

# Bang & Olufsen

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Datalink '86

## Preface

This description is intended to be an aid to the technicians who will install and service link systems. Here we will discuss the electrical and data aspects whereas the practical aspects are described in the "MCL 2 System Manual". We have presumed that the reader has some general knowledge of the products we will be describing, i.e., that they are familiar with operation, function and linking. The products are:

Beosystem 5500 with Master Control Panel 5500  
Beocenter 9000  
Master Control Link 2A  
Beovox Penta

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## INTRODUCTION

Together with the launching of a number of new products in 1986, Bang & Olufsen has introduced a new format for remote control via infrared light and for data transmission between products and link stations. The new format has a much greater capacity than the old, permitting for example fast transmission of data for current tape counter value and for the recording and playback levels of a tape recorder. This function is called dynamic updating.

Data transmission without dynamic updating between a Beomaster and "Tape 1", "Phono", "CD" and "Tape 2" is still carried out with the "old" data link format. It is thus possible to connect new and old products. Only the dynamic updating to "Tape 1" is carried out in the new format.

## DATA TRANSMISSION

### Data paths

By means of the link system it is possible to transmit data signals between connected products. This means that the products may be operated from a room other than the one in which they are located.

Data can be transmitted in several different ways.

- 1) Through a lead mounted in the signal cable between the products
- 2) Through a data lead in the link cable connecting the speaker output of the radio to one or several MCL 2A units (link stations)

The new data link format is used alongside the "old" which is known from previous products.

It can be seen from fig. 2045-1A which data link formats are used in connection with various products.

fig. 2045-1A

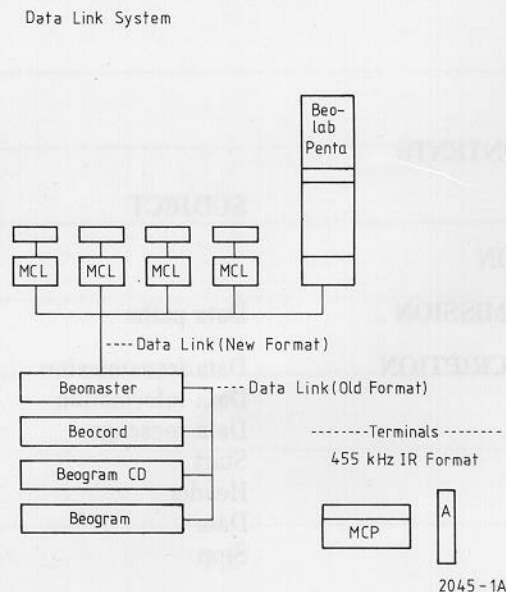
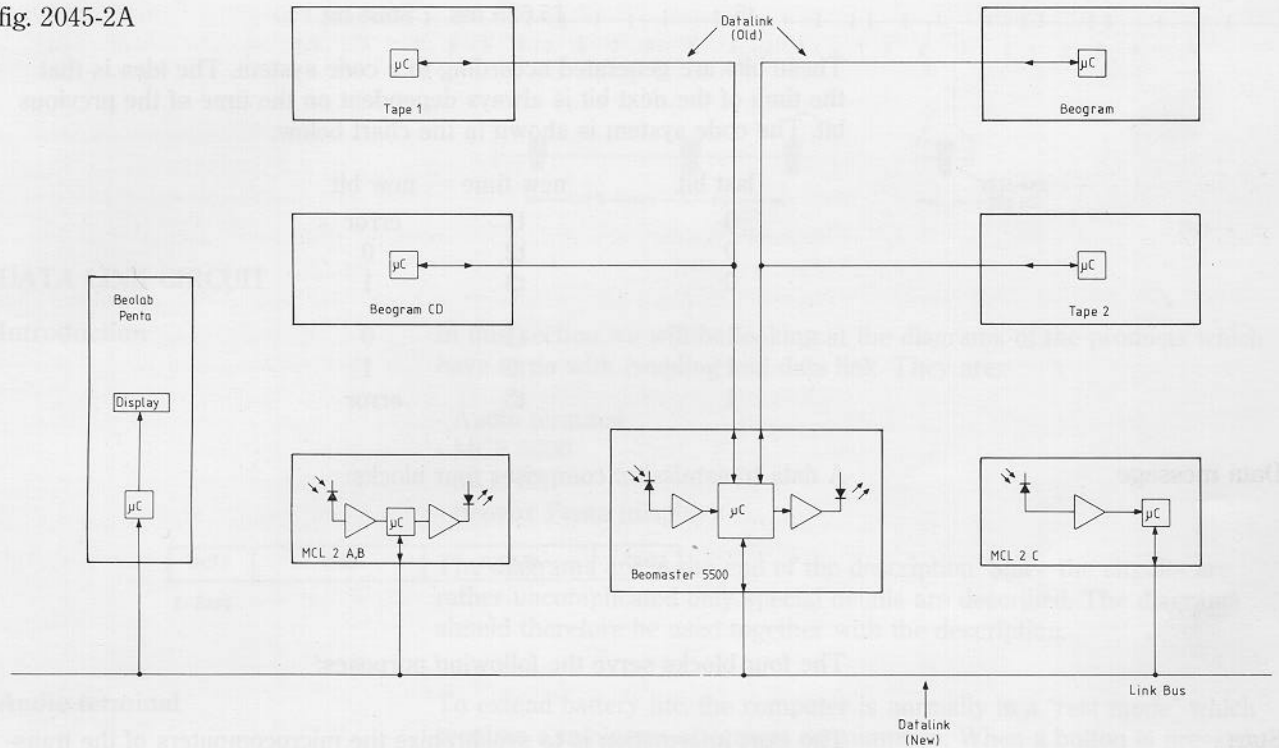


Fig. 2045-1A illustrates the data connections between the individual products. The products can be located in different rooms of the house. By means of one of Bang & Olufsen's remote control terminals it is possible from each of the rooms to switch between the functions wanted. Now, it all depends on whether or not there is a record on the turntable, a CD-disc in the CD player, a tape in the tape recorder or a station set on the radio.

Generally speaking, data is transferred from the computer in one product to the computer in another. There is an electric connection between the various data leads and the new data link format. From a purely data-orientated point of view they may all be considered to be interconnected. That will make it easier to understand what actually happens to the data in the system.

fig. 2045-2A



2045 - 2A

The computers see to it that the signal is processed "intelligently". This means that when we send a Tape 1 "Play" command, the tape recorder computer starts the tape recorder, while the computer in the radio sets the Program select IC in Tape 1 mode.

## FORMAT DESCRIPTION

### Data transmission

Transmission of data from a terminal to a product is effected with infrared light modulated with 455 kHz. Each bit is transmitted in the form of a modulated pulse with a length of 200  $\mu$ s.

Transmission of data from one product to another as well as through the link system is effected with square-wave pulses with a length of 1.5625 ms.

**Data information**

The digital information (data bits) is shaped by five different pulse lengths (times). The times are called t1 - t5, and their lengths and applications are shown in the chart below.

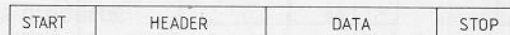
t1	3.125 ms	Data bit
t2	6.250 ms	- -
t3	9.375 ms	- -
t4	12.500 ms	Stop bit
t5	15.625 ms	Start bit

These bits are generated according to a code system. The idea is that the time of the next bit is always dependent on the time of the previous bit. The code system is shown in the chart below.

last bit	new time	new bit
0	t1	error
0	t2	0
0	t3	1
1	t1	0
1	t2	1
1	t3	error

**Data message**

A data transmission comprises four blocks:



2045-3

The four blocks serve the following purposes:

**Start**

The start information is to synchronize the microcomputers of the transmitter and the receiver. Furthermore, some bits in the start information are used for AGC adjustment of the receiver's IR-amplifier.

It consists of four pulses in a combination not found elsewhere in the format.

**Header (headline)**

Header contains a system address, i.e., information regarding which receiver the subsequent data are intended for. This may be "radio" or "tape 1", for example.

Furthermore, it contains information as to the composition of the data in the subsequent data block.

Finally, it contains information determining whether the message is for use in the receiver (local code) or should be forwarded through the data link system (link code).

**Data**

The data block comprises data which may be commands or ASCII codes. ASCII codes are an international system for data transmission of numbers and letters, etc.

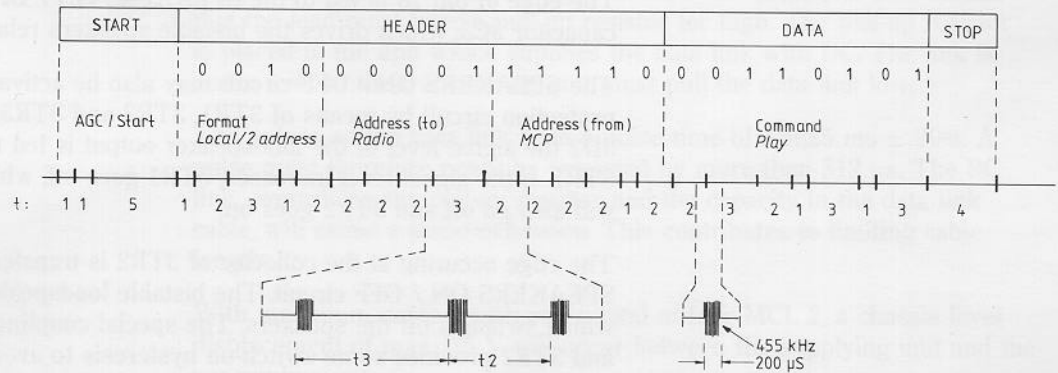
**Stop**

The stop information states that the data transmission is over. It consists of one pulse which has a distance from the previous pulse of 12.5 ms. Instead of a stop code there might be a new start code followed by new data.



Fig. 2045-4 gives an example of a complete data transmission

fig. 2045-4



2045-4

## DATA LINK CIRCUIT

### Introduction

In this section we will be looking at the diagrams of the products which have to do with coupling and data link. They are:

- Audio terminal
- MCP 5500
- MCL 2A
- Beovox Penta (display)

The diagrams are at the end of the description. Since the circuits are rather uncomplicated only special details are described. The diagrams should therefore be used together with the description.

### Audio terminal

To extend battery life, the computer is normally in a "rest mode" which requires a minimum of current consumption. When a button is pressed, e.g. "Tape 1", a high level is led through the diode 81D30 to 81IC31, pins 12 and 13. 81IC31 inverts the level, which pulls "TRQ" low, and the microcomputer 81IC36 starts operating.

The actual square-wave code occur on 81IC30, pin 15. This is modulated with 455 kHz from the crystal oscillator by means of the NAND-gate, 81IC31, pins 1, 2, 3. The subsequent NAND-gate, 81IC31, pins 4, 5 and 6, is coupled as an inverter. The inverter shapes the the signal before it goes on to the two output amplifiers which drive the LED's.

### MCP 5500

This is described in great detail in the circuit description for the Beomaster 5500.

### MCL 2A

The MCL 2A is a Master Control Link for operating Beosystem 5500, Beocenter 9000 and future Bang & Olufsen products. As to the way of function MCL 2A is identical with MCL 82, but technically it is adapted to the A / V system. This means that MCL 2A cannot be used with "old" Bang & Olufsen products.

The IR receiver is the same as in the Beomaster 5500, and it is described in the circuit description for Beosystem 5500, section 2.

The microcomputer IIC1 pin 18 MUTE can switch the set of speakers connected to the MCL 2A on and off.

The edge of pin 18 is fed to the SPEAKERS ON / OFF circuit via the capacitor 3C3, which drives the bistable speakers relay 3RL1.

The SPEAKERS ON / OFF circuit may also be activated by a speaker protection circuit by means of 3TR1, 3TR2 and 3TR3. Through 3D1 and 3D2 the signal level of the loudspeaker output is led to the basis of 3TR1. If the signal level increases, 3TR1 goes off, which means 3TR3 will also go off and 3TR2 goes on.

The edge occurring at the collector of 3TR2 is transferred via 3C3 to the SPEAKERS ON / OFF circuit. The bistable loudspeaker relay actuates, which switches off the speakers. The special coupling between 3TR3 and 3TR2 provides some switch-on hysteresis to avoid bounce. By means of 3R4 it is possible to adjust the speaker protection switch-on level.

### Beolab Penta (display)

The Beolab Penta has a built-in display which permits you to obtain information about signal source and volume setting on the speaker itself. The circuit controlling this display is connected straight to the data link connection.

The microcomputer drives the display in a matrix system with data and strobe outputs. The three LED's, 13D13, 14 and 15, are driven directly by the amplifier unit.

The transistor 12TR15 is a two-way data buffer whose main function is to separate the data link connection from the computer pin. The transistor prevents the microcomputer from short-circuiting the data link lead to chassis when it does not receive a power supply. This prevents the whole data system from being blocked in case of interruption in the mains supply to the Beolab amplifier.

## SIGNALS

### General

The data link operates according to a "wired or" principle. This means that the lead must have a pull-up resistor for high. The pull-up resistor is placed in the unit which supplies the data link with DC. The link is active low, so the transmitting unit must pull the data link low.

The pulses on the data link have a pulse time of  $1.5625 \text{ ms} \pm 20\%$ . A pulse must therefore never be extended by more than  $312 \mu\text{s}$ . The RC link, comprising the pull-up resistor and the capacity in the data link cable, will cause a pulse extension. This contributes to limiting cable length.

With maximum cable length and a total of four MCL 2, a chassis level displacement of max. 0.5 V will occur between the supplying unit and the consuming unit.

### Active levels

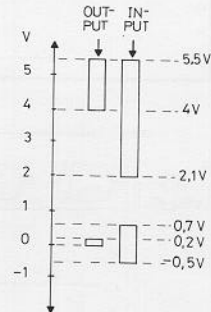
Measured at the data link terminal of the individual products, the levels obtained are:

input      high= 2.1 - 5.5 V  
              low = -0.5 - 0.7 V

output     high= 4.0 - 5.5 V  
              low = 0.0 - 0.2 V

These levels are also indicated in fig. 2045-10.

fig. 2045-10



2045-10



Diagram Audio Terminal,  
type 8920490

