DD32 NETWORK DEVICE

DIGITAL I/O-UNIT

for the OPTOCORE® OPTICAL DIGITAL NETWORK SYSTEM

OPERATION MANUAL

Application as a transmission system for YAMAHA **devices** DM2000, DM1000, DME32 **and** PM1D **via** DIO8

DD32 NETWORK DEVICE

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Device Description

Please familiarise yourself with the device and its operation by first reading carefully the* DD32 OPERATION MANUAL*. It contains some more pointers for the proper use of the devices.

DEVICE DESCRIPTION. Occupying only 1U of 19" rack space, the DD32 is devised for the transmission of a maximum amount of digital data via optical fibre. Data connections are of the widely available, D-Sub-25 and D-Sub-9 type allowing the preparation of various, inexpensive, hard patching adapter-cables catering for the diversity of each users connecting method. A significant amount of auxiliary ports are provided for various useful tasks. The unit is equipped with a dual 1Gbps, full-bandwidth, optical interface as well as a dual power supply with automatic switch-over.

PRINCIPAL PORTS. The unit provides 32 digital ports of the RS422 hardware standard, allowing the transmission of 32 digital channels (e.g. DMX) or 64 AES3 digital audio channels (32 stereo channels). The flexibility of the system should be noted in that the DD32 's principal ports may subsequently be determined as either in- or outputs in groups of four, defined by software adjustment. This eases the set-up of different, useful configurations in conjunction with YAMAHA's AES3 digital audio I/O plug-in cards MY8-AE and MY16-Ae in order to achieve the maximum potential of the DD32. This document contains the wiring plans for suitable D-Sub-25 adapters and split cables.

AUXILIARY PORTS. One of the four additional RS485 digital ports can be used to transport control signals fed in from YAMAHA's COM RS422 port to be output to a daisy-chain of AD824s. Even a decentralised system of these devices may be served by linking the isolated parts of the chain at the various locations via the fibre.

Furthermore an RS232 channel on the front panel completes the ability to transport control signals. This channel does not require anymore configuration beyond it's determination as a transmission channel or a remote control / upgrading channel.

RS485 TRANSMISSION. In comparison to the half-duplex, RS485 bus standard, the OPTOCORE ® OPTICAL DIGITAL NETWORK SYSTEM is a full-duplex system as are the RS422 and RS232 bus standards. Full-duplex transmission utilises two data buses, one send and one return, whereas a half-duplex transmission uses a common bus for all components of a system. A full-duplex system cannot totally fulfil this crucial condition. However, the OPTOCORE system is able to emulate the function of RS485 half-duplex transmissions. For this the ports sense whether they are driven or not. If a channel is driven, the opposite port is automatically configured as an output, there is no need for further configuration; the sense logic triggers on the first low to high transition of a data package. If the port is driven in reverse the channel will miss the first data-bit. This is the main reason, that a data transmission cannot be established. If this is the case as is with the YAMAHA data chain, the data polarity must be reversed on both sides of the OPTOCORE system by reversing the corresponding wires in the cable-connector.

AES3 HARDWARE STANDARD. The AES3 recommended hardware practice is based on the RS422 hardware standard, but prescribes a 110Ω±20% output impedance of drivers and the same value for the termination impedance of receivers. This leads one to expect an optimum transmission performance through a balanced cable with a nominal characteristic impedance of 110Ω. The RS422/RS485 standard recommends a 120Ω termination impedance at the beginning and also at the end of a data bus and apart from this, use low impedance drivers directly to the bus. The DD32's standard version RS422 principal ports are terminated with 330Ω, with which no performance restrictions have been experienced with short and medium length cables in the field.

If necessary the unit may be assembled as a "real" AES3 I/O unit during the manufacturing process. In this case however, inputs and outputs are "fixed" at the connectors and can no longer be rearranged by software adjustment. Hardware and software arrangement are totally dependant on the hardware assembly.

Please note that one physical channel transports two AES3 digital audio channels due to the left / right structure of this data-format.

VIDEO PORTS. A video in- and output are incorporated for the transmission of up to 10MHz-bandwidth and up to 10bit-encoded composite video signals via BNC connectors. The video in- and outputs are software patchable to any available video channel.

WORD CLOCK. A word clock output provides the necessary signal to synchronise the DM2000/DME32/PM1D and AD824/DA824 devices to the OPTOCORE system, which transports an excellent word clock to all junctions on the fibres. Due to the sophisticated sensing system, the impression may be imparted that the system is synchronised, however this is by no means always the case. Dis-synchronisation sometimes leads to an audible clicking in the channels, at a frequency dependant on the accidental correspondence of the OPTOCORE word clock to the independent clock of the connected device.

***For this reason always be sure that the connected units have correctly accepted the word clock provided by* OPTOCORE.**

OPTICAL CONNECTION. All signal transmissions supported by the OPTOCORE ® OPTICAL DIGITAL NETWORK SYSTEM are relayed via a single, 2 pair optical fibre per network ring. The dual, 1Gbps full-bandwidth optical interfaces are of the SC-type which are absolutely reliable for installations. For more rugged applications e.g. mobile usage, expanded beam connectors mounted on 1U panels are available, along with matching, inter-connection cables transported on cable drums. (Please refer to OPTOCORE-ACCESSORIES).

The Network

OPTOCORE ® OPTICAL DIGITAL NETWORK SYSTEM is a patented, synchronous, optical fibre network system specially designed to meet the requirements of the professional live audio, broadcast, studio, installation and video industries. The system offers a unique, flexible and scalable, dual redundant ring structure providing maximum safety in an user-friendly network with an exceptionally low latency time whilst using the least possible amount of optical fibres. Alternatively, a network can be reduced to a point to point connection. Controlling and channel-routing is easily achieved from any point within the network by computer or media-access device. Additionally, the excellent word clock capability of the system is available at all nodes on a ring.

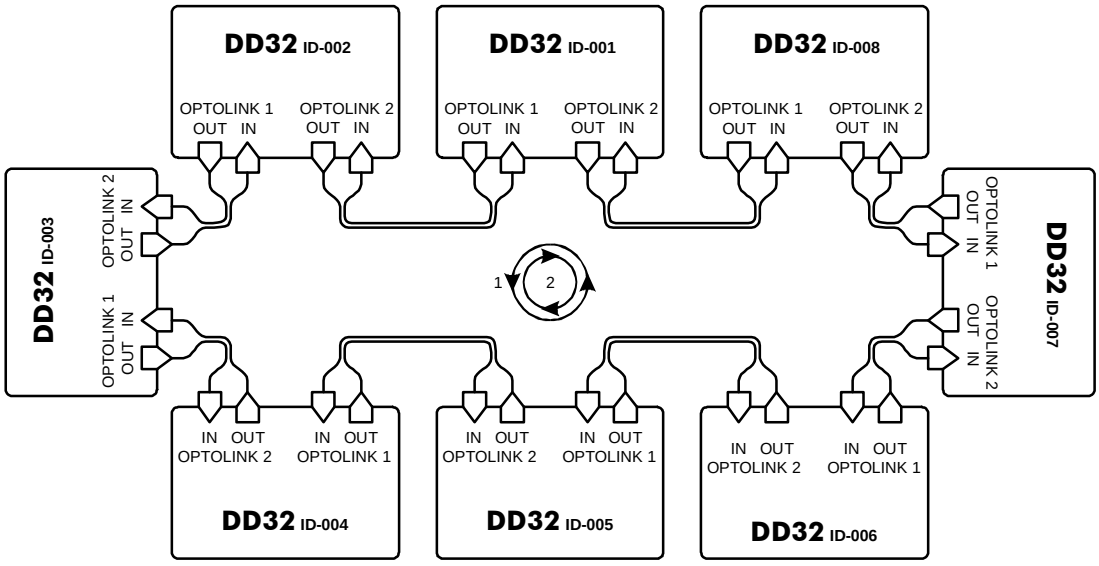
NETWORK SECURITY. OPTOCORE network devices include the possibility of connecting a second redundant optical fibre ring and incorporate dual power supplies ensuring maximum system safety with extremely fast, inaudible switching. In the unlikely case of a unit failure, the ring can be closed for the time needed for its replacement simply by connecting its in and out fibre with the help of an adapter.

DATA RATES. Maximum data transfer rates at 1Gbps in terms of digital audio are 512 channels @ 48kHz sample rate in each direction within a point to point connection, respectively ≥ 512 channels in a network, depending on the configuration.

DATA DELAY. The intrinsic signal delay of an OPTOCORE channel through the fibre is extremely small and is dominated by the necessary converting times. All data streams transmitted through similar channel types will appear at all outputs on a network at the same time. Transmission delay is negligible amounting to <200ns for each unit attached to the network. With OPTOCORE transmission there is no remarkable summing of delay throughout the units in a network.

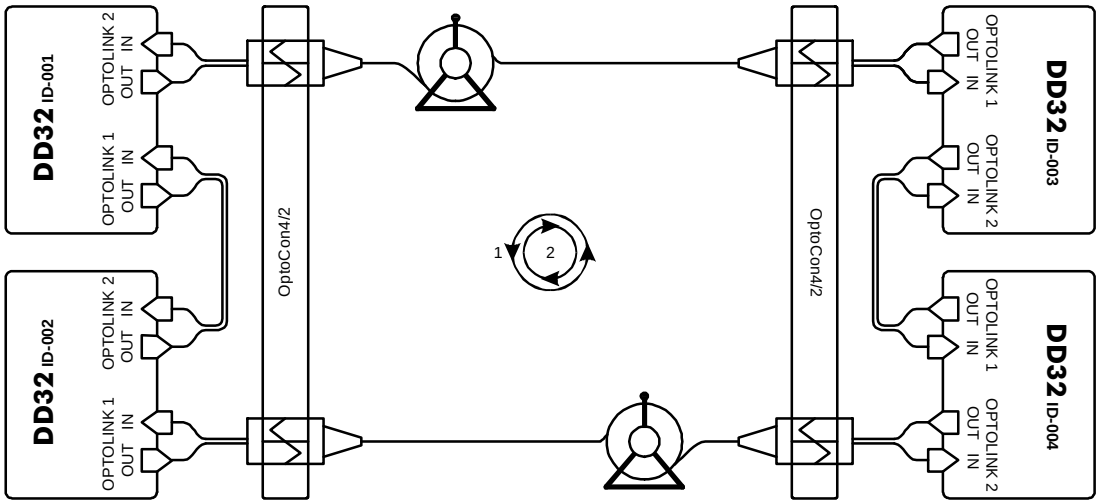
The processing of AD converted audio signals causes typically a delay of $39/F_S$ and the processing of DA converted audio signals causes typically a delay of $28/F_S$ (F_S = sample frequency). For synchronisation purposes and data re-arrangement another maximum of $2/F_S$ needs to be calculated. The result is a delay of only $69/F_S$ from "analog to digital to light to digital and back to analog", which calculates to a maximum of 1.44ms @ F_S=48kHz and 0.72ms @ F_S=96kHz. Thus the processing of already converted audio signals as with the DD32, causes the above mentioned maximum delay of $2/F_S$, which calculates to a maximum of 42µs @ F_S=48kHz and 21µs @ F_S=96kHz.

OPTICAL CONNECTION. The optical data-transmission guarantees an absolute interference-insensitive transmission of audio, video and data signals over great distances, and that with a fraction of the cable weight used in conventional copper-cored systems. Due to the nature of operation, devices on a network are totally electrically isolated from each other. All signal transmissions supported by the OPTOCORE ® OPTICAL DIGITAL NETWORK SYSTEM are relayed via a single, 2 pair optical fibre per network ring. Worst case transmission-reach is 700m in multi-mode using a 50µm fibre, whilst in single-mode and using a 9µm fibre, up to 70km is possible. The dual, 1Gbps full-bandwidth optical interfaces of a network device are of the SC-type which are absolutely reliable for installations. For more rugged applications e.g. mobile usage, expanded beam connectors mounted on 1U panels are available, along with matching, inter-connection cables transported on cable drums. (Please refer to OPTOCORE ACCESSORIES)

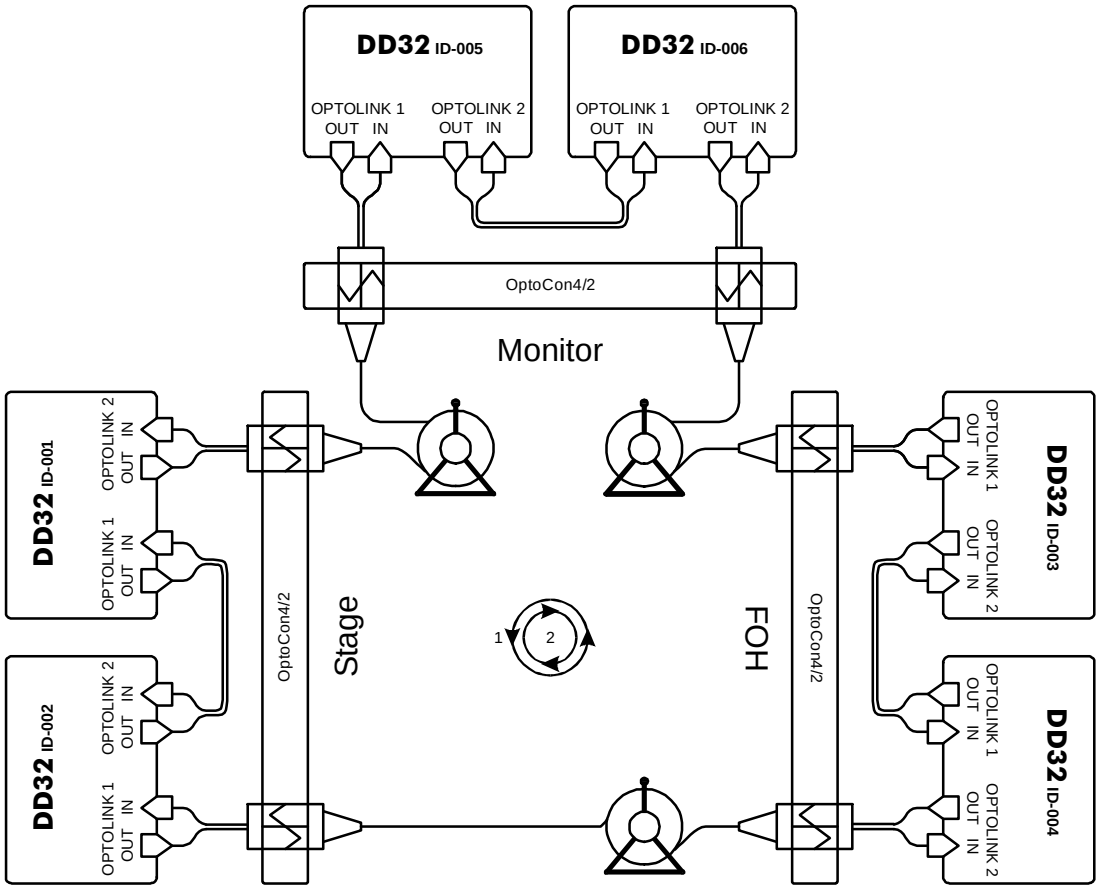


A redundant network consisting of eight DD32 s capable of handling a maximum of 512 AES3 digital audio channels

Optical Connection Examples



An example for a redundant network for mobile use with expanded beam connectors mounted on 1RU panels (please refer to OPTOCORE-ACCESSORIES) transceiving 128 digital audio channels. One optical fibre connection may be left out by losing some amount of data security.



An example for a redundant network for mobile use with expanded beam connectors mounted on 1RU panels (please refer to document OPTOCORE-ACCESSORIES), featuring a configuration of 96 digital audio channels supplied to monitor and FOH - console and 32 digital audio channels supplied to the stage. Note that another pair of devices may be added for supplying a broadcast van. One optical fibre connection may be left out by losing some amount of data security.

Configurations

To support the addressed YAMAHA devices the following configurations may be used. Further configurations for the transmission of digital, non-audio data or mixed data configurations will, for the present time, only be prepared on request.

The device with the ID-001 always takes the part of the master in a system of units.

In order to achieve the system's maximum potential, several D-Sub-adapter and split-cables have been defined for the interconnection of the OPTOCORE system with YAMAHA MY8-AE and MY16-AE plug-in cards with reference to the different configurations (See Connection Tables, Page 8 - 9 and Connection Diagrams, Page 11 - 14).

The Principal ports A ... D are set to transmit AES3 digital audio data and the input/output configuration is set to realise the following configurations by loading up the devices with the corresponding firmware to meet the user's requirements.

Please note that one physical channel transports two AES3 digital audio channels due to the left / right structure of this dataformat.

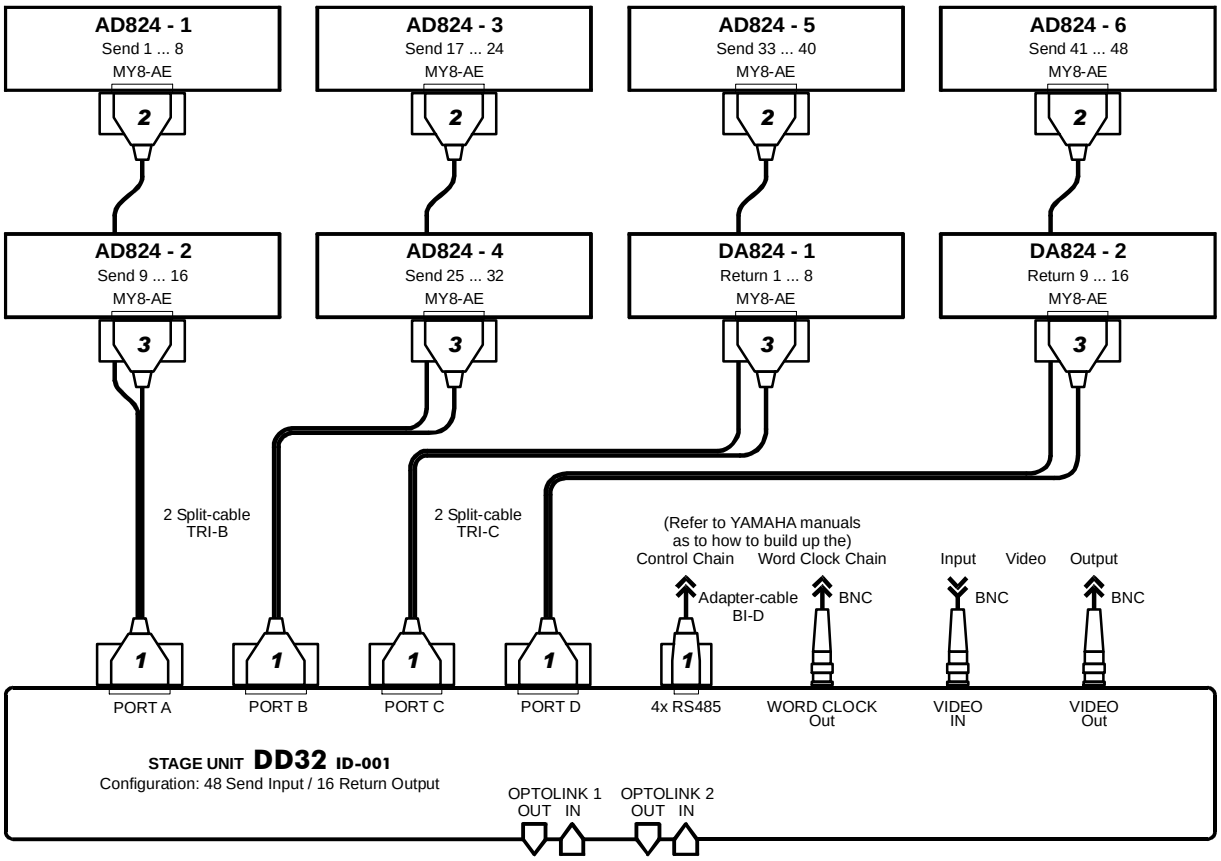
Configuration 1/2	**48 Send – 16 Return**							
DD32	**PRINCIPAL PORT**							
Designation	A		B		C		D	
Physical channel	1 ... 4	5 ... 8	9 ... 12	13 ... 16	17 ... 20	21 ... 24	25 ... 28	29 ... 32
AES3 Data channel	1 ... 8	9 ... 16	17 ... 24	25 ... 32	33 ... 40	41 ... 48	49 ... 56	57 ... 64
I/O-Setup	Send-In	Send-In	Send-In	Send-In	Send-In	Return-Out	Send-In	Return-Out
Channel-No.	1 ... 8	9 ... 16	17 ... 24	25 ... 32	33 ... 40	1 ... 8	41 ... 48	9 ... 16

Configuration 2/2	**16 Send – 48 Return**							
DD32	**PRINCIPAL PORT**							
Designation	A		B		C		D	
Physical channel	1 ... 4	5 ... 8	9 ... 12	13 ... 16	17 ... 20	21 ... 24	25 ... 28	29 ... 32
AES3 Data channel	1 ... 8	9 ... 16	17 ... 24	25 ... 32	33 ... 40	41 ... 48	49 ... 56	57 ... 64
I/O-Setup	Send-Out	Send-Out	Send-Out	Send-Out	Return-In	Send-Out	Return-In	Send-Out
Channel-No.	1 ... 8	9 ... 16	17 ... 24	25 ... 32	1 ... 8	33 ... 40	9 ... 16	41 ... 48

Remote Control, Firmware Upgrade, Changing Configurations

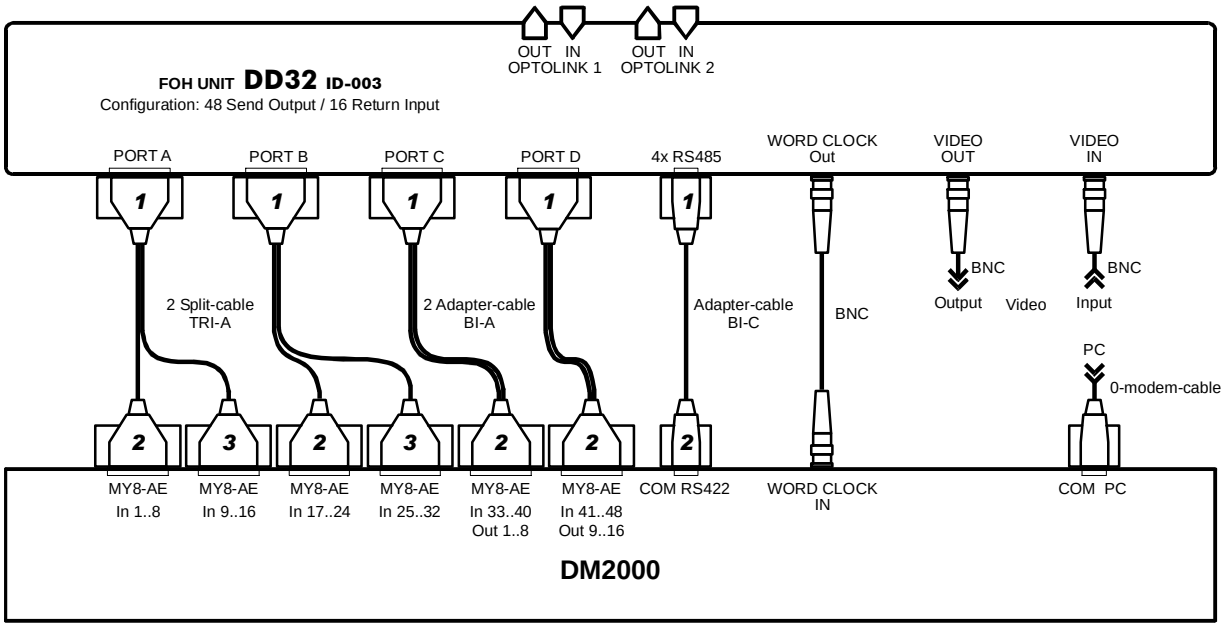
For this subject refer to the corresponding chapter of the DD32's OPERATION MANUAL (Page 12).

Inter-Connecting **DD32** **with** YAMAHA ***Devices***



Connecting the DD32 to YAMAHA 's AD824 and DA824 converter units in a 48 Send Input / 16 Return Output configuration, using the corresponding adapter and split -cables (refer to CONNECTION DIAGRAMS, Page 11 – 14).

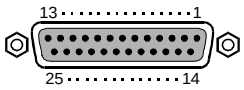
Note that a single OPTOCORE STAGE UNIT LX4A can be used instead of the shown set-up.

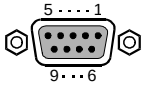


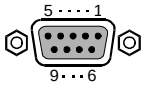
Connecting the DD32 to YAMAHA 's DM2000 digital console in a 48 Send Output / 16 Return Input configuration, using the corresponding adapter and split cables (refer to CONNECTION DIAGRAMS, Page 11 – 14).

CONNECTION TABLES 1 / 2

OPTOCORE Ports

Pin-out	**DD32 Principal Ports A - D**												
DD32 Principal Port	Channel		RS422 In or Output				RS422 In or Output				Special		GND
			1	2	3	4	5	6	7	8	9	10	
	AES-Data		1+2	3+4	5+6	7+8	9+10	11+12	13+14	15+16			
D-Sub-25-female	Pin	+	1	2	3	4	5	6	7	8	11	24	10,12, 13, 23, 25
		-	14	15	16	17	18	19	20	21	9	22	
							Locking system acc. to 4-40 UNC						

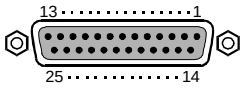
Pin-out	**DD32 Auxiliary Ports 4 x RS485**							
DD32 4 x RS485	Channel		RS485				GND	
			1	2	3	4		
D-Sub-9-female	Pin	+	1	2	3	4	5	
		-	6	7	8	9		
							Locking system acc. to 4-40 UNC	

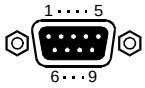
Pin-out	**OPTOCORE RS232-Port**							
OPTOCORE RS232	Channel	RS232		Internally bridged		Power		Use 1-modem cable, male – female, to connect to PC. Use 0-modem cable, male – female to connect to end-device.
		RXD	TXD			+5VS	GND	
D-Sub-9-female	Pin	3	2	1, 4, 6	7, 8	9	5	
						Locking system acc. to 4-40 UNC		

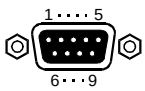
Pin-out	**OPTOCORE USB-Port**					
OPTOCORE USB	Channel	USB			GND	
		VBUS	D -	D +		
Device-connector	Pin	1	2	3	4	

CONNECTION TABLES 2 / 2

YAMAHA **Ports**

Pin-out	**YAMAHA AES/EBU Plug-in Card MY8-AE and MY16-AE**											
MY8-AE AES/EBU-Port	Channel		Input				Output				No connect	GND
			1	2	3	4	5	6	7	8		
	AES-Data		1+2	3+4	5+6	7+8	9+10	11+12	13+14	15+16		
D-Sub-25 female	Pin	+	1	2	3	4	5	6	7	8	9	10,12,13, 22, 23, 24, 25
		-	14	15	16	17	18	19	20	21	11	
							**A t t e n t i o n :** Locking system acc. to Metric 2.6mm					

Pin-out	**YAMAHA COM RS422 (COM PC/RS422 switched to RS422)**							
COM RS422	Channel		RS422		Internally bridged	No connect	GND	Use 0-modem cable, female – female to connect to device.
			RXD	TXD				
D-Sub-9 male	Pin	+	6	4	7, 8	1	5, 9	
		-	2	3				
						Locking system acc. to 4-40 UNC		

Pin-out	**YAMAHA COM PC/RS422 switched to PC (RS232)**						
COM PC	Channel	RS232		Internally bridged		GND	Use 0-modem cable, female – female to connect to PC.
		RXD	TXD				
D-Sub-9 male	Pin	2	3	4, 6	7, 8	5, 9	
						Locking system acc. to 4-40 UNC	

D-Sub-type Connection

The following are some recommendations for the type of cable and connector housings to be used.

Principal and Auxiliary Ports. The channels of these ports all use the RS422/RS485 hardware standard and each require a twisted pair with a common braided shield for the incorporated pairs.

RS232. Use shielded, standard 0-modem or 1-modem cables for the RS232 ports, as necessary.

Cable Quality. In our experience, normal computer data cable is absolutely sufficient for good quality AES data and data transmission over the short distances found in the application field of the DD32. Normally these cables have the advantage of better handling compared to special AES data cable. The following cable qualities have been used for several successful connections:

Multi-core data cable with common braided shield, Cu-stranded wire 18 X 0.10 mm^2, nominal guage 0.14mm^2, PVC-isolation, outer-diameter 1.05mm, Resistance max. 138mΩ/m, Capacity max. 120pF/m.

8-wire, 4-pairs, common braided shield, outer-diameter 6.6mm

16-wire, 8-pairs, common braided shield, outer-diameter 8.8mm

Connector Hood Quality. Applied locking screws for the D-Sub-types must be acc. to 4-40 UNC.

Attention ! ***The*** YAMAHA ***MY8-AE and MY16-AE D-Sub-25 connectors need locking screws acc. to metric 2.6mm.***

Care should be taken in selecting the right types of connector hoods in order to fulfil the requirements of EMI-radiation directives. Consequently it is necessary that the hood of the connectors be of full metal, approved acc. to VDE 0871, FCC 20780 and EG-standard 89/336 EEC, providing an attenuation better than 40dB on 30Mhz up to 1GHz. The shielding harness of the cable should have complete contact to the connector hood.

The hood types specified below meet these requirements. The list is intended to be continued.

Order-number	Useful for	Locking-screw	Supplier
AMET-09 RS	D-Sub-9	4-40 UNC	ASSMANN Electronic Components Contact: Anke Wolter fon: +49-2351-554-245 fax: +49-2351-554-861 mail: wolter@assmann.com web: www.assmann.com
AMET-09 RS-M2.6	D-Sub-9	Metric M2.6	
AMET-25 RS	D-Sub-25	4-40 UNC	
AMET-25 RS-M2.6	D-Sub-25	Metric M2.6	
AMET-RS-4-40 UNC	all types	4-40 UNC	
AMET-RS-M2.6	all types	Metric M2.6	

USB Connection. For the USB-port use a standard PC/device cable.

BNC Connection. Word Clock Output and Video In/Outputs are of the widely used 75Ω-BNC-type.

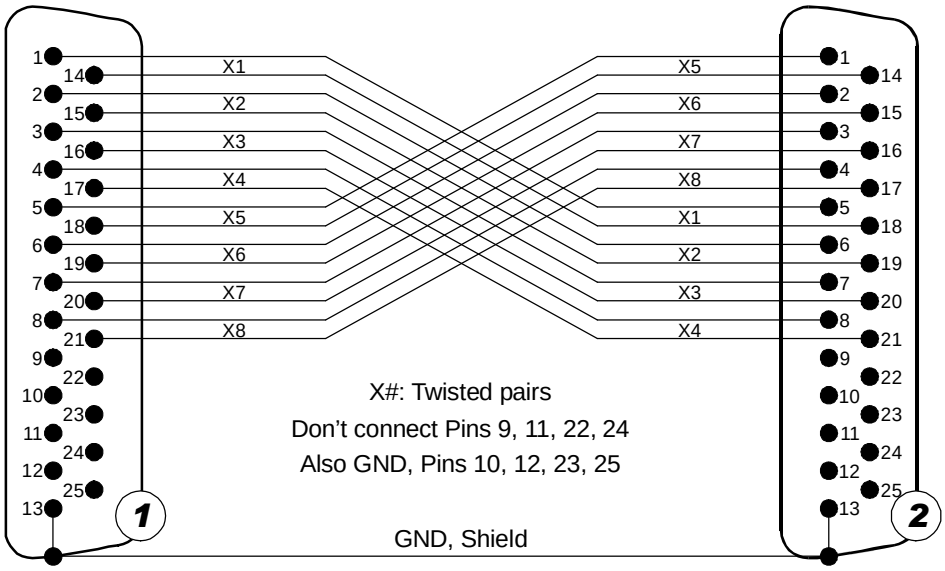
Mains Connection. 3-pin connector according to IEC-950 incorporating a fuse receptacle.

CONNECTION DIAGRAMS 1 / 4

Adapter-cable BI-A

DD32 Principal Port
D-Sub-25-male
Fastening system 4-40 UNC
X1...X4: Inputs
X5...X8: Outputs

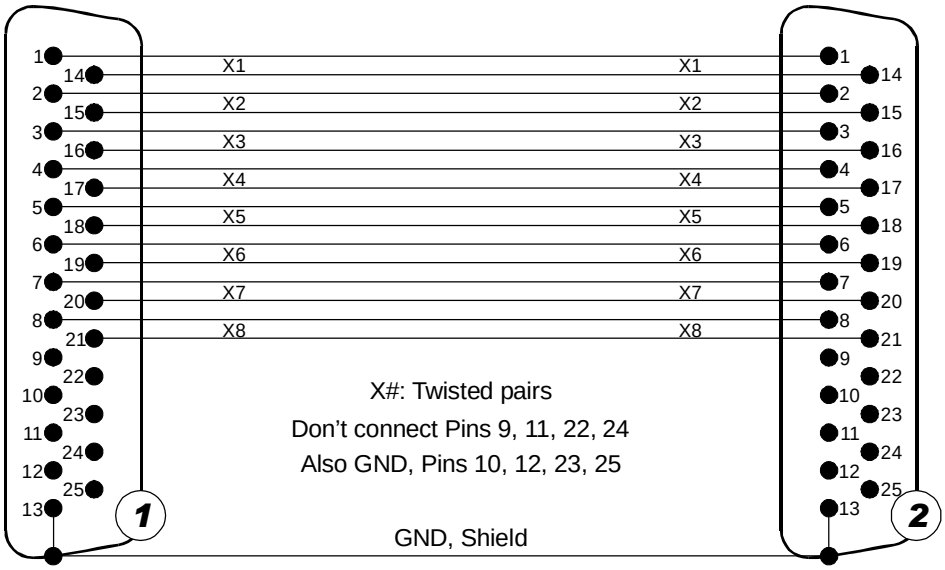
MY8(16)-AE
D-Sub-25-male
Fastening system Metric M2.6
X1...X4: Outputs
X5...X8: Inputs



Adapter-cable BI-B

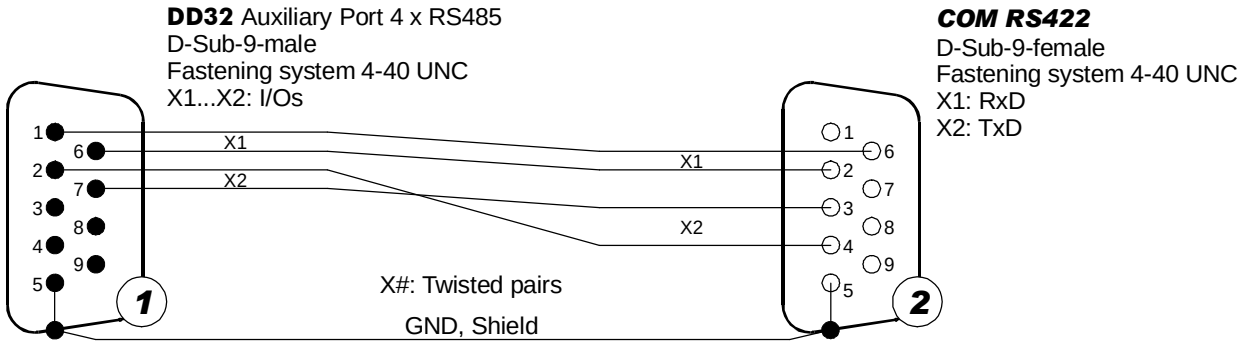
DD32 Principal Port
D-Sub-25-male
Fastening system 4-40 UNC
X1...X4: Outputs
X5...X8: Inputs

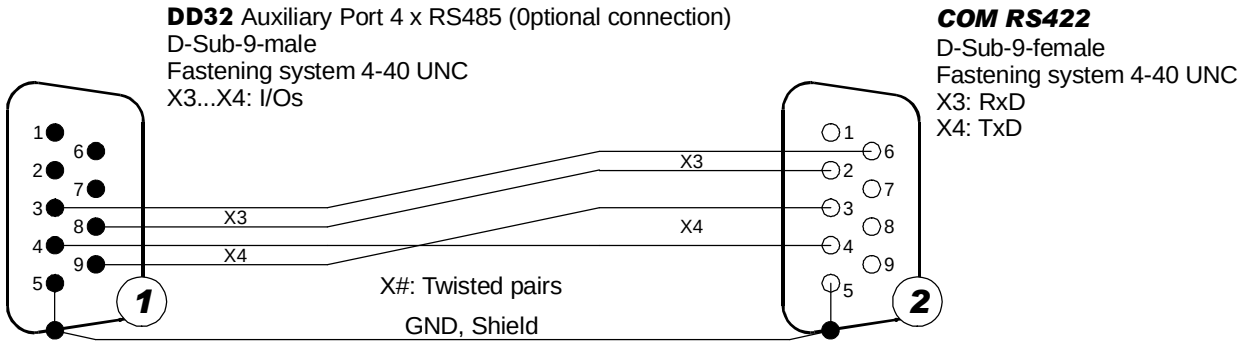
MY8(16)-AE
D-Sub-25-male
Fastening system Metric M2.6
X1...X4: Inputs
X5...X8: Outputs



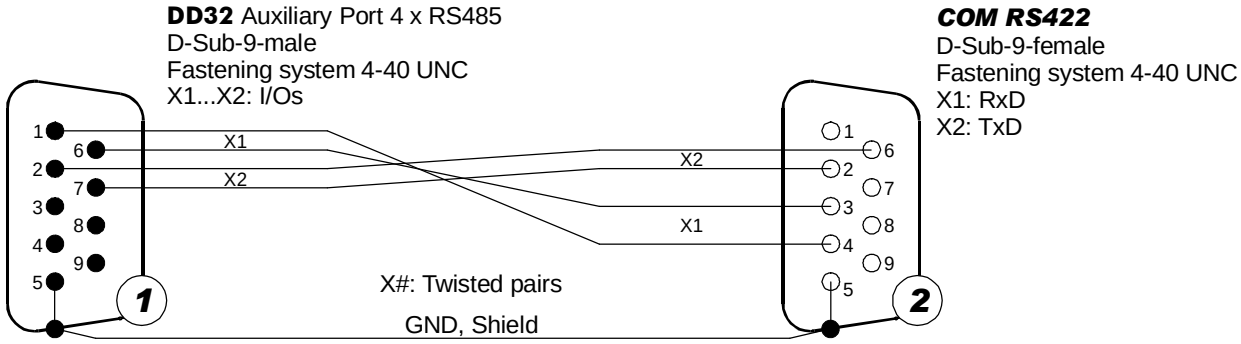
CONNECTION DIAGRAMS 2 / 4

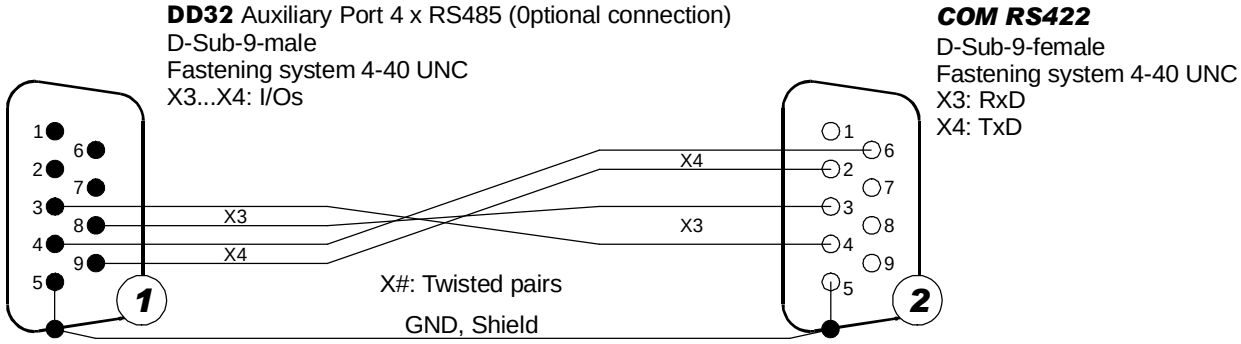
Adapter-cable BI-C





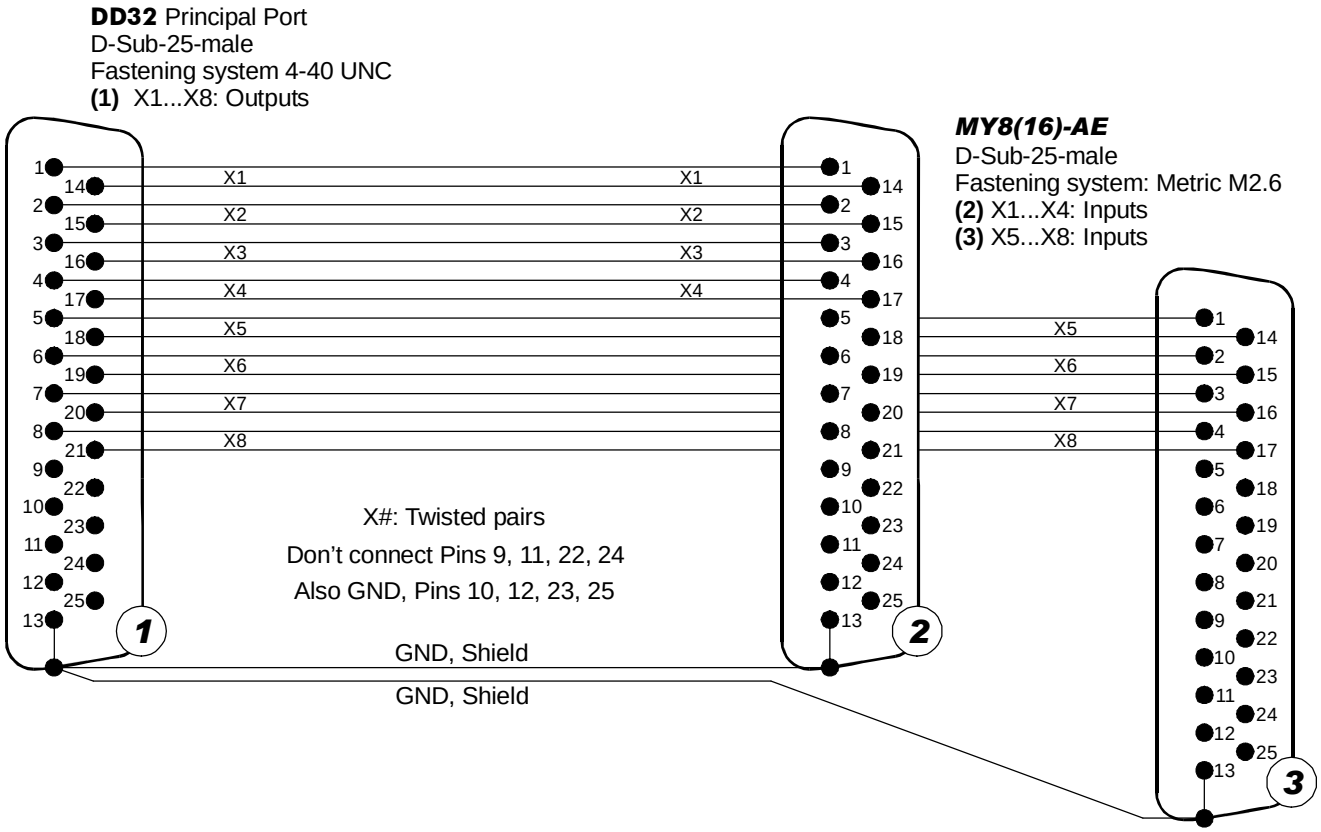
Adapter-cable BI-D



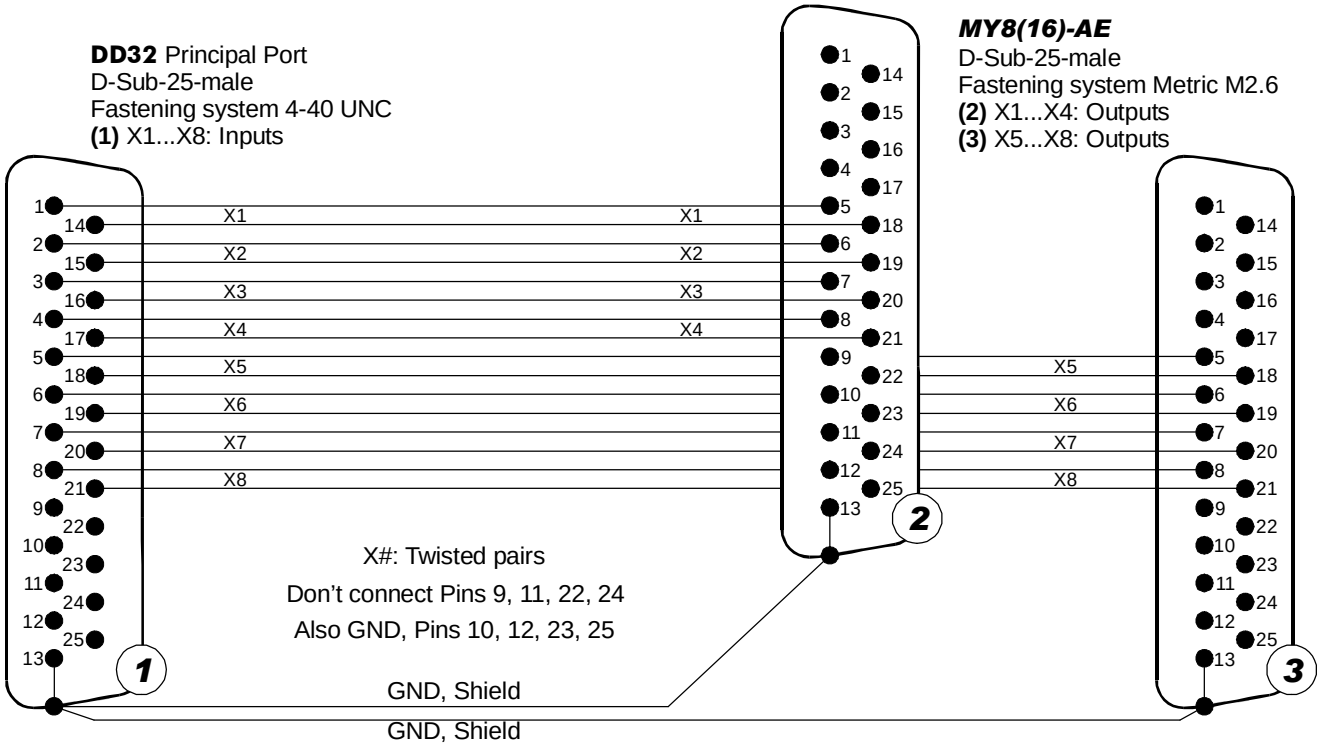


CONNECTION DIAGRAMS 3 / 4

Split-cable TRI-A

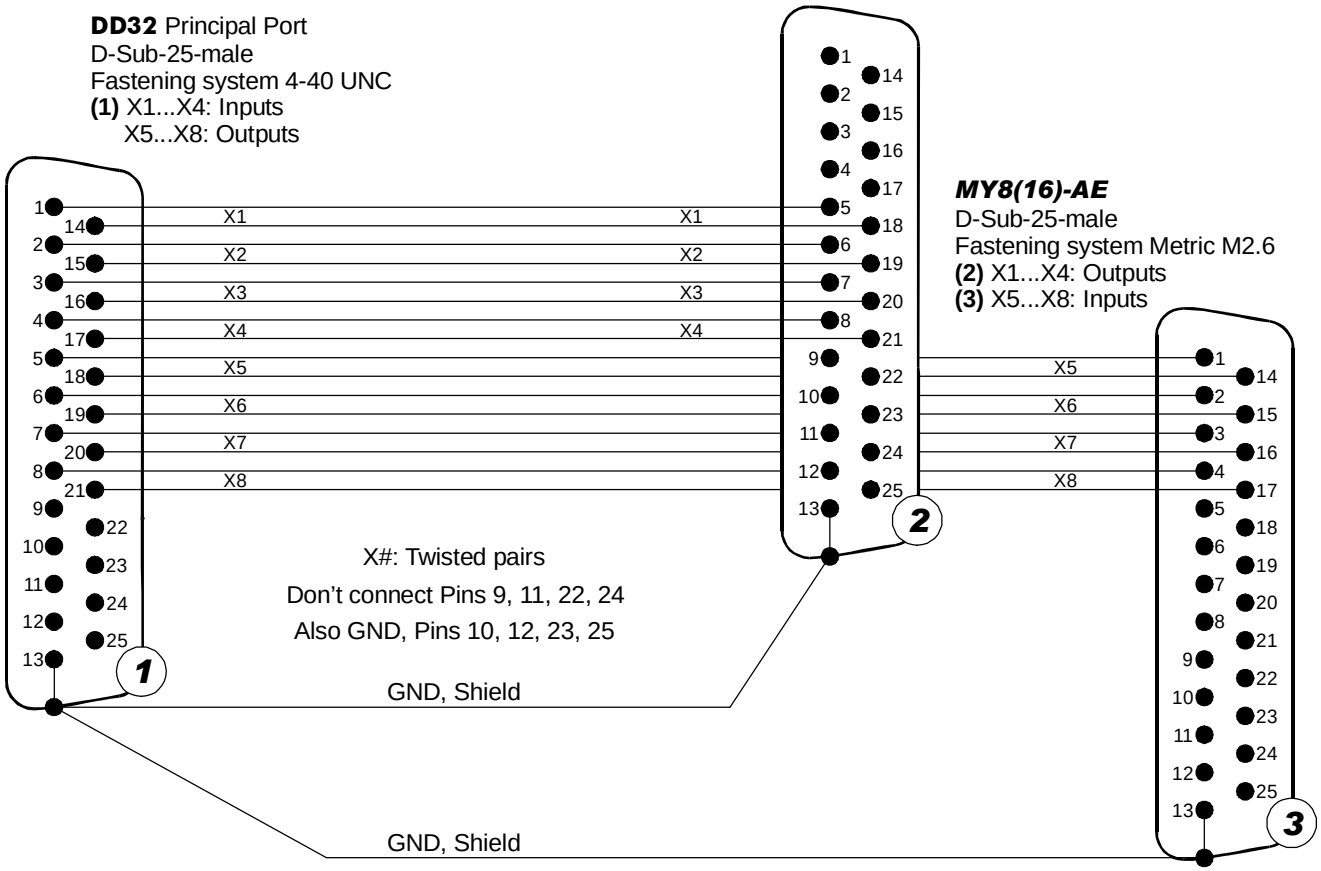


Split-cable TRI-B

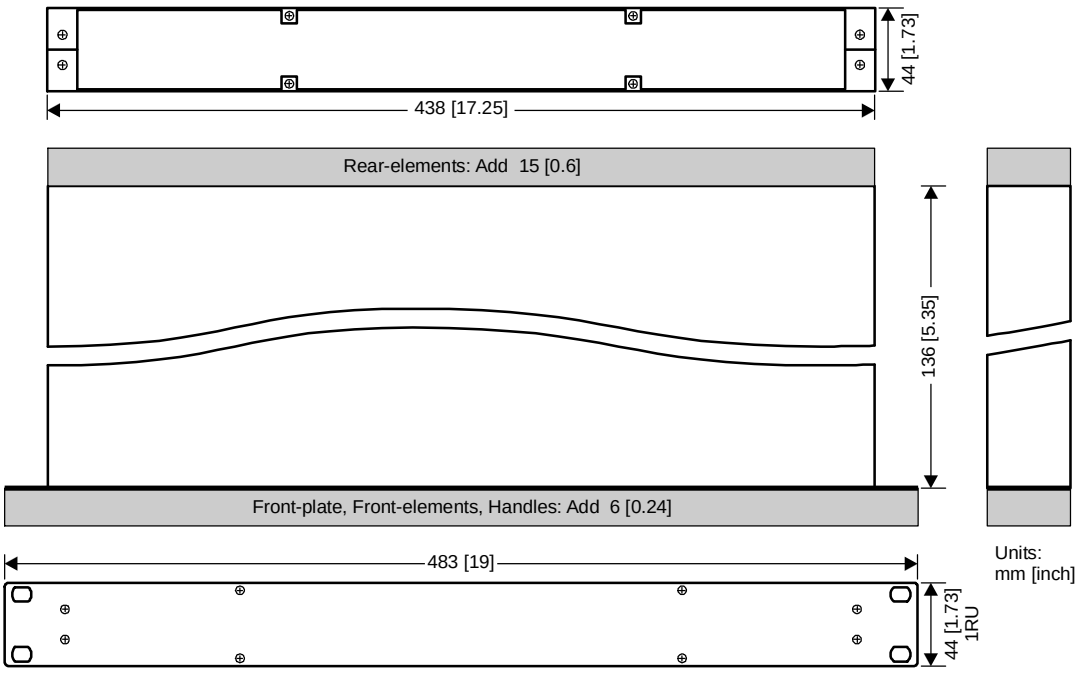


CONNECTION DIAGRAMS 4 / 4

Split-cable TRI-C



Dimensions



Weight

2.3 kg

Specifications and appearance are subject to change without notice.