FAMILY OF CONVERTER DEVICES

TYPE F2MUX

USER GUIDE

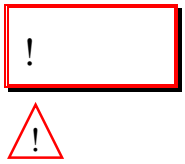
Rev. 5 - November 2018

ZIV
Antonio Machado, 78-80
08840 Viladecans, Barcelona-Spain

Tel.: +34 933 490 700
Fax: +34 933 492 258
Mail to: ziv@zivautomation.com

www.zivautomation.com

SAFETY SYMBOLS



WARNING OR CAUTION:

This symbol denotes a hazard. Not following the indicated procedure, operation or alike could mean total or partial breakdown of the equipment or even injury to the personnel handling it.

NOTE:

Information or important aspects to take into account in a procedure, operation or alike.

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1 INTRODUCTION

1.1 GENERAL

The F2MUX is a family of converter devices intended to convert an optical fiber, identified as INTF1, into an electrical or optical interface, identified as INTF2, of the following type:

- multimode optical fiber interface in accordance with C37.94 standard.
- electrical interface at 64 kbit/s in accordance with Recommendation G.703 of the ITU-T with codirectional clock.
- electrical interface at 2 Mbit/s in accordance with Recommendation G.703 of the ITU-T with codirectional clock, with either two unbalanced BNC connectors (75 Ω) or a balanced RJ-45 connector (120 Ω).
- electrical interface at 64 kbit/s in accordance with Recommendation V.35 of the ITU-T with either internal or external transmit clock.

The INTF1 optical fiber type can be multimode or single mode.

Each F2MUX version is supplied in a 19” one standard unit (s.u.) shelf, prepared for rack mounting.

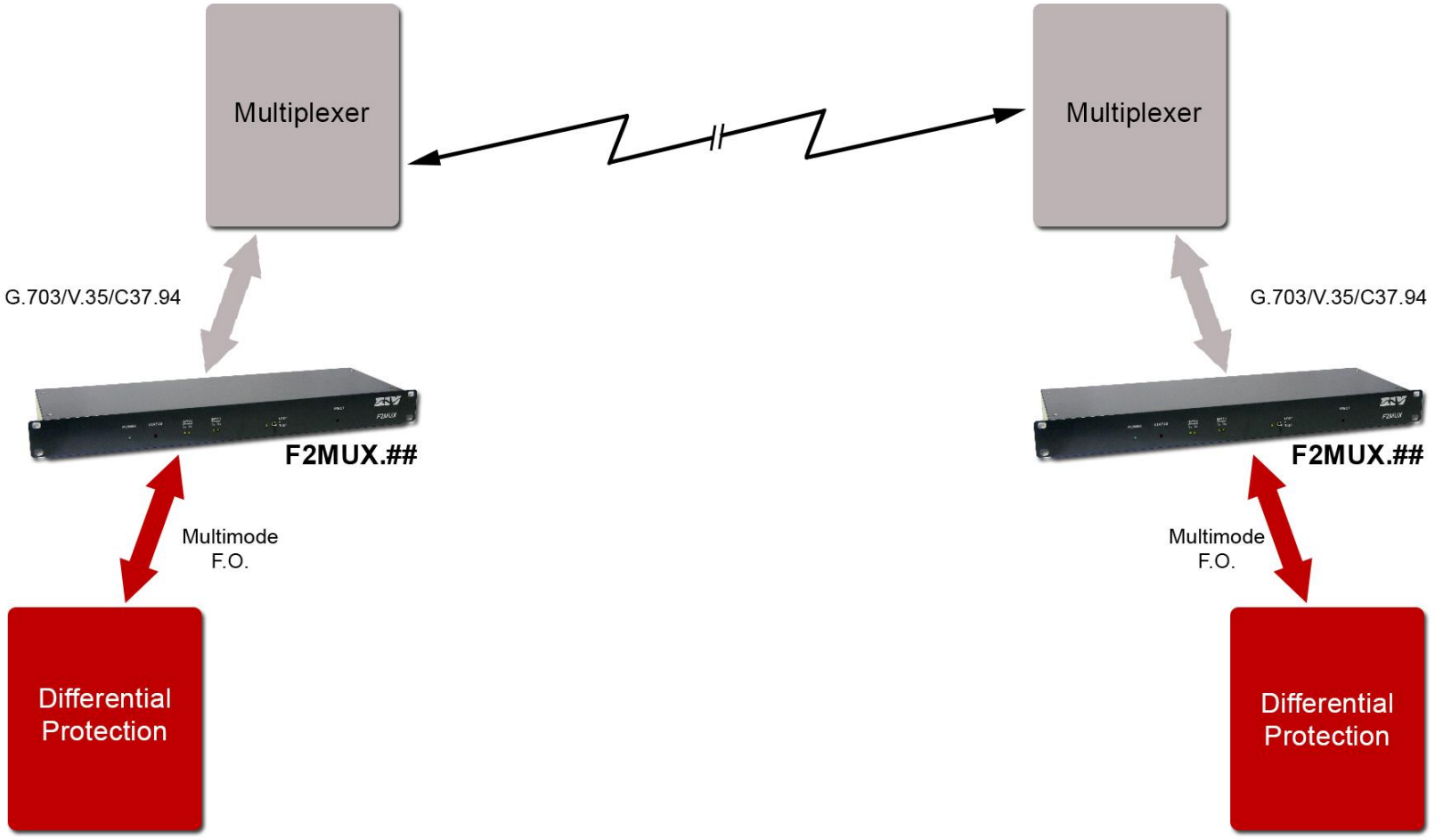
Each version has an integrated multirange isolated power supply (36-300 Vdc, 38-265 Vac).

F2MUX family of converter devices complies with IEC TS 61000-6-5 standard.

1.2 MAIN APPLICATION

The most significant application of the F2MUX is to communicate differential protection equipment through a multiplexer equipment (see FIGURE 1) or another telecommunication equipment.

FIGURE 1 Application example



1.3 AVAILABLE VERSIONS

The available versions are the following:

F2MUX.00 Optical into electrical conversion (G.703 at 64 kbit/s)

It comprises the converter from the **multimode** optical fiber (INTF1) into an electrical interface (INTF2) at 64 kbit/s in accordance with Recommendation G.703 of the ITU-T with codirectional clock.

F2MUX.01 Optical into electrical conversion (G.703 at 2 Mbit/s)

It comprises the converter from the **multimode** optical fiber (INTF1) into an electrical interface (INTF2) at 2 Mbit/s in accordance with Recommendation G.703 of the ITU-T with codirectional clock.

The use of the two unbalanced BNC connectors (75 Ω) or the use of the balanced RJ-45 connector (120 Ω) for twisted pair is selected by means of jumpers.

F2MUX.05 Optical into electrical conversion (G.703 at 2 Mbit/s)

It comprises the converter from the **single mode** optical fiber (INTF1) into an electrical interface (INTF2) at 2 Mbit/s in accordance with Recommendation G.703 of the ITU-T with codirectional clock.

The use of the two unbalanced BNC connectors (75 Ω) or the use of the balanced RJ-45 connector (120 Ω) for twisted pair is selected by means of jumpers.

F2MUX.02 Optical into electrical conversion (V.35 at 64 kbit/s)

It comprises the converter from the **multimode** optical fiber (INTF1) into an electrical interface (INTF2) at 64 kbit/s in accordance with Recommendation V.35 of the ITU-T with clocks configurable in MODE 0 (independent transmission and reception clocks coming from the line terminal) or MODE 1 (transmit clock generated internally by the F2MUX and receive clock coming from the line terminal) by means of jumpers.

F2MUX.04 Optical into optical conversion (C37.94)

It comprises the converter from the **multimode** optical fiber (INTF1) into a multimode optical fiber interface (INTF2) in accordance with C37.94 standard.

1.4 TECHNICAL CHARACTERISTICS

1.4.1 General characteristics

Operating characteristics	The F2MUX is able to convert an optical fiber into an electrical (G.703, V.35) or optical (C37.94) interface
Available models	**F2MUX.00**: Optical (multimode) into electrical (G.703 at 64 kbit/s) conversion **F2MUX.01**: Optical (multimode) into electrical (G.703 at 2 Mbit/s) conversion **F2MUX.05**: Optical (single mode) into electrical (G.703 at 2 Mbit/s) conversion **F2MUX.02**: Optical (multimode) into electrical (V.35 at 64 kbit/s) conversion **F2MUX.04**: Optical (multimode) into multimode optical (C37.94) conversion
Test devices	➢ Loop INTF2 interface ➢ Test INTF1 and INTF2 interfaces
Optical indications	➢ Terminal powered on ➢ Activity in INTF1 interface ➢ Activity in INTF2 interface ➢ Equipment in loop/test ➢ Alarm in INTF2 interface
Standard	IEC TS 61000-6-5

Electrical characteristics of INTF1 optical interface	
With multimode (62.5 µm) fiber type	
Wavelength	820 nm
Type of connector	ST female

Distance between optical interfaces	Up to 2 km
Transmitter optical power level	-16 dBm/-12 dBm/-9 dBm (Min./Typ./Max.)
Receiver optical power level	-24 dBm/-10 dBm (Min./Max.)
Protocol	Selectable by means of jumpers among: ➢ C37.94 at 64 kbit/s ➢ FM0 at 64 kbit/s, 128 kbit/s or 512 kbit/s ➢ Transparent mode 1 (up to 28800 bit/s) ➢ Transparent mode 2 (up to 960 kbit/s)
With single mode (9/125 µm) fiber type	
Wavelength	1310 nm
Type of connector	FC female
Distance between optical interfaces	More than 2 km
Maximum attenuation permissible	30 dB
Transmitter optical power minimum level	-5 dBm
Protocol	Selectable by means of jumpers among: ➢ C37.94 at 64 kbit/s ➢ FM0 at 64 kbit/s, 128 kbit/s or 512 kbit/s ➢ Transparent mode 1 (up to 28800 bit/s) ➢ Transparent mode 2 (up to 960 kbit/s)

Electrical characteristics of INTF2 optical interface	
Fiber type	Multimode (62.5 µm)
Wavelength	820 nm

Type of connector	ST female
Distance between optical interfaces	Up to 2 km
Transmitter optical power level	-16 dBm/-12 dBm/-9 dBm (Min./Typ./Max.)
Receiver optical power level	-24 dBm/-10 dBm (Min./Max.)
Frame structure	C37.94

Electrical characteristics of INTF2 electrical interface (G.703 at 64 kbit/s)	
Transmission speed	64 kbit/s
Synchronism	Codirectional clock
Input impedance	120 Ω ± 5%, symmetric (a shielded twisted pair is recommended)
Output impedance	120 Ω ± 5%, symmetric (a shielded twisted pair is recommended)
Type of connector	Two three-pin connectors (Tx and Rx)
Maximum line attenuation	6 dB at 128 kHz
Electrical characteristics and line coding	In accordance with Recommendation G.703 of the ITU-T
Phase-fluctuation tolerance	In accordance with Recommendation G.823 of the ITU-T

Electrical characteristics of INTF2 electrical interface (G.703 at 2 Mbit/s)	
Transmission speed	2 Mbit/s
Synchronism	Codirectional clock

Input impedance	Selectable between 75 Ω (unbalanced) or 120 Ω (balanced) by means of jumpers
Output impedance	Selectable between 75 Ω (unbalanced) or 120 Ω (balanced) by means of jumpers
Maximum line attenuation	12 dB
Type of connector	Selectable between two unbalanced BNC connectors (75 Ω) or a balanced RJ-45 connector (120 Ω) for twisted pair by means of jumpers
Electrical characteristics and line coding	In accordance with Recommendation G.703 of the ITU-T
Phase-fluctuation tolerance	In accordance with Recommendation G.823 of the ITU-T

Electrical characteristics of INTF2 electrical interface (V.35 at 64 kbit/s)	
Transmission speed	64 kbit/s
Synchronism	Selectable between internal transmit clock (MODE 1) or coming from the line terminal (MODE 0) by means of jumpers
Type of connector	25-pin female SUB-D
Electrical characteristics and line coding	In accordance with appendix 2 of Recommendation V.35 of the ITU-T

1.4.2 Operating conditions

Temperature and humidity	From –5 °C to +55 °and relative humidity not greater than 95%, in accordance with IEC 721-3-3 class 3k5 (climatogram 3k5)

Power supply	➢ Multirange (36-300 Vdc, 38-265 Vac). ➢ Rigid or flexible conductors of up to 2.5 mm^2. ➢ Protected against polarity inversion
Maximum consumption	3W
Protection against overvoltages	By current limitation at the power-control IC
R.F. emissions	In accordance with EN 55022 standard
Dielectric strength	In accordance with EN 60255-27 standard
Electromagnetic compatibility	
Electrostatic discharge immunity test	In accordance with EN 61000-4-2 standard
Radiated, radio-frequency, electromagnetic field immunity test	In accordance with EN 61000-4-3 standard
Electrical fast transient/burst immunity test	In accordance with EN 61000-4-4 standard
Surge immunity test	In accordance with EN 61000-4-5 standard
Immunity to conducted disturbances, induced by radio- frequency fields.	In accordance with EN 61000-4-6 standard
Power frequency magnetic field immunity test	In accordance with EN 61000-4-8 standard

1.4.3 Mechanical characteristics

Dimensions	19” (483 mm) wide and 1 s.u. high (44 mm). Depth of 170 mm (with connectors)
Weight	1.9 kg

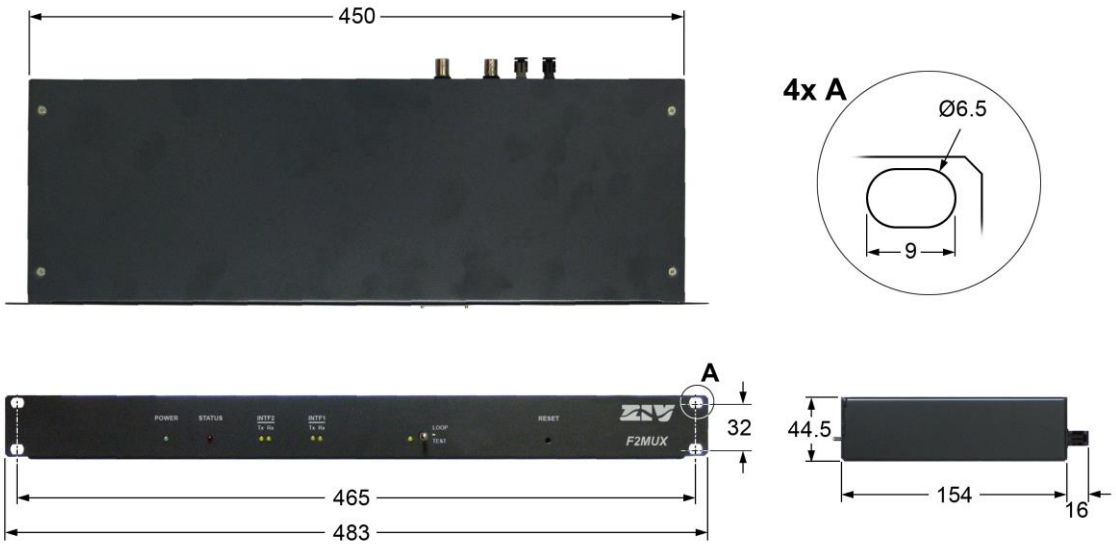
2 INSTALLATION

2.1 MECHANICAL AND ELECTRICAL CHARACTERISTICS

The F2MUX consists in a 19” one standard unit (s.u.) shelf, prepared for rack mounting.

FIGURE 2 shows the overall dimensions in mm of the F2MUX.

FIGURE 2 Overall dimensions in mm of the F2MUX



NOTE: the dimensions are identical for all versions

2.2 EXTERNAL CONNECTIONS

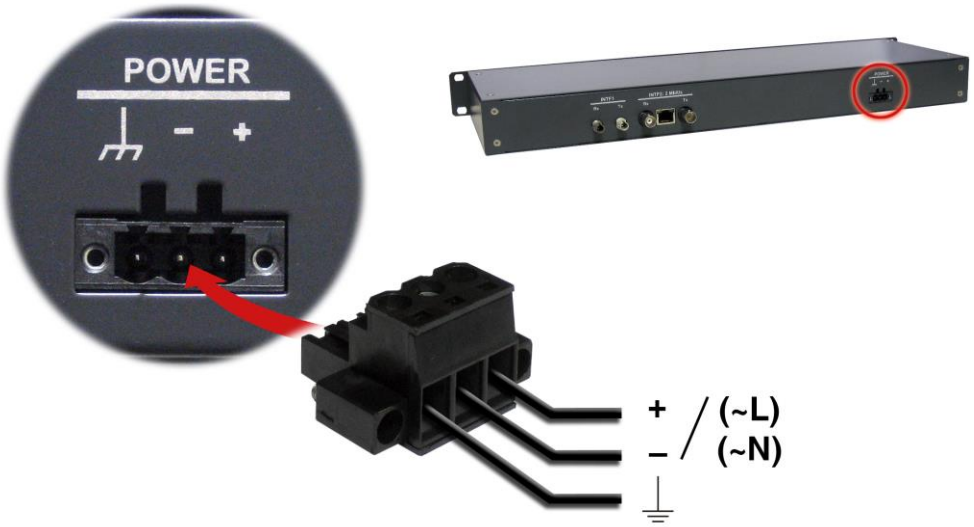
The power-supply connection and the connection of the different signals that access the converter are made, as detailed in the following sections, by means of the connectors located at the rear of the 1 s.u. shelf.

2.2.1 Power-supply connection

All F2MUX versions are powered from a DC or AC supply voltage (36-300 Vdc, 38-265 Vac), through the connector shown in FIGURE 3.

The female connector supplied with the equipment is suitable for rigid or flexible conductors of up to 2.5 mm^2.

FIGURE 3 Location and use of the power-supply connector in the F2MUX



In DC supply-voltage operation the equipment is protected against polarity inversion.

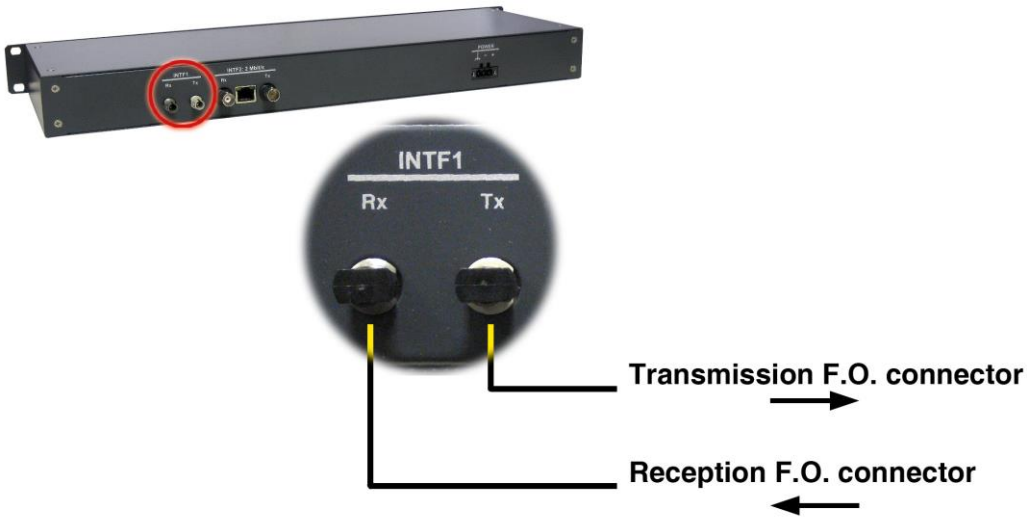
2.2.2 INTF1 connection

The F2MUX has two female optical connectors, identified as INTF1 (see FIGURE 4 for its location and usage).

Depending on the type of fiber, the connectors are ST or FC type.

> The type of protocol of the INTF1 interface is selected by means of jumpers (see section 3.2.2).
>
> The C37.94 (64 kbit/s) protocol is selected in factory.

FIGURE 4 Location and use of the INTF1 in the F2MUX



2.2.3 Connection of version F2MUX.00 (INTF2: G.703 at 64 kbit/s)

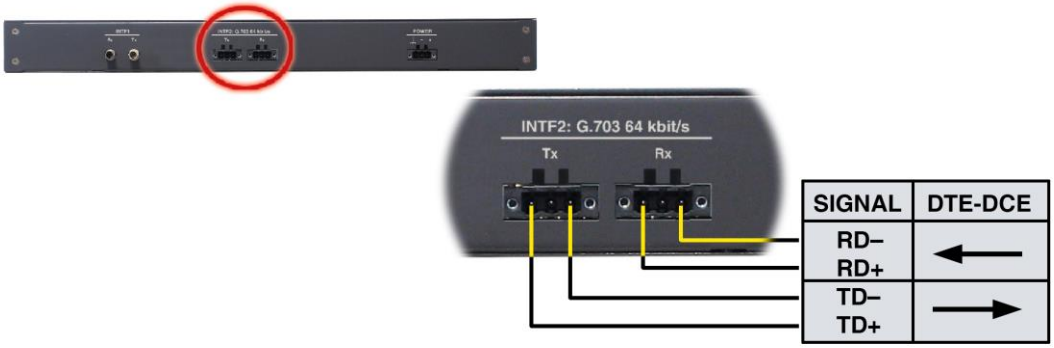
Apart from the power-supply connector and the connectors associated with INTF1, the F2MUX.00 version includes two terminal blocks, identified as INTF2, that correspond to the G.703 signals at 64 kbit/s with codirectional clock.

The use of the INTF2 connectors is indicated in FIGURE 6.

The connections of the power-supply and the INTF1 interface are detailed in sections 2.2.1 and 2.2.2, respectively.

FIGURE 5 Location of connectors in F2MUX.00 version

FIGURE 6 G.703 signals at 64 kbit/s with codirectional clock



2.2.4 Connection of versions F2MUX.01 and F2MUX.05 (INTF2: G.703 at 2 Mbit/s)

Apart from the power-supply connector and the connectors associated with INTF1, the F2MUX.01 and F2MUX.05 versions include the connection that corresponds to the G.703 signals at 2 Mbit/s with codirectional clock.

The INTF2 interface has two unbalanced BNC connectors (75 Ω), see FIGURE 8, and a balanced RJ-45 connector (120 Ω) for twisted pair, see FIGURE 9.

> The use of either the two BNC connectors or a RJ-45 connector is selected by means of jumpers (see section 3.2.1).
>
> The use of the two unbalanced BNC connectors (75 Ω) is selected in factory.

The connections of the power-supply and the INTF1 interface are detailed in sections 2.2.1 and 2.2.2, respectively.

FIGURE 7 Location of connectors in F2MUX.01 and F2MUX.05 versions

FIGURE 8 G.703 signals at 2 Mbit/s for unbalanced BNC connectors (75 Ω)

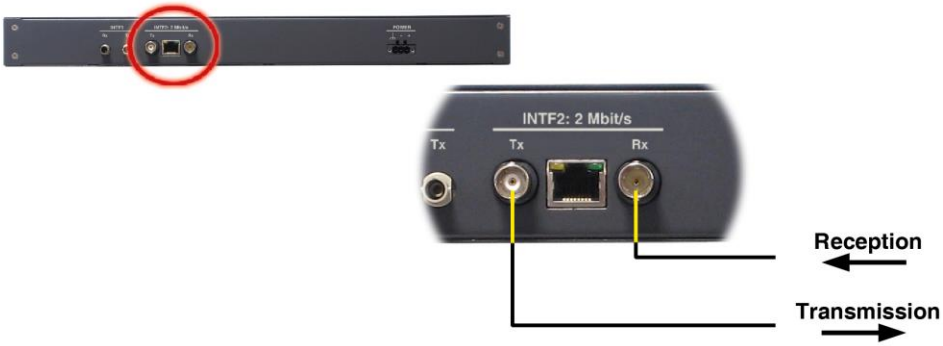
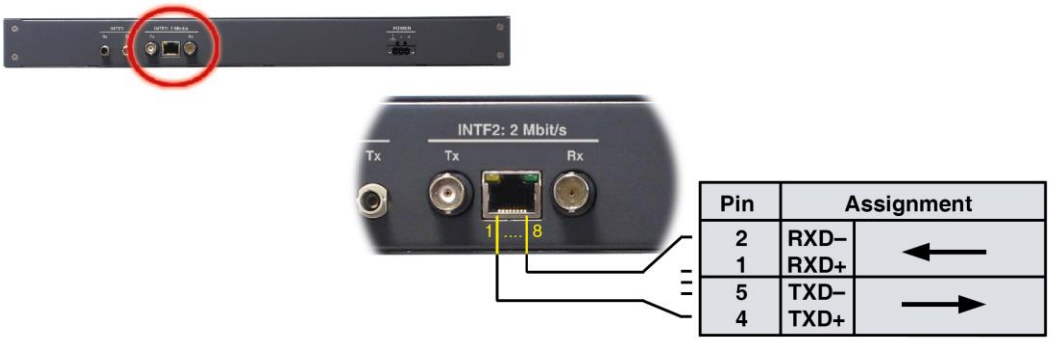


FIGURE 9 G.703 signals at 2 Mbit/s for balanced RJ-45 connector (120 Ω)



2.2.5 Connection of version F2MUX.02 (INTF2: V.35 at 64 kbit/s)

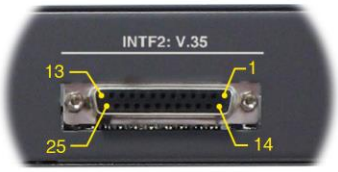
Apart from the power-supply connector and the connectors associated with INTF1, the F2MUX.02 version includes a 25-pin female connector that corresponds to the V.35 signals at 64 kbit/s.

The use of the INTF2 connector is shown in FIGURE 11.

The connections of the power-supply and the INTF1 interface are detailed in sections 2.2.1 and 2.2.2, respectively.

FIGURE 10 Disposition of connectors in F2MUX.02 version

FIGURE 11 V.35 signals at 64 kbit/s

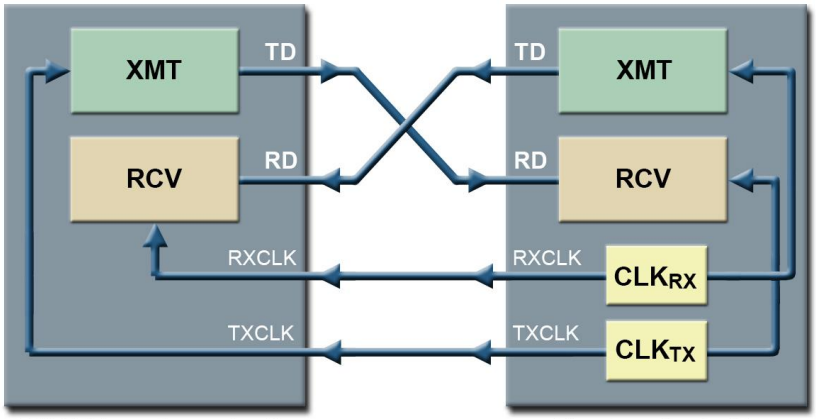


Pin	Signal	DTE-DCE	ISO 2593
1	EARTH	–	A
2	TXD+	→	P
3	RXD+	←	R
7	GND	–	B
9	RXCLK–	←	X
11	TXCLK–_OUT	→	W
12	TXCLK–	←	AA
14	TXD–	→	S
15	TXCLK+	←	Y
16	RXD–	←	T
17	RXCLK+	←	V
24	TXCLK+_OUT	→	U

The V.35 interface allows two clock configurations:

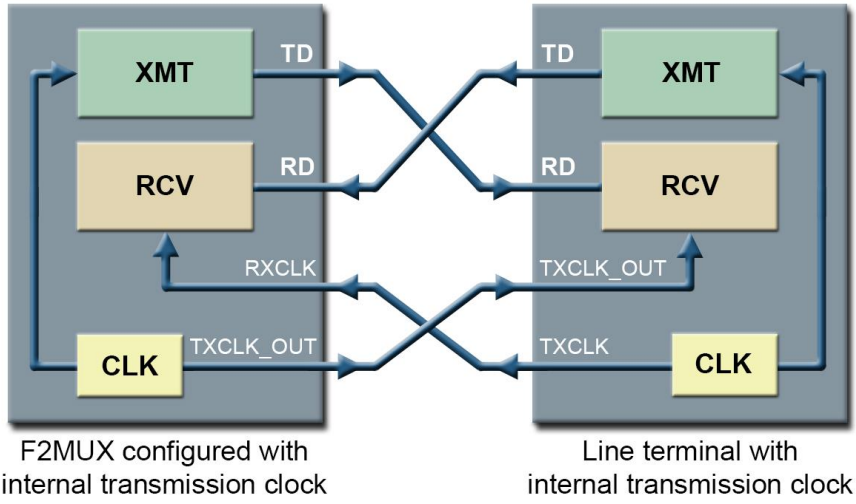
– Independent transmit and receive clocks in the F2MUX terminal and coming from the line terminal (MODE 0).

FIGURE 12 F2MUX with V.35 interface and independent transmit and receive clocks



– The transmit clock is generated internally in the F2MUX terminal and the receive clock comes from the line terminal (MODE 1).

FIGURE 13 F2MUX with V.35 interface and transmit clock generated internally



The MODE 0 is configured in factory (see section 3.2.1).

2.2.6 Connection of version F2MUX.04 (INTF2: C37.94)

Apart from the power-supply connector and the connectors associated with INTF1, the F2MUX.04 version includes two optical connectors type ST female that corresponds to the signals according to C37.94 frame structure.

The use of the INTF2 connector is shown in FIGURE 15.

The connections of the power-supply and the INTF1 interface are detailed in sections 2.2.1 and 2.2.2, respectively.

FIGURE 14 Location of the connectors in the F2MUX.04 version

FIGURE 15 C37.94 signals

3 COMMISSIONING

3.1 FRONT-PLATE ELEMENTS

There are several LEDs on the front plate of the F2MUX that allow monitoring the equipment status and the activity in the interfaces.

The front plate also includes a reset push-button and a switch to carry out a test or loop in the equipment.

The location and identification of the front-plate elements can be seen in FIGURE 16.

LED of power supply

LED POWER	Green. It is permanently lit when the equipment is powered with an external power-supply voltage.

LED of alarm

LED STATUS	Red. It turns on as an alarm signal when a problem in the INTF2 interface is detected.

LEDs associated with the optical interface (INTF1)

LED TX	Amber. It blinks when there is transmission data.
LED RX	Amber. It blinks when there is reception data.

LEDs associated with the electrical/optical interface (INTF2)

LED TX	Amber. It blinks when there is transmission data.
LED RX	Amber. It blinks when there is reception data.

Loop/Test switch

LOOP/TEST	This switch has three positions. Switching upwards executes a loop and switching downwards executes a test. The middle position is the rest position.

LED of loop/test

LED LOOP/TEST	Amber. It turns on when a loop is being carried out in the equipment or when a test is made and the result is correct.

Equipment reset push-button

RESET	This resets the equipment. In order to press the reset push-button a tool of no more than 3 mm in diameter must be used.

FIGURE 16 LEDs of F2MUX

3.2 CONFIGURATION ELEMENTS

The configuration elements available in the INTF1 and INTF2 interfaces are described in the following sections.

3.2.1 INTF2 interface

In the F2MUX.01/F2MUX.05 and F2MUX.02 versions, it is necessary to select the configuration of jumpers 1 and 2, of setting J2-J3, see FIGURE 17, respectively.

Jumper 1 of J2-J3	Selects the type of connector that will be used by the G.703 electrical interface at 2 Mbit/s. CARRIED OUT: balanced RJ-45 connector (120 Ω) NOT CARRIED OUT: unbalanced BNC connectors (75 Ω) The use of the BNC connectors (jumper not carried out) is selected in factory.
Jumper 2 of J2-J3	Selects the type of transmit clock that will be used by the V.35 electrical interface at 64 kbit/s. CARRIED OUT: MODE 0 (independent transmit and receive clocks and coming from the line terminal, see FIGURE 12). NOT CARRIED OUT: MODE 1 (transmit clock generated internally by the F2MUX and receive clock coming from the line terminal, see FIGURE 13). The mode 0 (jumper carried out) is selected in factory.

3.2.2 INTF1 interface

In the INTF-1, the type of protocol must be selected by means of jumpers 3 and 4, and jumpers 7 and 8, of setting J2-J3, see FIGURE 17.

Jumpers 3 and 4 of J2-J3	Selects the type of protocol that will be used by the INTF1 interface. The C37.94 protocol (jumpers not carried out) is selected in factory.

TABLE 1 Configuration of jumpers 3 and 4 of J2-J3 for selecting the INTF1 protocol

J2-J3		INTF1 protocol selection
Jumper 3	Jumper 4	
NOT carried out	NOT carried out	C37.94 at 64 kbit/s (1)
Carried out	NOT carried out	FM0 at 64 kbit/s, 128 kbit/s or 512 kbit/s (see TABLE 2)
NOT carried out	Carried out	Transparent mode 1 (for speeds up to 28800 bit/s) (2)
Carried out	Carried out	Transparent mode 2 (for speeds up to 960 kbit/s) (3)

(1) Can operate with any INTF2 possible (for G.703 at 2 Mbit/s occupies 1 slot of the frame of 2 Mbit/s of INTF2).

(2) Transparent mode 1.
Can operate with any INTF2 possible (for G.703 at 2 Mbit/s occupies 1 slot of the frame of 2 Mbit/s of INTF2).

(3) Transparent mode 2.
Only works with INTF2 G.703 at 2 Mbit/s (occupies 30 slots of the frame of 2 Mbit/s of INTF2).
Recommended only for speeds higher than 28800 bit/s (as it occupies 30 slots of the frame of 2 Mbit/s of INTF2).

Jumpers 7 and 8 of J2-J3 — Establishes the speed and the operation mode of the FM0 protocol

TABLE 2 Configuration of jumpers 7 and 8 of J2-J3 for selecting the speed of the FM0 protocol

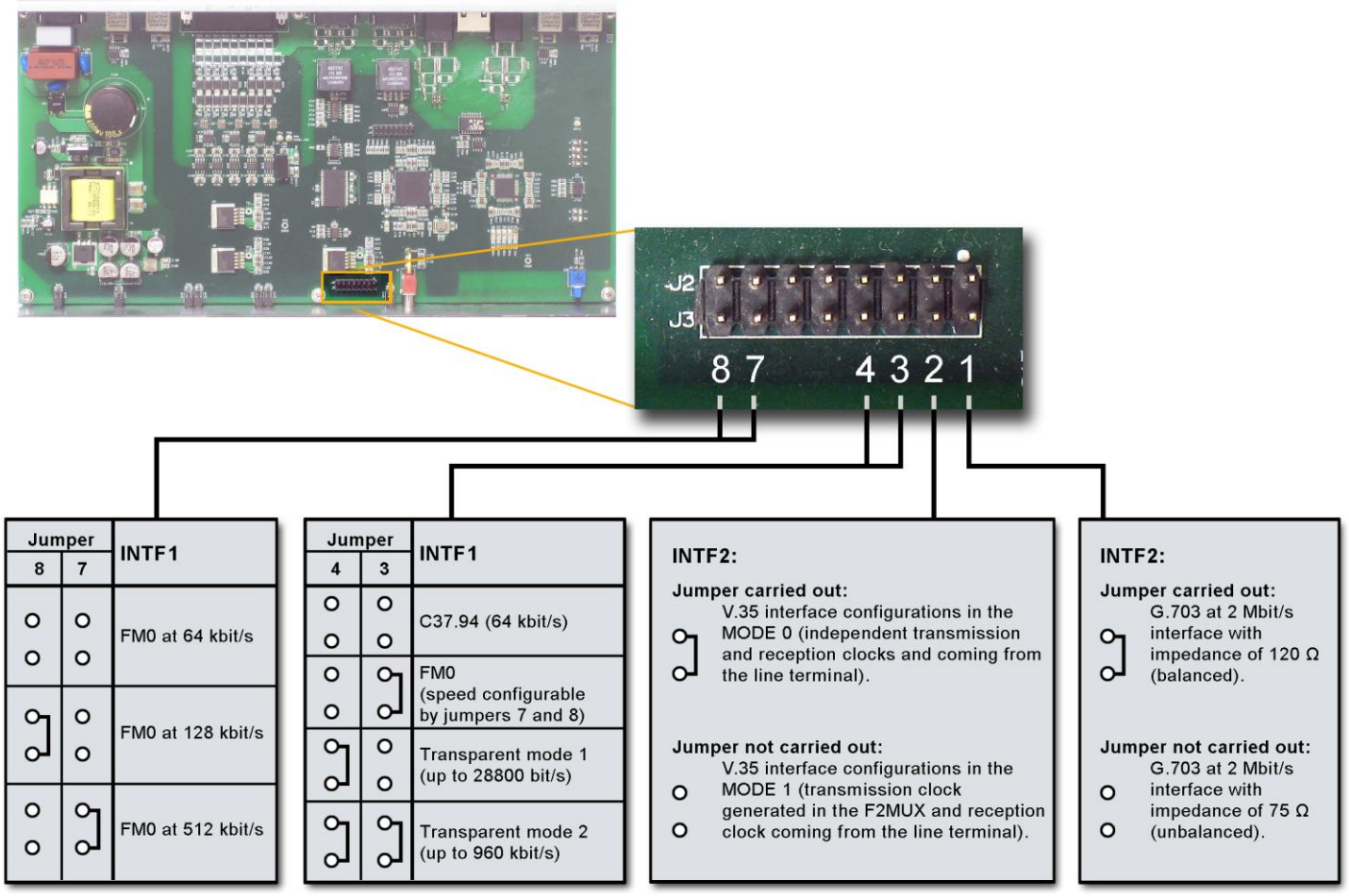
J2-J3		FM0 speed selection
Jumper 7	Jumper 8	
NOT carried out	NOT carried out	FM0 at 64 kbit/s (1)
NOT carried out	Carried out	FM0 at 128 kbit/s (2)
Carried out	NOT carried out	FM0 at 512 kbit/s (3)

(1) Can operate with any INTF2 possible (for G.703 at 2 Mbit/s occupies 1 slot of the frame of 2 Mbit/s of INTF2).

(2) Only works with INTF2 G.703 at 2 Mbit/s (occupies 2 slots of the frame of 2 Mbit/s of INTF2).

(3) Only works with INTF2 G.703 at 2 Mbit/s (occupies 8 slots of the frame of 2 Mbit/s of INTF2).

FIGURE 17 Configuration elements of the F2MUX



3.3 TEST DEVICES

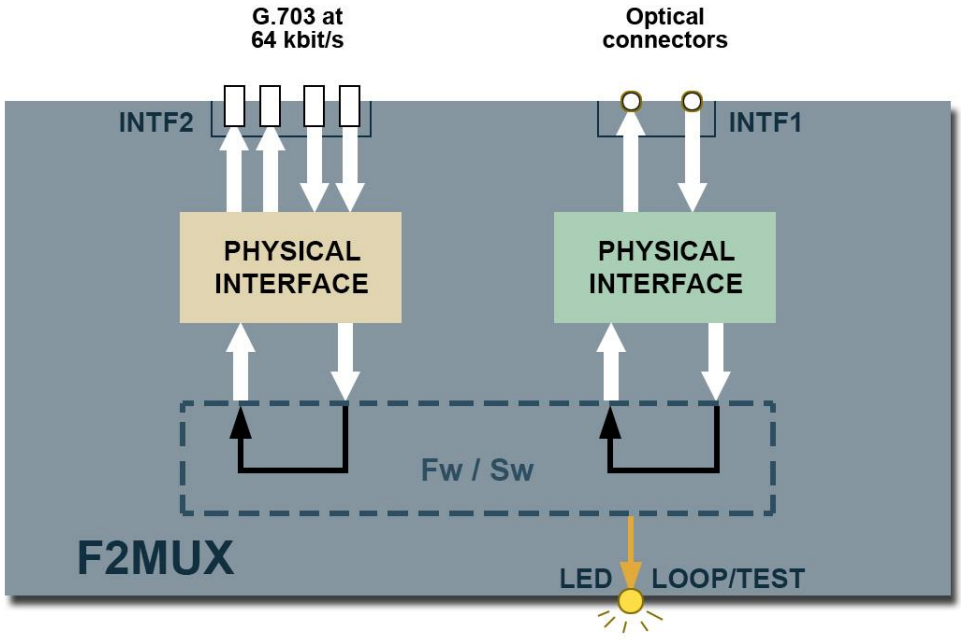
3.3.1 INTF2 interface loop

By putting the front-plate switch in LOOP position, a loop is generated. As the example in FIGURE 18 shows, the loop is established between transmit and receive of the INTF1 interface, and between transmit and receive of the INTF2 interface. In the example, the INTF2 interface is associated with the F2MUX.00 version.

The loop, therefore, allows the communication channel between the F2MUX and the multiplexer equipment or another telecommunication equipment to be verified.

When the equipment is in loop mode, the LED on the front plate near the loop/test switch lights up in amber.

FIGURE 18 Loop



3.3.2 INTF1 and INTF2 interface test

Before carrying out the test, the Tx port must be looped into the Rx port in both INTF1 and INTF2 interfaces, as the example in FIGURE 19.

Once carried out these connections, the test is generated by putting the front-plate switch in the TEST position.

The F2MUX compares the data flow transmitted through the INTF1 interface to the data flow received through the INTF2 interface. If the result is correct the LED on the front plate lights up in amber. If it is not, it remains off.

FIGURE 19 Test