DMX 512 Language
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Until a few years ago there was a proliferation of control systems designed by the manufacturing firms; the most common was the linear analogue control: with this system every single dimmer required a control with a wire deriving from the console. For instance, a 48-channel console needed, beside the common mode generator (earth), one connector or more multipolar connectors with at least 48 contacts. Obviously, the higher the number of channels, the higher the number of contacts and connectors needed, multipolar cables and connectors were expensive, bulky and heavy, breakdowns were frequent and incompatibility was guaranteed. Each firm used different connectors and different identification pins and, if that was not enough, voltages and control currents were dissimilar and often had different polarities. With the launch of consoles with microchip-based memories, the connection between them and the dimmers was rarely digital, all dimmers were analogical and it was preferred to distribute signals through multipolar connectors. Some avant-garde companies started to employ more efficient transmission systems, such as the analogical or digital multiplex; this created even more confusion because apart from the historical incompabilities new ones were added: they were proprietary protocols, incompatible with each other, and none of the rival companies used one from a competing firm in order not to favour it.

DMX512

The DMX512 was developed in 1986 by commission of the USITT (United States Institute of Theatrical Techonologies) to make the communication system between the console and the dimmer standard and efficient. The DMX512 is a protocol of data transmission which takes advantage of the international standard EIA RS485; this definition not only regards the type of data transmitted, but especially the hardware, in other words the circuits used for the transmission and the reception, electric characteristics, etc. The RS485 is employed in all those applications which require a reliable and simple serial transmission, it is also much used in industry, in automation and in computer connections. Unlike the better known RS232, the RS485 enables to cover longer distances. The RS485 transfers information through a pair of wires and not through a single one; the signal present on the pair of wires is comparable to that of audio microphones, defined "balanced", i.e. made of two wires as well as the earthing system.

The correct definition for this type of line is differential. Its main characteristic is its high immunity to common mode electric and electromagnetic disturbances (related to earth). This is due to the intrinsic characteristics of the amplifiers of the differential, devices that, both in analogue applications and in digital ones, eliminate all the undesired signals of the same sign present simultaneously in the two wires, while the amplify the differential ones

(of opposite polarity). The signal that we are interested in is the one related to the levels of the dimmer and the other devices connected to the line; these signals are transmitted intentionally in a differential way and are thus amplified without adding the noise (electric and electromagnetic disturbances), which is generally common mode (with the same polarity with relation to the ground). The amplifiers of differential currently used in the DMX512 are, in reality, small in-built circuits, the trasmitting one, installed on the console, is defined as Line Driver, the receiving one, installed on the dimmers or on the decoder, is called Line Receiver.

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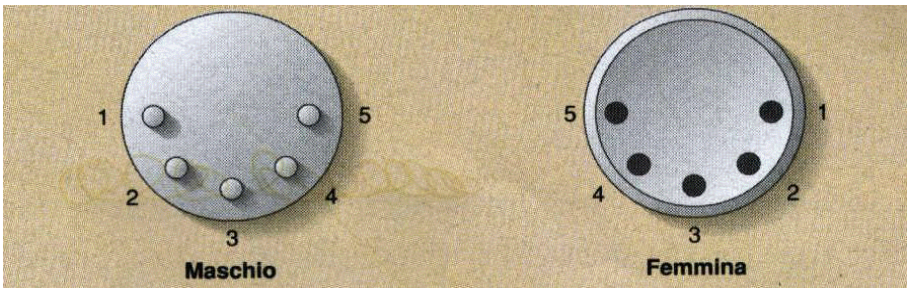
Cables

The DMX512 employs a cable with two connectors called twisted pair. As described above, if the transmitted signal are differential (of opposite polarity), this pair considerably increases immunity to disturbances. The choice of the cable must not be overlooked; many different types can be bought with different dimension as regards section, insulation and outer coating. The use of a cable with a robust but sufficiently soft sheathing is recommended for live applications, while it is possible to use a cable that is a bit rigid for fixed installations, the important thing is that it corresponds to the characteristics required by the standard EIA RS485. The cable of a pair must have: a low capacity per metre, an impedance between 100 and 150 ohm, an external shielding with a metal integral screening, an internal shielding with a mylar sheet and a minimum section of 24AWG (ø 0,5 mm). This line group is generally quite immune to disturbances, many users believe that a microphone cable is enough, but this is not true! The DMX line can work well even with an unshielded twisted pair, but this does not guarantee that it will not stop functioning at any time. Those installations and those situations in which unsuited cables have continued to work for years can and will certainly create problems when we least expect them, at that point we will realize that the homologated cable covers all the possible causes of interference that can occur even occasionally and not only in specific circumstances, the same does Not apply to an unsuited cable.

Torna all'inizio

Connectors

Fig.1- Connections in XLR for DMX512



The DMX512 employs 5-pin XLR connectors, in general, only 1-, 2- and 3-pin connectors are used, the connections are extremely simple. The male and the female are connected pin to pin (pin 1 of the male to pin 1 of the female, etc.); the shielded screening must be connected to pin 1 and never to the metal casing of the connector, because this would join the technical earth to the ground, with the possibility of creating a ring that could endanger the correct functioning of the system. Without entering upon the subject of the phenomena caused by the wrong earthing of the shielded screening of the data transmission data cable it is important, nonetheless, to know that the eventual earthing of this connector must be done

in only one point of the entire system, and this normally applies only to fixed installations. In general, the rings are created when the dimmers and the console are earthed in two different points, for instance by connecting the console to a ground plate that is different from the one used for the earthing of the dimmers. At times, there can be a difference of potential between two different earths; in this case we would have to make a current pass through the shielded data cable which would join the earth of the dimmers to that of the console. For this reason the grounding of the technical earth of a plant must be effected in a unique point with a delta connection. In any case, the inconvenient of currents that can pass through the control cable is practically eliminated by using opto-couplers which are already installed on almost all devices. The optocoupler is a device that is normally included inside the digital dimmers, the scanner or the digital/analogue decoder, and that enables to pair the DMX signals coming from the console to the dimmer itself without any electric contact between the parts. This device allows to connect a higher number of receivers (dimmer, decoder, scanner, motorized devices, etc.) without any electric contact between them and, consequently, without the occurrence of any interference phenomena with the consequent malfunction of the system. The galvanic insulation is obtained by an optocoupler which, by being interposed between the external line and the internal circuits of the appliance, make possible to transfer information by optic translation (led+phototransistor) without any contact between the external circuits. This device has already been adopted by most manufacturers, even though it is still possible to find some appliances that do not have this characteristic; they are generally low cost and non professional appliances, we recommend that you enquire about the characteristics of the galvanic insulation before purchasing a scanner or a dimmer.

Torna all'inizio

Functioning principles

This is not intended to be a treatise on the functioning of the DMX512, thus only the basic principles will be introduced, for those who would like to get more details there are several English texts. As already mentioned, the RS485 is a physical communication standard, the DMX on the contrary is a communication protocol that uses the RS485 as a physical standard. The software upgrading necessary for its use must be developed by the manufacturers. The USITT, beside the protocol parameters, also provides indications and recommendations on the software.

The DMX512 uses an asynchronous data transmission at 250Kb per second, this means that the signals coming from the console and from the receiver are not synchronous, but that the receivers (dimmer, scanner, motorized or decoder) are synchronized to the signal of the console every time that the latter sends a specific message. It is the transmitter that substantially provides the receiver or the receivers with the signals to be synchronized. The levels related to the channels, whether they are dimmers or something else, are transmitted by the console in a serial way, i.e. in rapid sequence one after the other; the receivers (dimmers) are able to memorize the information destined to them and to wait that the information regarding the other 512 channels are forwarded. When the console has sent the information to all the 512 dimmers, the signal that informs that in a short while the transmission of channel 1will take place is then sent and the cycle starts again; the time employed by the DMX512 to refresh all the 512 channels is about 22ms, thus a decidedly short time that allows any variation of the luminous state without perceiving any delay.

Torna all'inizio

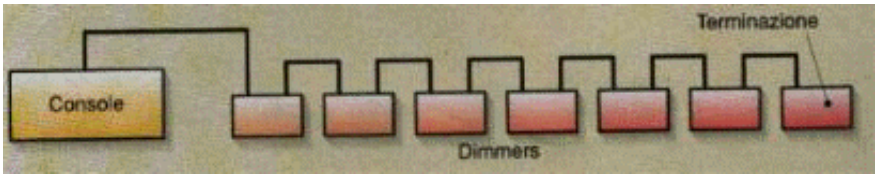
Distances

The DMX512 can reach a 500m distance; considering that these characteristics of the

RS485 line are provided in ideal working conditions, and considering the variable quantity of the dimmers or other connected devices (a maximum of 32), the author advices that a 250m distance is not exceeded as it is sufficient for any show. Obviously, these distances can be increased if necessary, but in that case a buffer or a splitter should be used.

Terminations

Fig.2- The last link of the chain must always be "terminated" with a 120ohm-1/4W resistance.

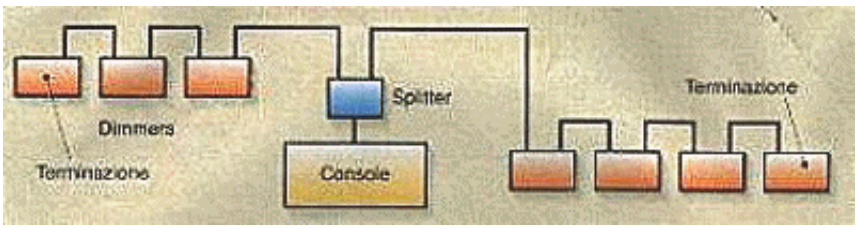


The wrong termination of the DMX line is often the most common cause of the malfunction of the whole system: it is very important to insert a line termination resistance on the last appliance of the chain, without this termination the transmission can be unstable and cause inconvenience. The termination consists of a 120 ohm and 0.25W resistance inserted between pin 2 and pin 3 of the last female connector available for the plant (that of the last dimmer or the last scanner). The most practical system consists of a male XLR connector with a 120 ohm resistance inside. This termination "cap" can be easily self-built. Many dimmers and quite a few scanners have already got a termination system with a small switch next to the DMX connector. It is important to remember that the termination must be effected only on the last device of the chain.

Torna all'inizio

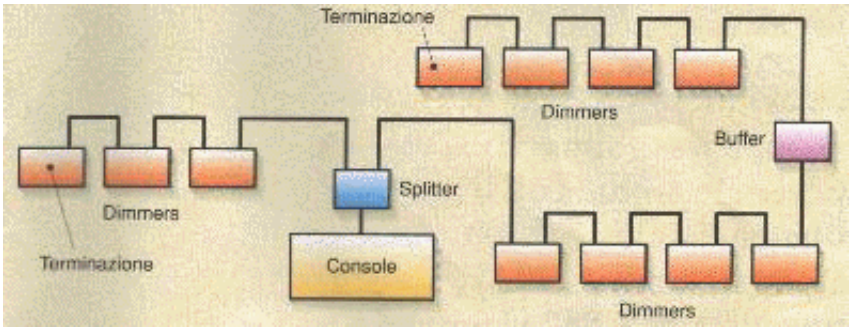
Splitter & Buffer

Fig.3- The distribution of the control signal must always be effected with the "splitters".



When laying the DMX cable, Y branchings are forbidden and extremely dangerous, because they considerably damage the quality of the signal and do not make the transmission very stable; to effect a Y branching it is necessary to use a splitter. Splitters are multiple amplifiers that allow to make Y branchings with several outputs too, moreover they recondition the signal thus enabling the extension of the distance of use. The buffers have an input and an output and their function is that of amplifying and conditioning the signal to facilitate an extension of the distance of use, without the possibility of using Y connections. The splitter and the buffer can be either opto-insulated or not, those that are opto-insulated are certainly preferable because, apart from their already described characteristics, they make it possible to solve the problem related to possible malfunctions caused by undesired earth rings, they are even often used to insulate two or three lines from each other.

Fig.4-On very long lines buffers are used to amplify and recondition the control signal.



Torna all'inizio

DMX 1990

In 1990, the USITT modified a transmission parameter of the DMX protocol since some appliances were not able to function correctly. For these appliances there are protocol adaptors that must be interposed on the DMX line. In 1986, it seemed really impossible that 512 channels would become insufficient for a show, but with the introduction of automation technologies and, as a result, with the use of scanners and motorized devices, the number of employed circuits has increased exponentially, it is sufficient to say that a scanner can use up to 30 channels. If it is true, then, that the DMX is still more than sufficient for dimmers, it is also true that it is less so for scanners. The DMX 512 uses a 8-bit protocol; this permits to obtain a 256-point resolution, certainly sufficient for the fader of a dimmer but insufficient for a 360° resolution of a motorized device. To augment this resolution many motorized devices and scanners use two adjacent channels, this reduces the number of total available channels. Currently, some firms have begun to use Ethernet for the distribution of signals related to all the usable peripherals in a show.

Ethernet is the most diffused LAN (local area network) in the world, the DMX transfers information at the speed of 250Kb per second (250,000 bits per second) while the Ethernet system works at 10Mb per second (10,000,000 bits per second) or 100Mb (Fast Ethernet). The Ethernet network uses a unique connection cable for all the devices of the system, this makes possible a great flexibility of use and a sizeable reduction of control cables. These are the main characteristics: speed of transmission raised from 10Mbs to 100Mbs; bidirectional; economic cables; economic connectors; long distances; high immunity to disturbances; expandability and two types of connection: 10BASET and 10BASE2. Some firms have already implemented it on their consoles, but a standard for the DMX512 has not been decided yet. In a few years we should have a standard protocol for this communication system too.