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## FAMILY OF CONVERTER DEVICES TYPE F2MUX



### USER GUIDE

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## 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 GENERAL DESCRIPTION

### 1.1 OPERATING PRINCIPLE

The F2MUX is a family of converter devices intended to convert an optical interface into an electrical interface or optical with a different protocol and/or connector.

The most significant application of the F2MUX is to communicate differential protection equipment through a multiplexer equipment (see FIGURE 2) or another telecommunication equipment.

The device input interface is identified as INTF1 and consists of an optical fiber interface that can be multimode with ST female connectors (P2 of INTF1) or single mode with FC female connectors (P1 of INTF1).

The INTF1 input interface is configurable in mode:

- C37.94 with a fixed number of timeslots (1, 2 or 8) or with the number specified in the frame itself.
- CMI/FM0 at 64 kbit/s, 128 kbit/s, 512 kbit/s or 2048 kbit/s.
- Transparent 1 (up to 28800 bit/s).
- Transparent 2 (up to 960 kbit/s).

The device output interface is identified as INTF2 and can be one of the following:

- P1 of INTF2: electrical interface at 2 Mbit/s in accordance with Recommendation G.703 of the ITU-T with codirectional clock, with connector type selectable between two unbalanced BNC connectors (75  $\Omega$ ) or a balanced RJ-45 connector (120  $\Omega$ ).
- P2 of INTF2: electrical interface at 64 kbit/s in accordance with Recommendation G.703 of the ITU-T with codirectional clock, with two three-pin connectors, one for transmission and one for reception.
- P3 of INTF2: optical fiber interface in accordance with C37.94 standard, with SFP (Small Form Factor Pluggable) bay.
- P4 of INTF2: multimode optical fiber interface in accordance with C37.94 standard, with two ST female connectors, one for transmission and one for reception.

# F2MUX

As an example, in FIGURE 1, a rear view of the equipment is shown in which the arrangement of the different interfaces can be seen. It must be considered that the device will leave the factory **only with the INTF1 and INTF2 interfaces corresponding to the F2MUX version.**

FIGURE 1 Example of the arrangement of the different interfaces of an F2MUX device <sup>(1)</sup>



The F2MUX is supplied in a 19" shelf that is one standard unit (s.u.) in height, prepared for rack mounting. The shelf integrates an isolated multirange power supply (36-300 Vdc, 38-265 Vac), as well as the INTF1 and INTF2 interfaces corresponding to the F2MUX version.

F2MUX versions are detailed in section 1.2, according to the type of interface.

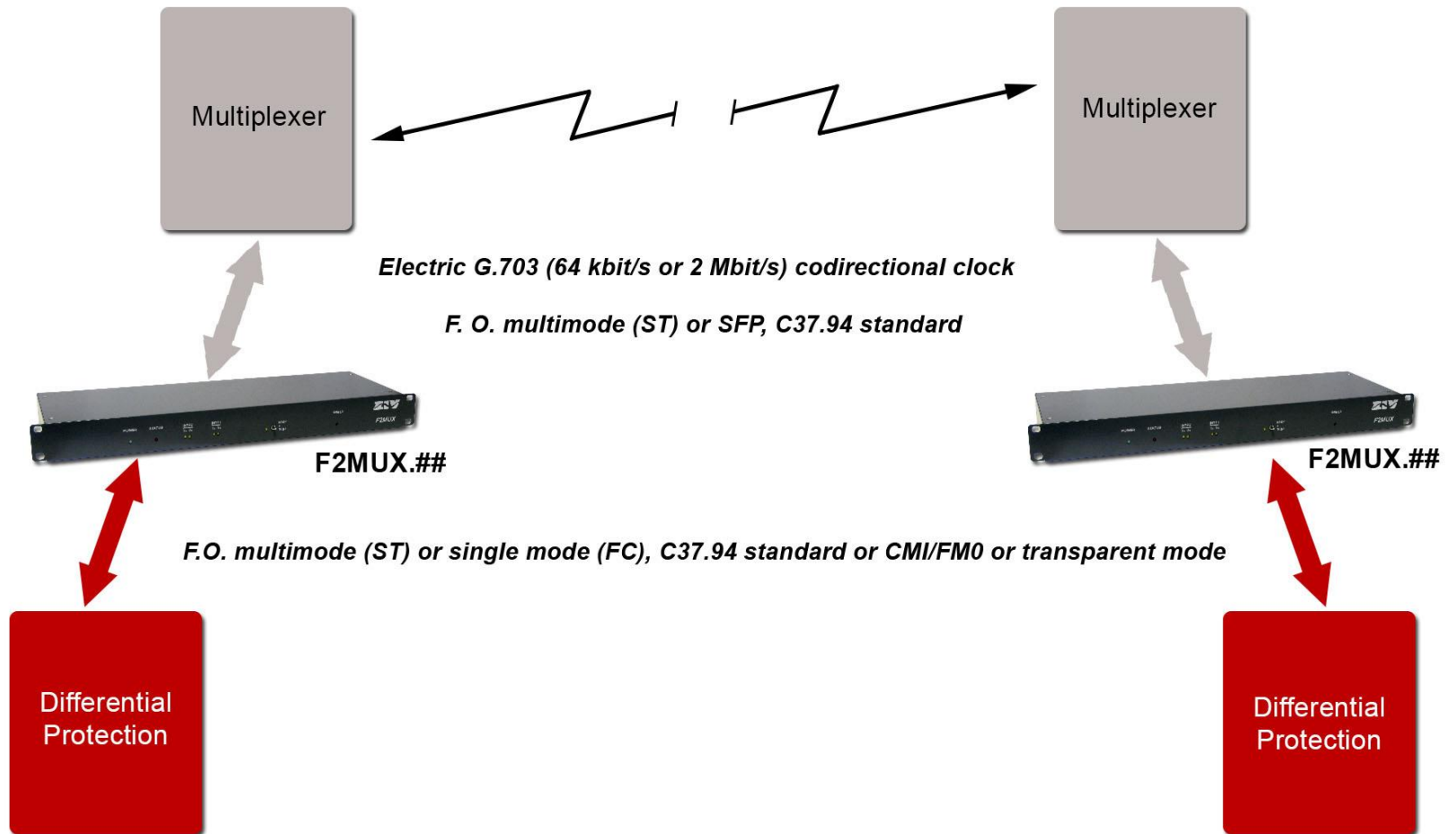
The F2MUX family of converter devices complies with IEC TS 61000-6-5 standard.

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<sup>(1)</sup> It must be considered that the device will leave the factory **only with the INTF1 and INTF2 interfaces corresponding to the F2MUX version.**

# F2MUX

FIGURE 2 Example of use



### AVAILABLE F2MUX VERSIONS

The list of available F2MUX versions are as follows:

#### **F2MUX.10 Multimode (ST) optical into electrical G.703 at 2 Mbit/s conversion**

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 optical interface has two ST female connectors, one for transmission and one for reception.

The electrical interface selects, by settings, the use of two unbalanced BNC connectors (75  $\Omega$ ) or the use of the balanced RJ-45 connector (120  $\Omega$ ) for twisted pair.

#### **F2MUX.11 Multimode (ST) optical into electrical G.703 at 64 kbit/s conversion**

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.

The optical interface has two ST female connectors, one for transmission and one for reception.

The electrical interface has two three-pin connectors, one for transmission and one for reception.

#### **F2MUX.12 Multimode (ST) optical into C37.94 optical conversion (SFP bay)**

It comprises the converter from the multimode optical fiber (INTF1) into an optical fiber interface (INTF2) in accordance with C37.94 standard. The INTF1 optical interface has two ST female connectors, one for transmission and one for reception, whilst the INTF2 optical interface has an SFP (Small Form Factor Pluggable) bay.

The INTF1 optical interface is configurable in mode: C37.94, CMI/FM0 (at 64 kbit/s, 128 kbit/s, 512 kbit/s or 2048 kbit/s), transparent 1 (up to 28800 bit/s) and transparent 2 (up to 960 kbit/s).

#### **F2MUX.13 Multimode (ST) optical into multimode (ST) C37.94 optical conversion**

It comprises the converter from the multimode optical fiber (INTF1) into a multimode optical fiber interface (INTF2) in accordance with C37.94 standard. Both optical interfaces, INTF1 and INTF2, have two ST female connectors, one for transmission and one for reception.

The INTF1 optical interface is configurable in mode: C37.94, CMI/FM0 (at 64 kbit/s, 128 kbit/s, 512 kbit/s or 2048 kbit/s), transparent 1 (up to 28800 bit/s) and transparent 2 (up to 960 kbit/s).

## **F2MUX.20 Single mode (FC) optical into electrical G.703 at 2 Mbit/s conversion**

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 optical interface has two FC female connectors, one for transmission and one for reception.

The electrical interface selects, by settings, the use of two unbalanced BNC connectors (75  $\Omega$ ) or the use of the balanced RJ-45 connector (120  $\Omega$ ) for twisted pair.

## **F2MUX.21 Single mode (FC) optical into electrical G.703 at 64 kbit/s conversion**

It comprises the converter from the single-mode 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.

The optical interface has two FC female connectors, one for transmission and one for reception.

The electrical interface has two three-pin connectors, one for transmission and one for reception.

## **F2MUX.22 Single mode (FC) optical into C37.94 optical conversion (SFP bay)**

It comprises the converter from the single-mode optical fiber (INTF1) into an optical fiber interface (INTF2) in accordance with C37.94 standard. The INTF1 optical interface has two FC female connectors, one for transmission and one for reception, whilst the INTF2 optical interface has an SFP (Small Form Factor Pluggable) bay.

The INTF1 optical interface is configurable in mode: C37.94, CMI/FM0 (at 64 kbit/s, 128 kbit/s, 512 kbit/s or 2048 kbit/s), transparent 1 (up to 28800 bit/s) and transparent 2 (up to 960 kbit/s).

## **F2MUX.23 Single mode (FC) optical into multimode (ST) C37.94 optical conversion**

It comprises the converter from the single-mode optical fiber (INTF1) into a multimode optical fiber interface (INTF2) in accordance with C37.94 standard. The INTF1 optical interface has two FC female connectors, one for transmission and one for reception, whilst the INTF2 optical interface has two ST female connectors.

The INTF1 optical interface is configurable in mode: C37.94, CMI/FM0 (at 64 kbit/s, 128 kbit/s, 512 kbit/s or 2048 kbit/s), transparent 1 (up to 28800 bit/s) and transparent 2 (up to 960 kbit/s).



## 1.3 TECHNICAL CHARACTERISTICS

### 1.3.1 General characteristics

Operating principle	The F2MUX is able to convert and optical fiber interface into an electrical interface or optical with a different protocol and/or connector
Available F2MUX versions	<p><b>F2MUX.10:</b> Multimode (ST) optical into electrical G.703 at 2 Mbit/s conversion</p> <p><b>F2MUX.11:</b> Multimode (ST) optical into electrical G.703 at 64 kbit/s conversion</p> <p><b>F2MUX.12:</b> Multimode (ST) optical into C37.94 optical conversion (SFP bay)</p> <p><b>F2MUX.13:</b> Multimode (ST) optical into multimode (ST) C37.94 optical conversion</p> <p><b>F2MUX.20:</b> Single mode (FC) optical into electrical G.703 at 2 Mbit/s conversion</p> <p><b>F2MUX.21:</b> Single mode (FC) optical into electrical G.703 at 64 kbit/s conversion</p> <p><b>F2MUX.22:</b> Single mode (FC) optical into C37.94 optical conversion (SFP bay)</p> <p><b>F2MUX.23:</b> Single mode (FC) optical into multimode (ST) C37.94 optical conversion</p>
Test devices	<ul style="list-style-type: none"> <li>➤ Loop in INTF2 interface</li> <li>➤ Test in INTF1 and INTF2 interfaces</li> </ul>
Optical indications	<ul style="list-style-type: none"> <li>➤ Terminal powered on</li> <li>➤ Activity in INTF1 interface</li> <li>➤ Activity in INTF2 interface</li> <li>➤ Equipment in loop/test</li> <li>➤ Alarm in INTF2 interface</li> </ul>
Standard	IEC TS 61000-6-5

### INTF1 interface characteristics

<b>P2: Optical interface with multimode (62.5 μm) fiber type</b>	
Type of connector	ST female
Wavelength	820 nm
Transmitter optical power level (for logic level "1")	-18 dBm/-9 dBm (Min./Max.)
Permissible optical power level in reception	-24 dBm/-10 dBm (Min./Max.)
Approximate range	Up to 2 km
Operating mode	Selectable by internal settings from among: <ul style="list-style-type: none"> <li>➤ C37.94 with a fixed number of timeslots (1, 2 or 8) or with the number specified in the frame itself</li> <li>➤ CMI/FM0 at 64 kbit/s, 128 kbit/s, 512 kbit/s or 2048 kbit/s</li> <li>➤ Transparent 1 (up to 28800 bit/s)</li> <li>➤ Transparent 2 (up to 960 kbit/s)</li> </ul>

<b>P1: Optical interface with single mode (9/125 μm) fiber type</b>	
Type of connector	FC female
Wavelength	1310 nm
Transmitter optical power level (for logic level "1")	-3.5 dBm
Permissible maximum attenuation	30 dB
Approximate range	Up to 60 km
Operating mode	Selectable by internal settings from among: <ul style="list-style-type: none"> <li>➤ C37.94 with a fixed number of timeslots (1, 2 or 8) or with the number specified in the frame itself</li> <li>➤ CMI/FM0 at 64 kbit/s, 128 kbit/s, 512 kbit/s or 2048 kbit/s</li> <li>➤ Transparent 1 (up to 28800 bit/s)</li> <li>➤ Transparent 2 (up to 960 kbit/s)</li> </ul>

### INTF2 interface characteristics

<b>P1: Electrical interface G.703 at 2 Mbit/s</b>	
Transmission rate	2 Mbit/s
Synchronism	Codirectional clock
Input impedance	Selectable by internal settings between 75 $\Omega$ (unbalanced) or 120 $\Omega$ (balanced)
Output impedance	Selectable by internal settings between 75 $\Omega$ (unbalanced) or 120 $\Omega$ (balanced)
Maximum line attenuation	12 dB
Type of connector	Selectable by internal settings between two unbalanced BNC connectors (75 $\Omega$ ) or a balanced RJ-45 connector (120 $\Omega$ ) for twisted pair
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

<b>P2: Electrical interface G.703 at 64 kbit/s</b>	
Transmission rate	64 kbit/s
Synchronism	Codirectional clock
Input impedance	120 $\Omega \pm 5\%$ , symmetric (a shielded twisted pair is recommended)
Output impedance	120 $\Omega \pm 5\%$ , 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

<b>P3: Optical interface with SFP (Small Form Factor Pluggable) bay</b>	
SFP 4CZ07980014	Type of fiber: multimode Type of connector: LC Wavelength: 850 nm Approximate range: Up to 2 km Operating mode: C37.94 standard
SFP 4CZ07980013	Type of fiber: single mode Type of connector: LC Wavelength: 1310 nm Approximate range: Up to 40 km Operating mode: C37.94 standard

<b>P4: Optical interface with multimode (62.5 µm) fiber type</b>	
Type of connector	ST female
Wavelength	820 nm
Transmitter optical power level (for logic level "1")	-18 dBm/-9 dBm (Min./Max.)
Permissible optical power level in reception	-24 dBm/-10 dBm (Min./Max.)
Approximate range	Up to 2 km
Operating mode	C37.94 standard

### 1.3.4 Mechanical characteristics

<b>Dimensions</b>	19" (483 mm) wide and 1 s.u. high (44 mm). Depth of 170 mm (with connectors). See FIGURE 3
<b>Approximate weight</b>	2 kg
<b>Fixing</b>	By four 6.5 mm diameter holes

## 1.3.5 Operating conditions

<b>Temperature and humidity</b>	From $-5\text{ }^{\circ}\text{C}$ to $+55\text{ }^{\circ}\text{C}$ and relative humidity not greater than 95%, in accordance with IEC 721-3-3 class 3k5 (climatogram 3k5)
<b>Power supply</b>	<ul style="list-style-type: none"> <li>➤ Multirange (36-300 Vdc, 38-265 Vac).</li> <li>➤ Rigid or flexible conductors of up to <math>2.5\text{ mm}^2</math>.</li> <li>➤ Protected against polarity inversion.</li> </ul>
<b>Maximum consumption at 48 Vdc</b>	3.5 W
<b>Protection against overvoltages</b>	By current limitation at the power-control IC
<b>R.F. emissions</b>	In accordance with EN 55022 standard
<b>Dielectric strength</b>	In accordance with EN 60255-27 standard
<b>Electromagnetic compatibility</b>	
Electrostatic discharge immunity	In accordance with EN 61000-4-2 standard
Radiated, radio-frequency, electromagnetic field immunity	In accordance with EN 61000-4-3 standard
Electrical fast transient/burst immunity	In accordance with EN 61000-4-4 standard
Surge immunity	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	In accordance with EN 61000-4-8 standard

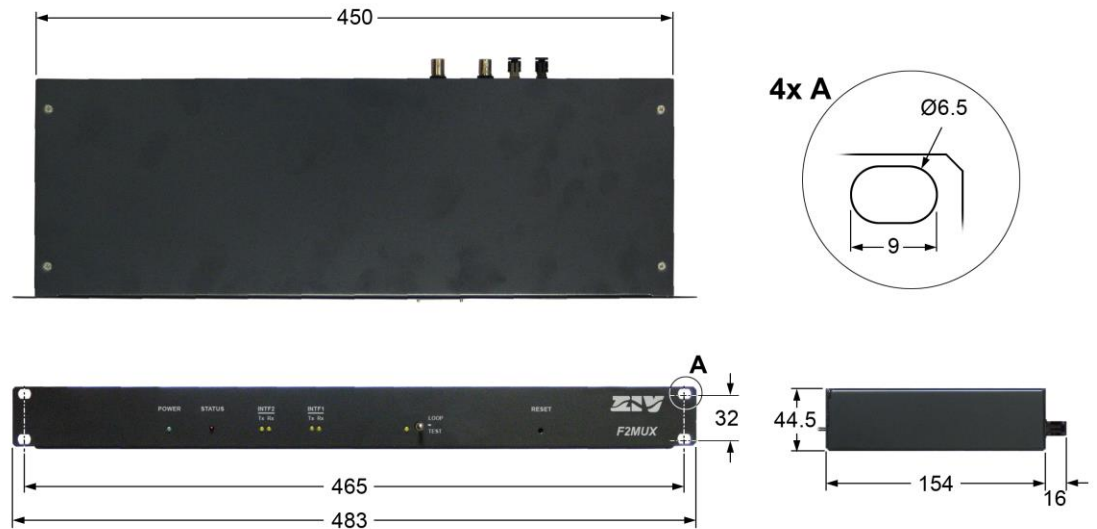
## 2 MECHANICAL AND ELECTRICAL CHARACTERISTICS

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

FIGURE 3 shows the overall dimensions in mm of the F2MUX.

The connection of the power supply and that of the different signals that access the converter is carried out, as detailed in the following sections, through the connectors located on the rear of the 1 s.u. shelf.

FIGURE 3 Overall dimensions in mm of the F2MUX



**NOTE:** dimensions are identical for all F2MUX versions

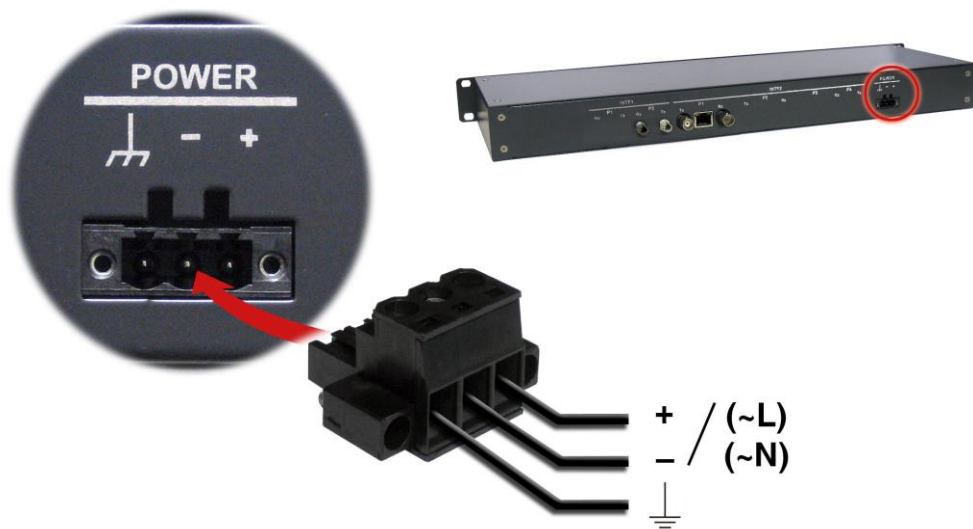
# F2MUX

## 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 4.

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

FIGURE 4 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 INTF1 INTERFACE CONNECTION

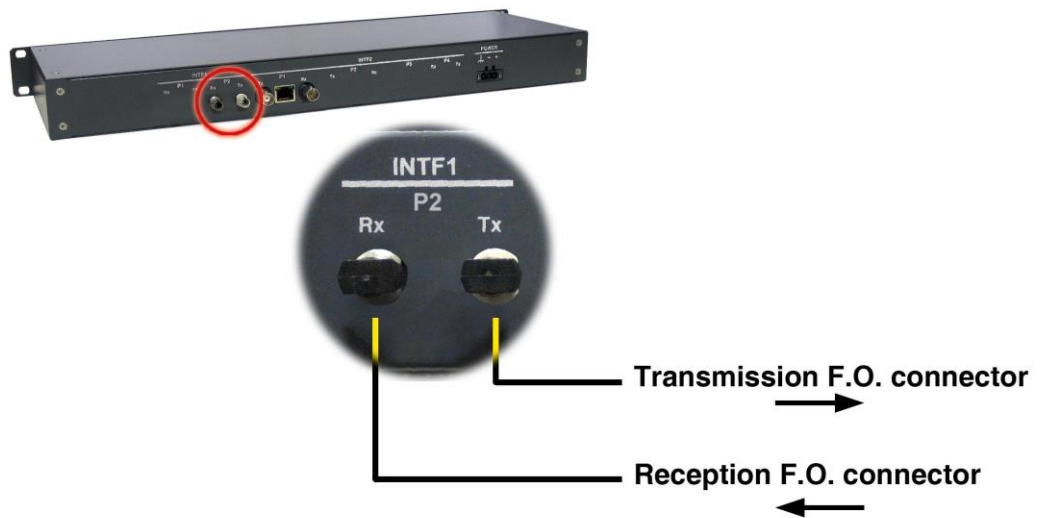
### 2.2.1 Multimode optical interface (P2 position)

F2MUX.1# versions include, in the P2 position of INTF1, two ST female multimode optical connectors, the use of which is indicated in FIGURE 5.

The operating mode is configured by internal settings (see FIGURE 13).

The use of the C37.94 standard with frame timeslots is set at the factory. The frame itself contains information about the number of timeslots used.

FIGURE 5 Multimode (ST female) optical fiber signals of INTF1 (P2 position)





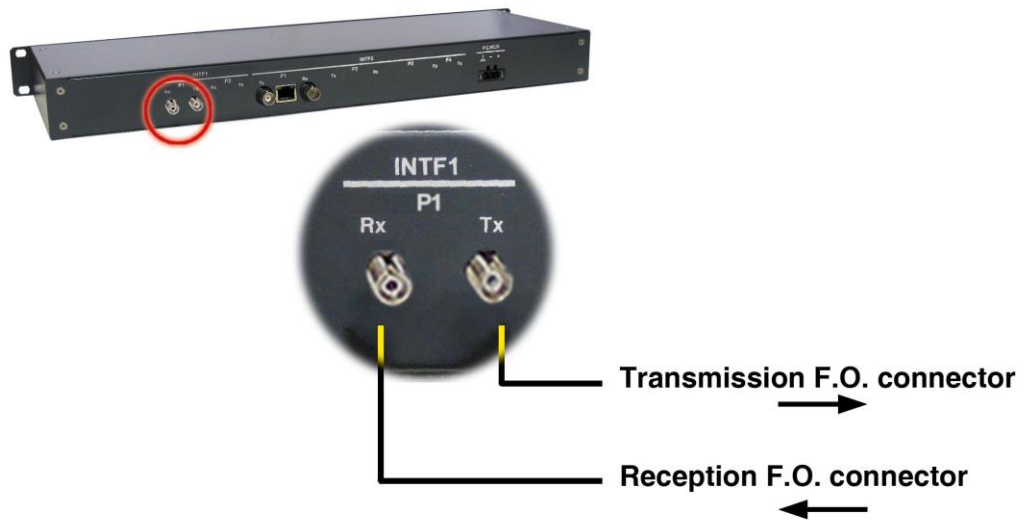
## 2.2.2 Single-mode optical interface (P1 position)

F2MUX.2# versions include, in the P1 position of INTF1, two FC female single-mode optical connectors, the use of which is indicated in FIGURE 6.

The operating mode is configured by internal settings (see FIGURE 13).

The use of the C37.94 standard with frame timeslots is set at the factory. The frame itself contains information about the number of timeslots used.

FIGURE 6 Single mode (FC female) optical fiber signals of INTF1 (P1 position)



## 2.3 INTF2 INTERFACE CONNECTION

### 2.3.1 G.703 interface at 2 Mbit/s (P1 position)

F2MUX.10 and F2MUX.20 versions include, in the P1 position of INTF2, the connectors that corresponds to the G.703 signals at 2 Mbit/s with codirectional clock. The use of the connectors is indicated in the following figures.

The use is configured by internal settings, see FIGURE 14, between: two unbalanced BNC connectors (75  $\Omega$ ), straps S9 and S15 in position 2-3, or a balanced RJ-45 connector (120  $\Omega$ ) for twisted pair, straps S9 and S15 in position 1-2.

The use of the two unbalanced BNC connectors (75  $\Omega$ ) is set at the factory.

FIGURE 7 G.703 signals at 2 Mbit/s, for BNC connectors, of INTF2 (P1 position)

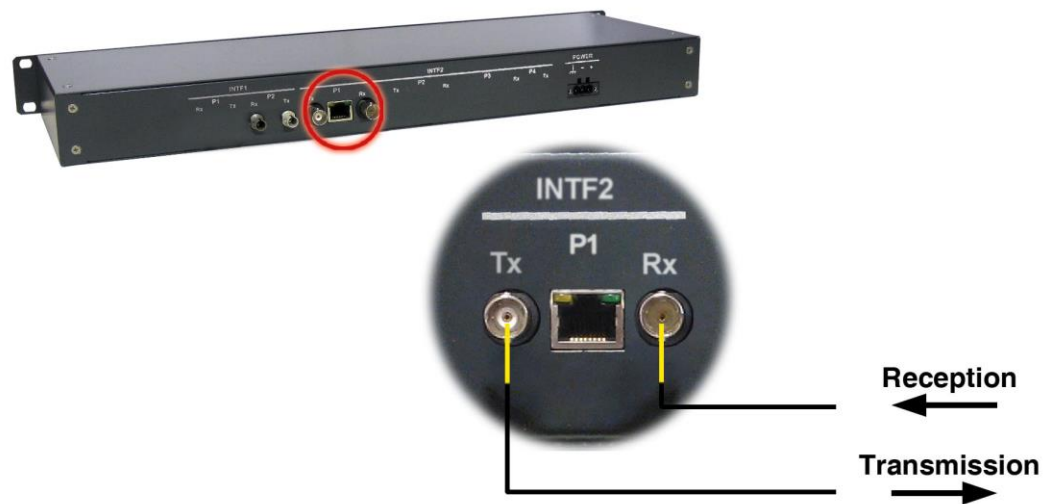
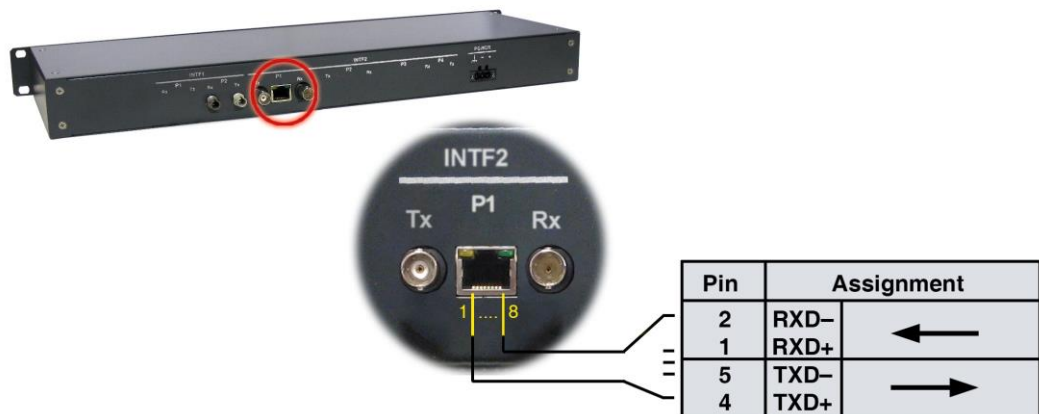


FIGURE 8 G.703 signals at 2 Mbit/s, for RJ-45 connector, of INTF2 (P1 position)

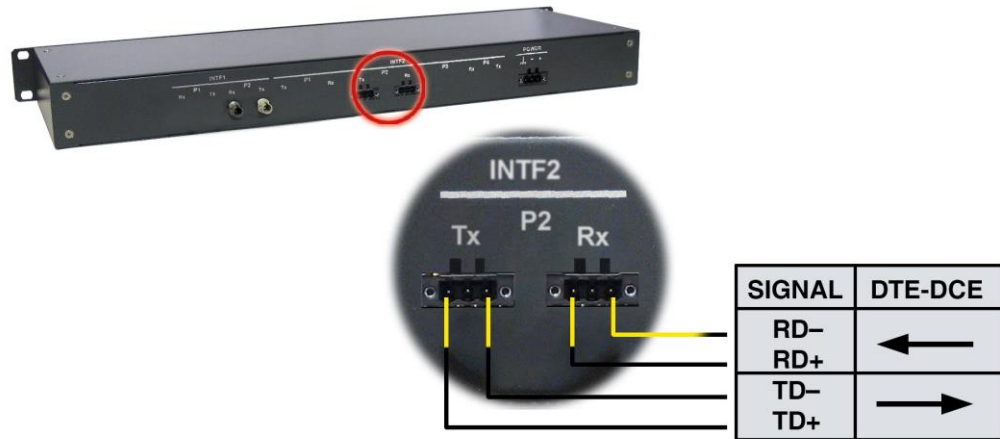


# F2MUX

## 2.3.2 G.703 interface at 64 kbit/s (P2 position)

F2MUX.11 and F2MUX.21 versions include, in the P2 position of INTF2, the connectors that corresponds to the G.703 signals at 64 kbit/s with codirectional clock. The use of the connectors is indicated in FIGURE 9.

FIGURE 9 G.703 signals at 64 kbit/s, for three-pin connectors, of INTF2 (P2 position)



## 2.3.3 C37.94 optical interface with SFP bay (P3 position)

F2MUX.12 and F2MUX.22 versions include, in the P3 position of INTF2, an SFP (Small Form Factor Pluggable) bay for optical signals according to C37.94 standard. The use of the SFP bay is shown in FIGURE 10.

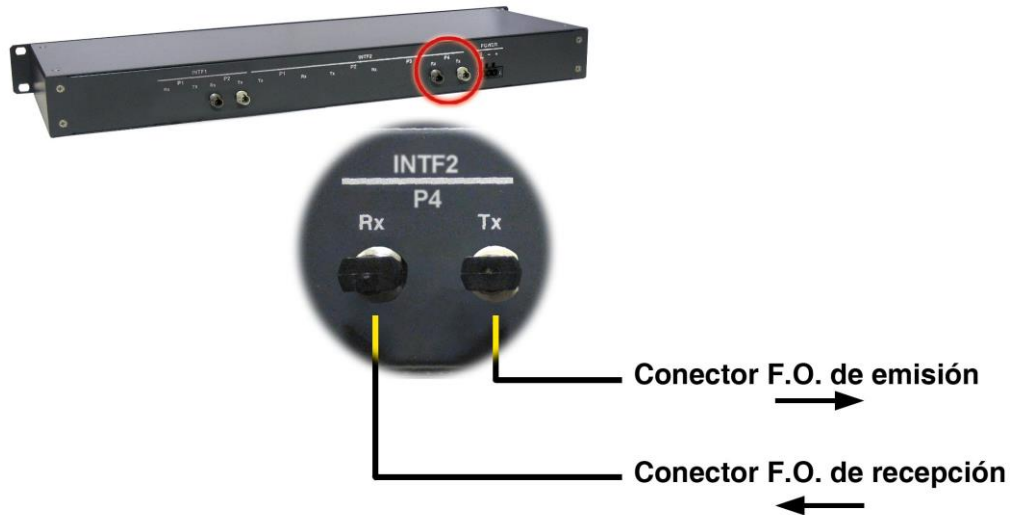
FIGURE 10 C37.94 signals, for SFP bay, of INTF2 (P3 position)



## 2.3.4 C37.94 multimode optical interface with ST connectors (P4 position)

F2MUX.13 and F2MUX.23 versions include, in the P4 position of INTF2, two ST female optical connectors for optical signals according to C37.94 standard. The use of the connector is shown in FIGURE 11.

FIGURE 11 C37.94 signals, for ST connectors, of INTF2 (P4 position)



## 3 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 12.

### 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 lights up 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 lights up when a loop is being carried out in the equipment or when a test is made and the result is correct.

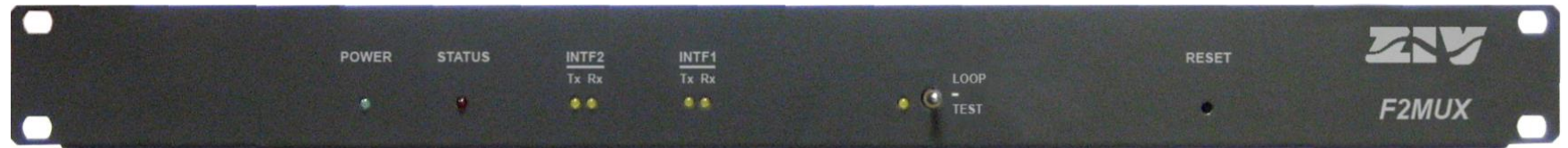
## **Equipment reset push-button**

RESET

This resets the equipment. To activate the push-button, use some type of tool of no more than 3 mm in diameter.

# F2MUX

FIGURE 12 Location and identification of the front-plate elements of the F2MUX device



**NOTE:** the location and identification of the front-plate elements is identical for all F2MUX versions

## 4 INTERNAL SETTINGS

The internal settings available in the interfaces are described in FIGURE 13 (INTF1 interface) and FIGURE 14 (INTF2 interface).

### 4.1 INTF1 INTERFACE

In the INTF1 interface, it is necessary to configure the operating mode.

The use of the C37.94 standard with frame timeslots is set at the factory. The frame itself contains information about the number of timeslots used.

The FM0 / CMI mode at 64 kbit/s can operate with any type of INTF2 interface. For G.703 at 2 Mbit/s occupies 1 slot of the frame of 2 Mbit/s of INTF2.

The FM0 / CMI mode at 128 kbit/s only operates with INTF2 G.703 at 2 Mbit/s. It occupies 2 slots of the frame of 2 Mbit/s of INTF2.

The FM0 / CMI mode at 512 kbit/s only operates with INTF2 G.703 at 2 Mbit/s. It occupies 8 slots of the frame of 2 Mbit/s of INTF2.

The FM0 / CMI mode at 2048 kbit/s only operates with unframed INTF2 G.703 at 2 Mbit/s.

### 4.2 INTF2 INTERFACE

In the INTF2 interface, for the G.703 at 2 Mbit/s interface, it is necessary to configure the type of connector to use between: two unbalanced BNC connectors (75  $\Omega$ ) or a balanced RJ-45 connector (120  $\Omega$ ) for twisted pair.

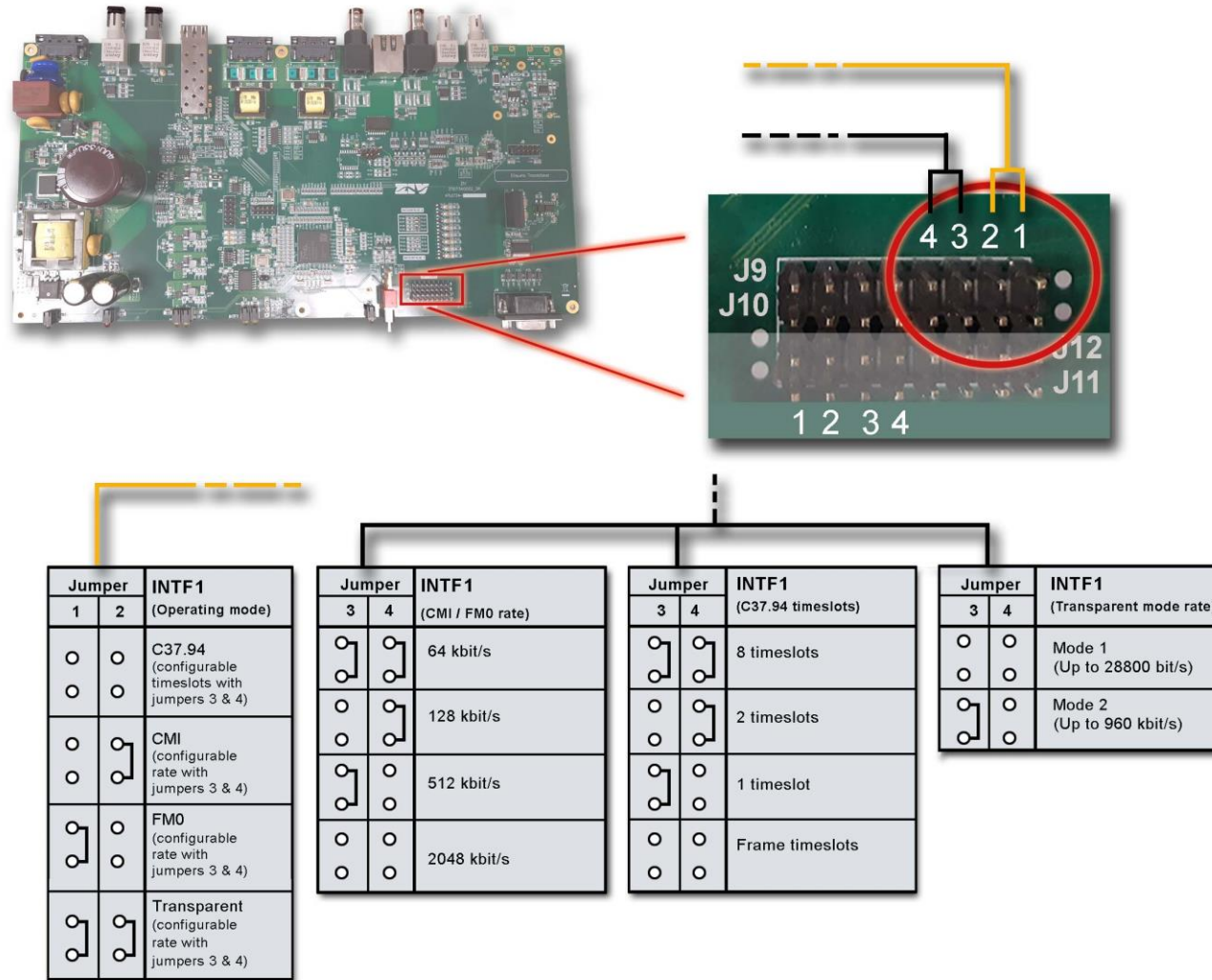
The use of the two unbalanced BNC connectors (75  $\Omega$ ) is set at the factory.

When the INTF2 interface operates in C37.94 mode, the number of channels used by the C37.94 standard will automatically adapt to the data rate selected on the INTF1 interface. Therefore, due to the inherent limitation of the C37.94 standard, transmission rates above 768 kbit/s cannot be used on the INTF1 interface.



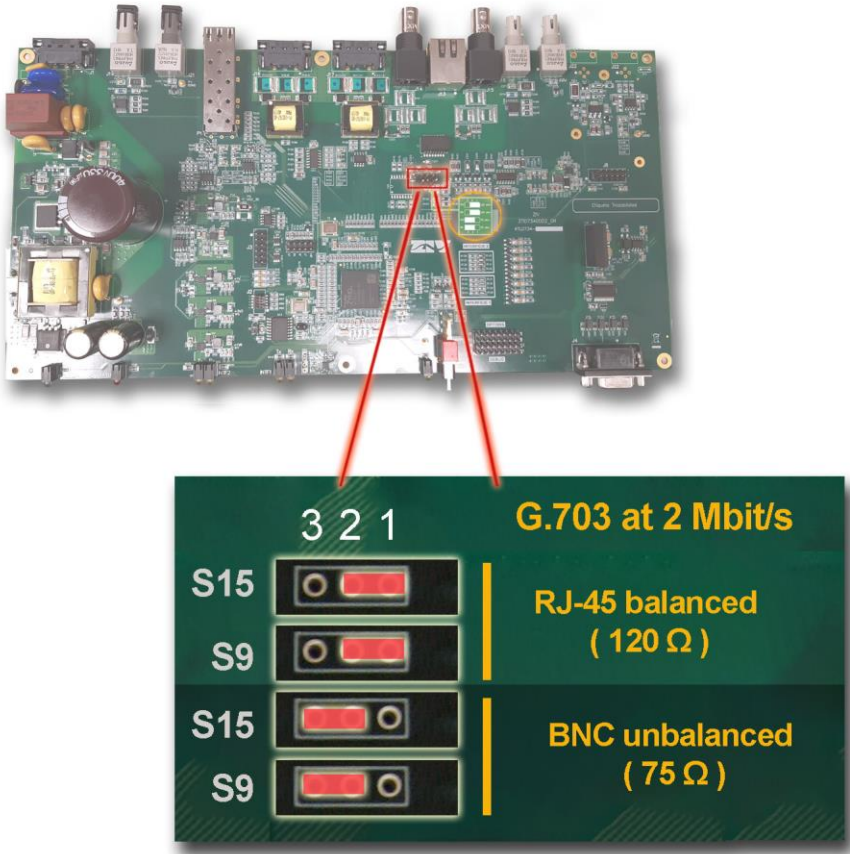
# F2MUX

FIGURE 13 Configuration elements of the INTF1 optical interface of the F2MUX device



# F2MUX

FIGURE 14 Configuration elements of the INTF2 electrical interface (G.703 at 2 Mbit/s) of the F2MUX device



## 5 TEST DEVICES

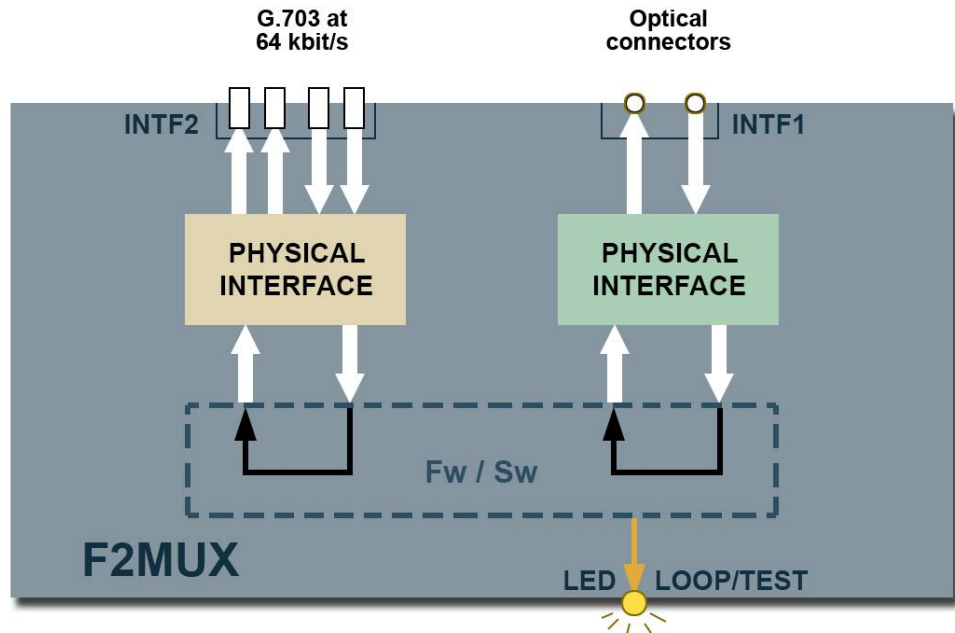
### 5.1 INTF2 INTERFACE LOOP

By putting the front-plate switch in LOOP position, a loop is generated. As the example in FIGURE 15 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.#1 version.

The loop 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 15 Loop example in INTF2 interface



## 5.2 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 16.

Once the previous connections have been made, the test is generated by putting the front-plate switch in 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 of the comparison is ok, the LED on the front plate near the loop/test switch lights up in amber. If not, it remains off.

FIGURE 16 Test example in INTF1 and INTF2 interfaces

