use the EBS-1506 controller as it is the only one that enables a user to operate three heads.

In order to estimate the maximum current to be used by the electromagnetic heads you should use the appropriate formula or charts given in section [4.1.2](#). The maximum current input for the piezoceramic head is constant and equals to **0.92 A** (see the description in section [4.1.3](#)).

In order to estimate the maximum current to be used by the head you need to determine the following:

- The maximum print intensity,
- The maximum resolution, **R**, and shift, **P**,
- The average value of the electromagnet tuning factor, **WW**. The maximum value is 1, but in most applications it does not exceed 0.5.

Example:

Estimating the maximum current input for the 16-dot and 25-dot electromagnetic heads that are used in the example at point [2](#).

Let's take the following settings:

- Resolution **R**=50 dots/dcm,
- Shift **P**=60 m/min,
- Intensity **INTENS**=50 (a value smaller than 63 has been chosen to show how to calculate the adjustment – see NOTE in section [4.1.2](#),
- Tuning factor **WW**=1, the result can be adjusted after the current input has been calculated for the maximum tuning factor **WW**.

The above data can be used to find an approximate value of the input current on the appropriate chart or to calculate it using the formula given in section **4.1.2**.

For the 16-dot (**D=16**) head to be operated with the above settings, you get:

$$I_h' = 0.065 + 0.167 \cdot 10^{-6} \cdot (20 + \text{INTENS}/2) \cdot R \cdot P \cdot D \cdot WW = 0.065 + 0.167 \cdot 10^{-6} \cdot (20 + 50/2) \cdot 50 \cdot 60 \cdot 16 \cdot 1 = 0.42572 \text{ A}$$

Because INTENS=50<63, so you need to calculate the adjustment which is $((63 - \text{INTENS})/2)\% = 6.5\%$.

If you include the adjustment, the maximum current input for the 16-dot head is:

$$I_h = I_h' + \text{adjustment} = I_h' + 0.065 \cdot I_h' = 0.42572 + 0.0276718 = 0.4533918 \text{ A}$$

For the 25-dot (**D=25**) head to be operated with the above settings, you get:

$$I_h' = 0.065 + 0.167 \cdot 10^{-6} \cdot (20 + \text{INTENS}/2) \cdot R \cdot P \cdot D \cdot WW = 0.065 + 0.167 \cdot 10^{-6} \cdot (20 + 50/2) \cdot 50 \cdot 60 \cdot 25 \cdot 1 = 0.628625 \text{ A}$$

Because INTENS=50<63, so you need to calculate the adjustment which is $((63 - \text{INTENS})/2)\% = 6.5\%$.

If you include the adjustment, the maximum current input for the 25-dot head is:

$$I_h = I_h' + \text{adjustment} = I_h' + 0.065 \cdot I_h' = 0.628625 + 0.040861 = 0.669486 \text{ A}$$

The total current used by all heads (two electromagnetic and one piezoceramic) is about **2.04288 A**.

You can see clearly that such a system must be based on the EBS-1506 controller not only due to the number of heads but also due to the current input. While configuring the system you need to remember to connect up to 2 heads whose total current input does not exceed **1.5 A** directly to the controller that is equipped with an **PGDU3** card. The other heads must be connected via a branch-joint.

In the above example you can connect the piezoceramic head directly to the controller while both electromagnetic heads via the branch-joint. Piezoceramic heads have to be connected to the transmission line before the electromagnetic heads.

NOTE:

Please remember that the above calculations are made for the most extreme case, when the tuning factor WW is 1. Because in the real circumstances the factor does not exceed 0.5, therefore the current input for the heads will be proportionally smaller. If we assume that the heads will work with the tuning factor of 0.5 then the current input for all electromagnetic heads will be smaller by a half than the calculated input. The maximum current input for the piezoceramic heads does not depend significantly on print parameters.

EBS-1506 printing system: 1x 32-pixel, 96-nozzle PIEZOceramic head,
2x 16-nozzle and 25 nozzle electromagnetic heads.

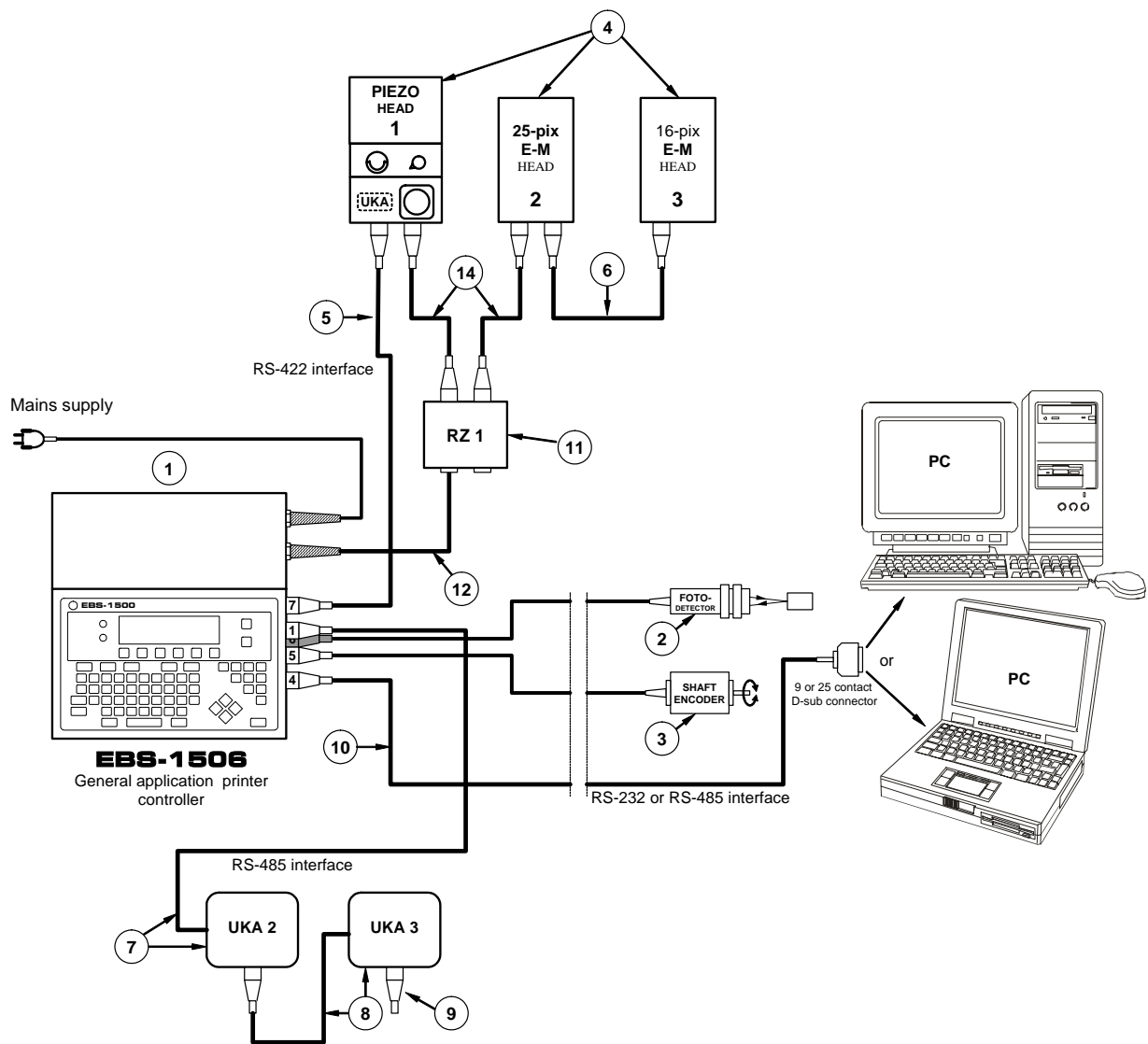


Fig. 4.7.1. Connection diagram of the printing system designed in the above example