

# Televes®



T.OX SERIES

Refs. 233306, 233311  
233411, 234305  
234311, 233501  
233601

EN Optical Fiber Transmitter and Receiver  
with return path channel

User manual

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# Optical Fiber Transmitter and Receiver

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## Safety instructions:

### Caution Statements

- **Product inspection** - Inspect the equipment for shipping damage. Should any damage be discovered, immediately file a claim with the carrier.
- **Important Safety Instructions** - To ensure proper installation and operation, take a moment to read this guide before proceeding with the installation. If you have any questions or comments about the T.OX Series Optical Fiber Transmitters and Receivers please contact your dealer.

**WARNING:** TO PREVENT FIRE OR ELECTRICAL SHOCK DO NOT EXPOSE TO RAIN OR MOISTURE.



**CAUTION:** TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT REMOVE COVER. NO USER-SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL.

	A product and cart combination should be moved with care. Quick stops, excessive force and uneven surfaces may cause the product and cart combination to overturn.
	The lightning flash with arrow head symbol, within an equilateral triangle, is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.
	The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the product.

**WARNING:** TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS PRODUCT TO RAIN OR MOISTURE. DO NOT OPEN THE CABINET, REFER SERVICING TO QUALIFIED PERSONNEL ONLY.

**CAUTION:** TO PREVENT ELECTRIC SHOCK, DO NOT USE THIS (POLARIZED) PLUG WITH AN EXTENSION CORD RECEPTACLE OR OTHER OUTLET UNLESS THE BLADES CAN BE FULLY INSERTED TO PREVENT BLADE EXPOSURE.

### Important Safety Instructions

- 1. Read and Follow All Instructions** - All the safety and operating instructions should be read prior to and followed while operating this product.
- 2. Retain Instructions** - The safety and operating instructions should be retained for future reference.

**3. Heed Warnings** - All warnings on the product and in the operating instructions should be adhered to

**4. Cleaning** - Disconnect this product from any electrical source before cleaning. Use a damp cloth; do not use liquid or aerosol cleaners.

**5. Attachments** - Do not use attachments that are not recommended by the product manufacturer as they may cause hazards.

**6. Water and Moisture** - Do not use this product near any source of water.

**7. Mounting** - Do not place this product on an unstable cart, stand, tripod, bracket, or table. The product may fall, causing serious injury to persons or nearby objects, and serious damage to this product. Use only with a cart, stand, tripod, bracket, or table recommended by the manufacturer, or sold with the product. Any mounting of the product should follow the manufacturer's instructions, and should use a mounting accessory recommended by the manufacturer.

**8. Ventilation** - Slots and openings in the cabinet are provided for ventilation and to ensure reliable operation of the product. These openings should never be blocked or covered in any way. This product should not be placed in any case, cabinet, or rack unless proper ventilation is provided and the manufacturer's instructions have been adhered to.

**9. Power Sources** - This product should be operated only from the type of power source indicated on the marking label.

**10. Grounding or Polarization** - Do not bypass or defeat electrical plug polarization or grounding. Doing so will violate the warranty and may pose a risk of fire or electrocution.

**11. Wire Protection** - Ensure all connected wiring is

routed correctly to avoid damage including pinching, excessive bends, or compression.

**12. Electrical Supply, Grounding, and Surge Protection** – Ensure that all local or national electrical codes are followed. Seek the advice of a licensed electrician, professional engineer, or other licensed expert. See example wiring figure.

**13. Power Lines** – Always use caution and avoid operating this or any connected equipment near uninsulated power line or any other hazards.

**14. Object and Liquid Entry** - Never allow objects or liquid of any kind into this product through openings. Doing so could result in fire or electric shock.

**15. Servicing** – There are no user serviceable parts. Do not attempt to service this product or remove covers. Doing so may expose you to dangerous voltage or other hazards. Refer all servicing to qualified service personnel. Examples of damage requiring service include but are not limited to:

- Damage to power-supply wiring.
- If liquid has been spilled, or objects have fallen into the product.
- If the product has been exposed to rain or water.
- If the product does not operate normally by following the operating instructions. Adjust only those controls that are covered by the operating instructions as an improper adjustment of other controls may result in damage and will often require extensive work by a qualified technician to restore the product to its normal operation.
- If the product has been dropped or physically damaged.
- When the product exhibits a distinct change in performance.

**16. Replacement Parts** – Ensure that repairs are performed by qualified technicians and that only manufacturer supplied or authorized parts are used.

**17. Safety Check** – Upon completion of any service or repairs to this product, ensure safety checks to determine that the product is functioning per manufacturer specifications are performed.

**18. Heat** - The product should be situated away from heat sources such as radiators, heat registers, stoves, or other products (including amplifiers) that produce heat. Ensure that ambient temperature is maintained in the manufacturer specified operating range.

## Optical connection instructions:

- An SC/APC single mode fiber cable must be used. Remove the protective cover from the optical connector on the unit and the cap on the cable connector.
- Carefully align the guides on both connectors when plugging a cable to the device, then push the connector all the way in.
- Take special care to avoid damaging the unprotected ends of the connectors, as small scratches, impurities and/or particles of dirt, oil, grease, sweat, etc. may significantly affect the quality of the signal.
- To clean the ends of the connectors, gently rub with a lint-free lens cleaning cloth, dampened using additive-free isopropyl alcohol. Make sure the alcohol evaporates fully before connecting. Keep the connector covers and cable caps in a safe place in case they are needed in the future. Always fit the covers on the connectors of devices that are not

connected to cables to prevent the laser beam from damaging the eyes.

- Do not turn the transmitter on without a fiber optic cable connected to it.

## Warning.-

- This product emits an invisible laser beam. Avoid contact with laser radiation. The use of binoculars or magnifying glasses may increase damage caused to the eyes.



According to EN60825-1\_ 2007

- The use of the equipment in any other way than the specified in this manual may lead to exposure to harmful radiation.
- Do not use the equipment in any way that does not comply with the operating instructions or in any conditions that exceed the stipulated environmental specifications.
- Never point the laser beam at people or animals.

## 1. Technical specifications

Optical transmitters				233306	233311	233411	234305	234311
RF Input/Output	Frequency range	Forward channel	MHz	54 - 2150				
		Return channel		----	----	5 - 42	----	----
	Maximum input level for CSO & CTB $\geq 60$ dB <sup>(1)</sup>	54 - 870 MHz	dBmV	31	27	27	25	27
		950-2150 MHz		20				
	Input level regulation margin (in 2 dB steps)		dB	0-18				
	Output level regulation margin (in 2 dB steps)		dB	----	----	0-18	----	----
	Return path maximum RF output level		dBmV	----	----	52 <sup>(2)</sup>	----	----
	Equivalent input noise EIN	850 MHz	dBm/Hz	-150				
		2000 MHz		- 146				
	Flatness		dB	$\pm 1.5$				
	Return losses		dB	$\geq 10$				
Impedance		ohm	75					
Test port attenuation (typical)		dB	16					
Optical output (forward channel)	Laser		type	MQW-DFB				
	Wavelength		nm	1310 $\pm$ 20			1550 $\pm$ 20	
	Output optical power		mW/dBm	4 / 6	10 / 10	10 / 10	2.5 / 4	10 / 10
Optical input (return channel)	Optical device		type	----	----	InGaAs Pin Photodiode	----	----
	Wavelength		nm	----	----	1200 -1600	----	----
	Detection bandwidth		MHz	----	----	1 - 3000	----	----
	Max. Optical power received		mW/dBm	----	----	2 / 3	----	----
General	Powering/Consumption	12 Vdc	mA	210	270	330	265	325
		24 Vdc		104	140	170	140	160
	RF connectors		type	female F				
	Optical connectors			SC/APC				
	Operating temperature		F°	+23 ... +113				
	Weight		lbs	1.87	1.87	1.98	1.87	1.87
Dimensions		inches	1.96 x 8.54 x 6.88					

(1) Input: 41 TV CH CENELEC and 1 complete satellite transponder. The input attenuator in 0dB position.

(2) According to DIN45004B.

Optical receivers			233501	233601	
RF Input/Output	Frequency range	Forward channel	MHz	54 - 2150	
		Return channel		----	5 - 42
	Maximum Output Level for CSO and CTB $\geq 60$ dB <sup>(1)</sup>	54 - 870 MHz	dBmV	33	
		950-2150 MHz		30	
	Output level regulation margin (in 2 dB steps)		dB	0 - 18	
	Return path maximum input level <sup>(2)</sup>		dBmV	----	35
	Return path equivalent input noise, measured at 30 MHz and the transmitter output connected directly to the receiver		dBm/Hz	----	-152.5
	Flatness		dB	$\pm 1.5$	
	Return losses		dB	$\geq 11$	
Impedance		ohm	75		
Optical input (forward channel)	Optical device		type	InGaAs Pin Photodiode	
	Wavelength		nm	1200 -1600	
	Detection bandwidth		MHz	1 - 3000	
	Maximum Optical power received		mW/dBm	4 / 6	
Optical output (return channel)	Laser		type	----	DFB
	Wavelength		nm	----	1310 $\pm$ 20
	Maximum output power		mW/dBm	----	4 / 6
General	Powering/Consumption	12 Vdc	mA	300	355
		24 Vdc		155	175
	RF connectors		type	female F	
	Optical connectors			SC/APC	
	Operating temperature		F $^{\circ}$	+23 ... +113	
	Weight		lbs	1.87	1.98
Dimensions		inches	1.96 x 8.54 x 6.88		

(1) Output: 42 TV CH CENELEC and 1 complete satellite transponder. The output attenuator in 0dB position.

(2) According to DIN45004B.

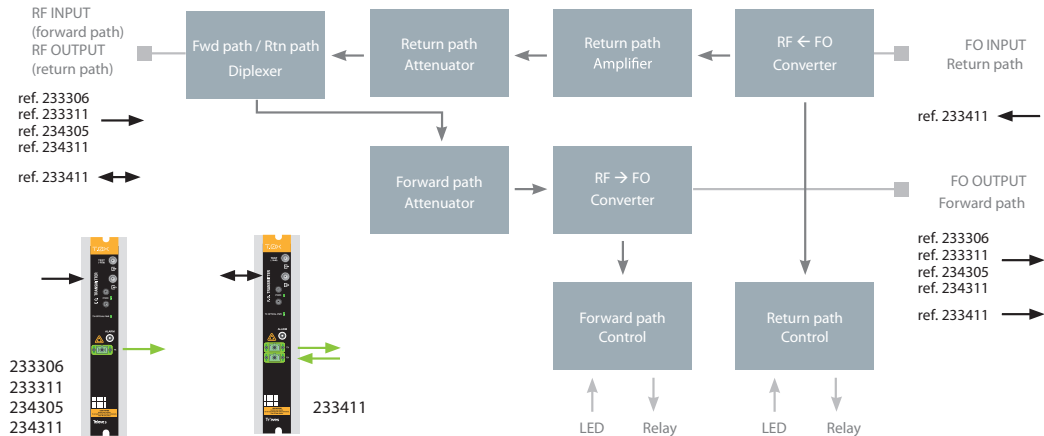
## 1.5. Amplifier technical specifications

Amplifier 5575	Frequency range	MHz	46 ... 862	Connector	type	"F"
	Gain	dB	44 ± 2.5	Powering	V <sub>===</sub>	24
	Regulation margin	dB	20	Consumption at 24 V <sub>===</sub> :	mA	450
	Output level (at 60 dBc):	dBmV	45 (42 CH CENELEC)	Test port	dB	-30

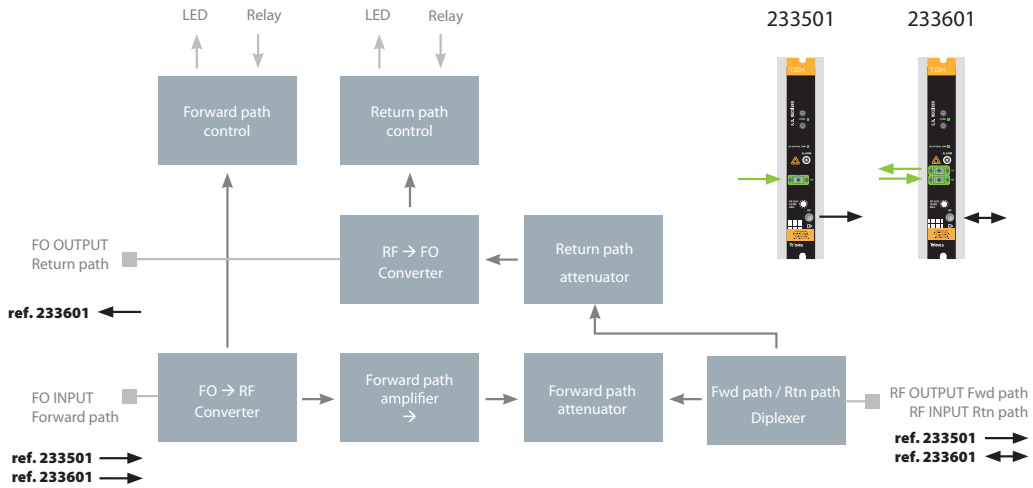
## 1.6. Power Supply Unit technical specifications

Power Supply Unit 563901	Mains voltage	V~ / Hz	108 - 132 / 50 - 60	Total max. current (output1 + output2):	A	5 (24V <sub>===</sub> )
	Output voltage	V <sub>===</sub>	24	Max. current per output	A	4 (24V <sub>===</sub> )

## 1.7. Block diagram







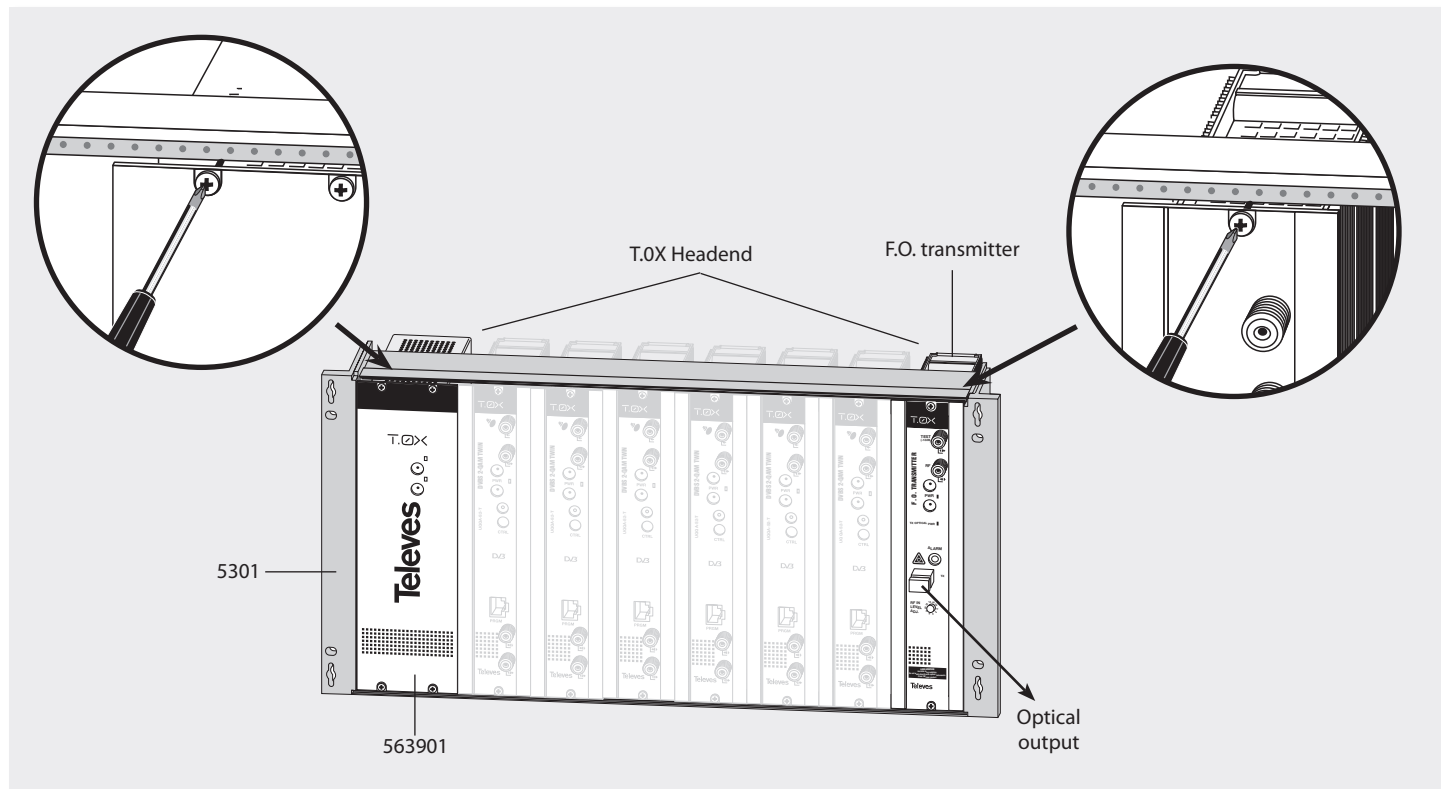
## 2. Ordering information

When ordering, please, specify reference number as per table below.

Fiber Optics		SMATV	
233306	T.0X Optical Transmitter (1310nm/6dBm)	563701	T.0X 8PSK-QAM TWIN Transmodulator
233311	T.0X Optical Transmitter (1310nm/10dBm)	555902	T.0X CDC Headend Manager IP
233411	T.0X Optical Transmitter (1310nm/10dBm) / Return path receiver		
233501	T.0X Optical Receiver		
233601	T.0X Optical Receiver / Return Path Transmitter (1310nm/6dBm)		
234305	T.0X Optical Transmitter (1550nm/4dBm)		
234311	T.0X Optical Transmitter (1550nm/10dBm)		
2337	T.0X 2-way Optical Splitter		
2339	T.0X 4-way Optical Splitter		
234401	T.0X 8-way Optical Splitter		
234501	T.0X 16-way Optical Splitter		
234601	T.0X 32-way Optical Splitter		
563901	Power Supply Unit (110 Vac UL)		
		Accessories	
		7234	Programming Unit
		5301	19in Chassis (7 modules+1PSU)
		422603	Control BUS lead T.0X L=1 m
		140057	Power Bus Jumper (15 inches)

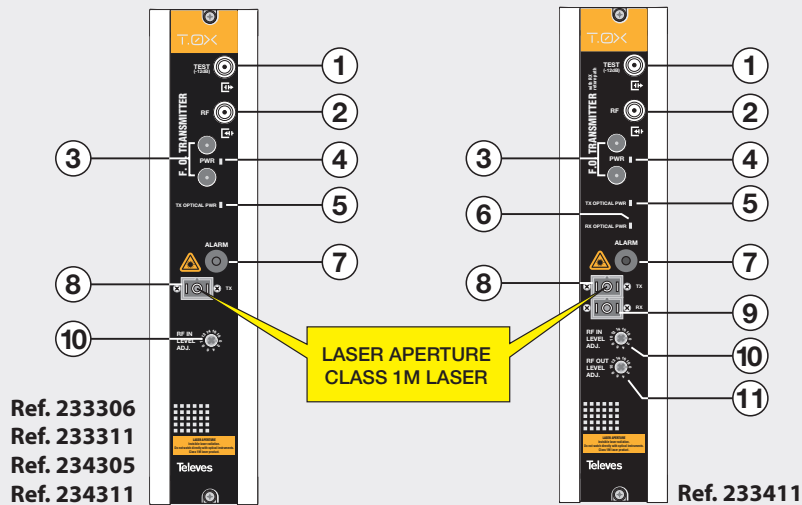
## 3. Mounting

### 3.1. 19" rack mounting



## 4. Product description

### 4.1. Optical transmitter



1. Test output (-16dB)
2. RF Input  
54-2150 MHz (forward path)  
5 - 42 MHz (return path)
3. Power
4. Power LED
5. Forward path power LED
6. Return path power LED
7. Alarm connector
8. Forward path optical output
9. Return path optical input
10. Forward path RF attenuator
11. Return path RF attenuator

Ground  +12 ... 24V

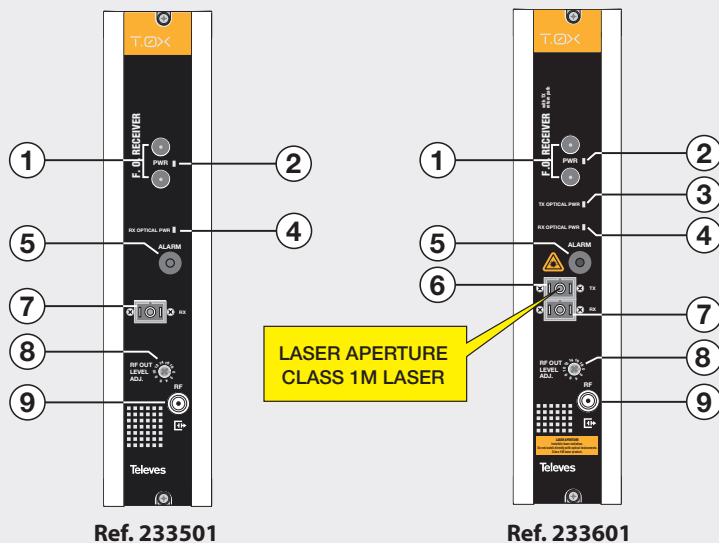


#### CAUTION:

The use of the device outside of the specifications provided in this user manual can lead to hazardous radiation exposure.

LED ON	Indicates
TX Optical PW	Forward path optical power delivered between 9.5 to 10.5dBm
RX Optical PW	Return path optical level received between -7 to 3dBm

## 4.2. Optical receiver



1. Power
2. Power LED
3. Forward path power LED
4. Return path power LED
5. Alarm connector
6. Return path optical output
7. Forward path optical input
8. Return path attenuator
9. RF output
  - 54 - 2150 MHz (forward path)
  - 5 - 42 MHz (return path)



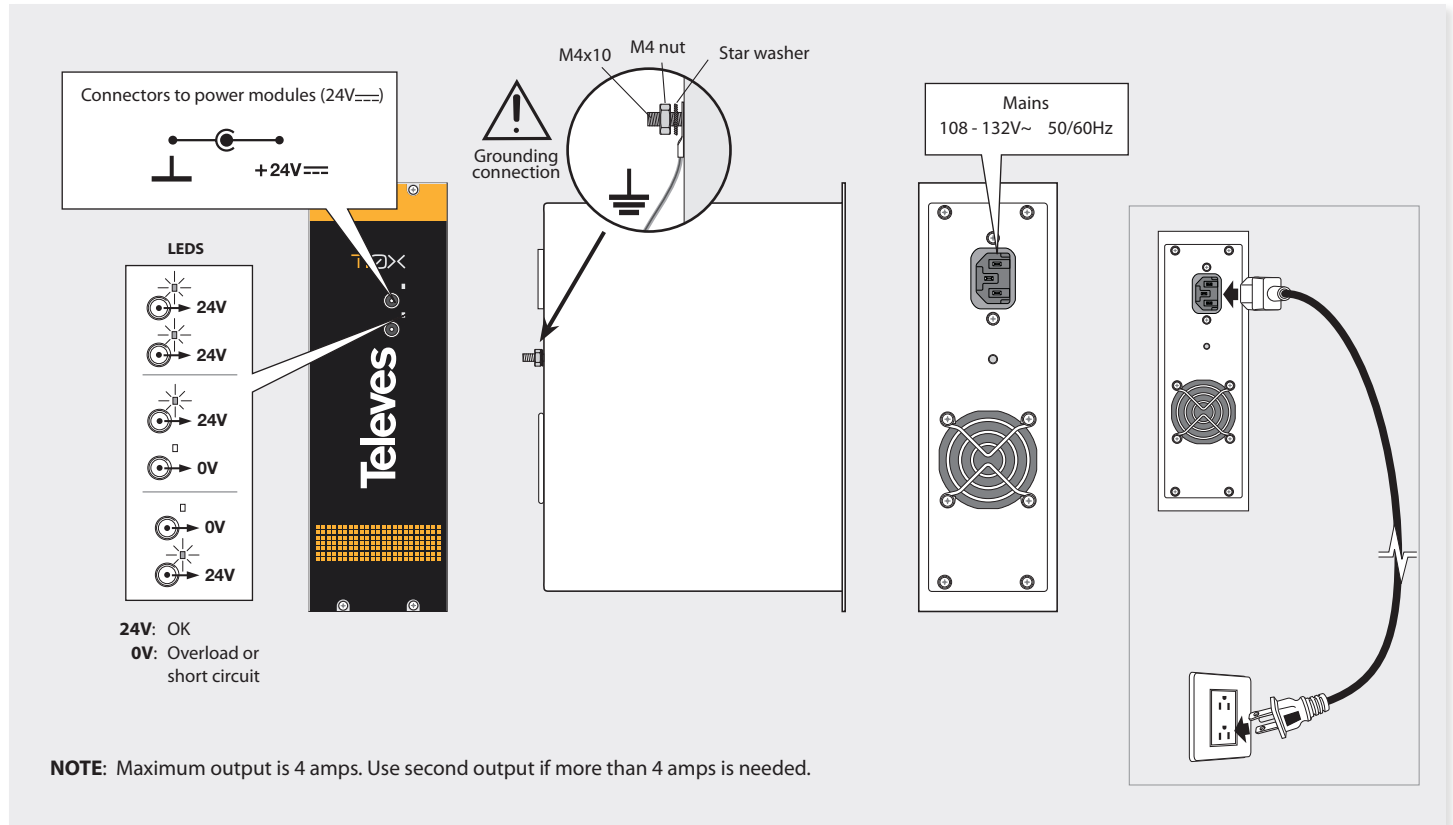
**CAUTION:**

The use of the device outside of the specifications provided in this user manual can lead to hazardous radiation exposure.

LED ON	Indicates
RX Optical PW	Forward path optical power received between -10 to 5dBm.
TX Optical PW *	Return path optical power delivered between 5.5 to 6.5dBm.

\* other options under request

### 4.3. Power Supply Unit



## 5. Example applications

These technical specifications are maximums and should be complied with appropriately.

Use the calculations in the table shown below and the following formulas to calculate the RF input level:

$$EIN = EINn + 10 \times \log(BW) \quad [1]$$

$$C/N = Vin - EIN \quad [2]$$

where:

- **EIN** stands for equivalent input noise. This is the RF noise that would have to be present at the input of the transmitter in an ideal system that did not add noise, in order to obtain the same output level at the output of the receiver in the real system (which always add noise).
- **EINn** is the EIN for a bandwidth of 1Hz.
- **BW** is the bandwidth of the RF signal.
- **Vin** is the RF input level, and is given in dBm.

Examples:

Opt. Link attenuation (dB)	Gain at 870 MHz (dB)	EINn (dBm/Hz)	Gain at 1.5 GHz (dB)	EINn (dBm/Hz)	Gain at 2.15 GHz (dB)	EINn (dBm/Hz)
0	16.2	-150.4	17.0	-150.4	17.4	-146.4
2	12.3	-148.4	13.13	-148.9	13.4	-145.7
4	8.7	-146.6	9.4	-147.0	9.7	-144.9
4.5	7.7	-145.85	8.4	-146.3	8.7	-144.6
5	6.6	-144.9	7.4	-145.6	7.7	-144.2
5.5	5.6	-144.1	6.4	-144.8	6.7	-143.7
6	4.6	-143.3	5.4	-144.1	5.7	-143.2
6.5	3.6	-142.5	4.4	-143.2	4.7	-142.7
7	2.6	-141.6	3.4	-142.4	3.7	-142.1
7.5	1.6	-140.8	2.4	-141.6	2.7	-141.5
8	0.6	-139.9	1.4	-140.7	1.7	-140.8
8.5	-0.3	-139.1	0.4	-139.8	0.7	-140.1
9	-1.3	-138.2	-0.5	-139.1	-0.3	-139.4
9.5	-2.3	-137.25	-1.5	-138.1	-1.3	-138.7
10	-3.3	-136.35	-2.5	-137.2	-2.2	-138.0
10.5	-4.3	-135.4	-3.5	-136.3	-3.2	-137.2
11	-5.3	-134.5	-4.5	-135.5	-4.3	-136.3
11.5	-6.3	-133.5	-5.5	-134.47	-5.3	-135.5
12	-7.3	-132.55	-6.5	-133.5	-6.3	-134.6
12.5	-8.3	-131.6	-7.5	-132.57	-7.3	-133.7
13	-9.3	-130.6	-8.5	-131.6	-8.3	-132.8
13.5	-10.3	-129.7	-9.5	-130.65	-9.3	-131.9
14	-11.3	-128.7	-10.5	-129.67	-10.3	-131.0
14.5	-12.3	-127.7	-11.5	-128.7	-11.3	-130.1
15	-13.3	-126.7	-12.5	-127.7	-12.3	-129.2
15.5	-14.3	-125.8	-13.5	-126.7	-13.3	-128.2
16	-15.3	-124.8	-14.5	-125.7	-14.3	-127.3
16.5	-16.3	-123.8	-15.5	-124.8	-15.3	-126.3
17	-17.3	-122.8	-16.5	-123.8	-16.3	-125.4

EN

Measurements made using a 6.1dBm transmitter feeding 3 miles of fiber cable. An optical attenuator was used at the optical receiver's input.

**Example 1**

Calculate the C/N at the output of the optical receiver (C/N link), in the installation of the figure below:

This is a link where the optical signal is split between 4 fibers of 0.62 miles (1Km), using a splitter ref. 2339. The signal received at the other end is converted back to RF using of the optical receiver ref. 233501.

The transmitter input levels:

- 23 dBmV (-26 dBm 42CH CENELEC) **analog channels, off-air/CATV band.**

- 13 dBmV (-36 dBm) **digital channels, off-air/CATV+SAT.**

Analog terrestrial channel bandwidth: 5 MHz

Satellite digital transponder bandwidth: 27 MHz

On the other hand:

- 0.62 miles (1Km) optical fiber is equivalent to 0.4 dB of attenuation.
- The splitter features 6.8 dB loss.
- The 2 fiber optic connectors represent 0.8 dB (2 × 0.4).

Therefore, total losses of the optical fiber link are:

*FO losses+Optical splitter losses+Connectors losses*

This is:  $0.4 + 6.8 + 0.8 = 8$  dB

Now we use the formulas and data given in the table above.

For the off-air/CATV band, we consider the column of the *Gain at 807 MHz*. This column intersects with

the row of 8 dB of loss calculated for the optical fiber link in the value of 0.6 dB, which would correspond  $EIN_n = -139.9$  dB/Hz.

Apply the formula [1] and we obtain:

$$EIN_{TV} = -139.9 + 10 \times \log(5 \times 10^6) = -72.9 \text{ dBm}$$

Now apply the formula [2] to calculate the C/N, as

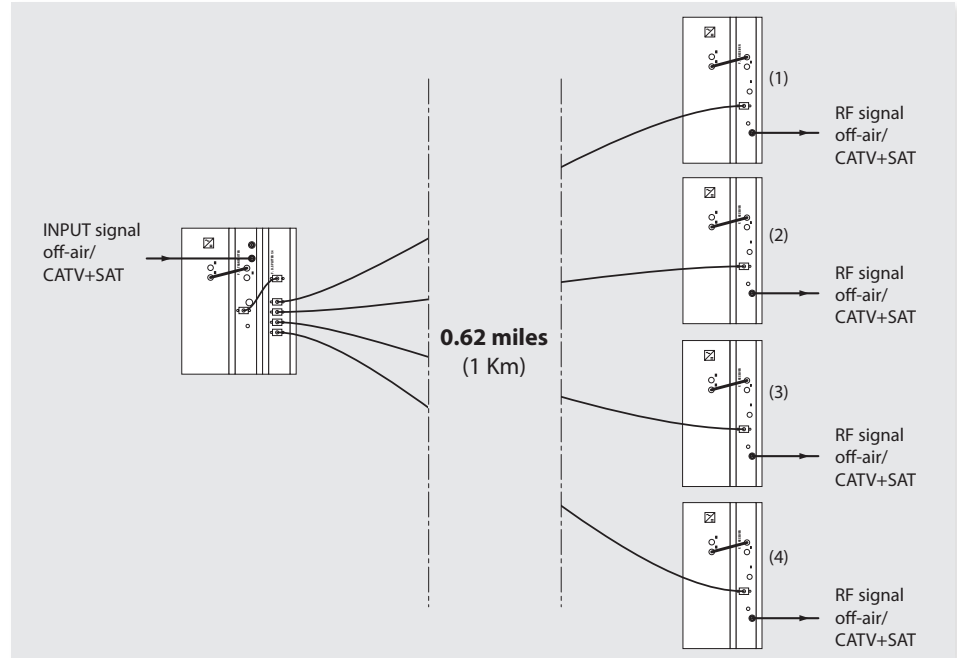
follows:

$$C/N_{TV} = V_{in} - EIN_{TV}$$

$$C/N_{TV} = -26 \text{ dBm} - (-72.9 \text{ dBm}) = -26 + 72.9$$

$$\text{Then, } C/N_{TV} = 46.9 \text{ dB}$$

In practice, combining satellite and off-air/CATV channels makes the off air/CATV C/N 1dB worse.





Now we do the calculation for digital satellite channels, following the same process above, but by looking at the column *Gain at 2.1 GHz* of the table (band in which are delivered digital channels) and the following results :

$$EIN_n = -140.8 \text{ dB/Hz}$$

$$EIN_{SAT} = -140.8 + 10 \times \log(27 \times 10^6) = -65.7 \text{ dBm}$$

As the input level is -36 dBm, C/N is:

$$C/N_{SAT} = -36 - (-65.7) = -36 + 65.7$$

$$C/N_{SAT} = 29.7 \text{ dB}$$

**Example 2**

Let's repeat the example above but applied to an installation with a 32 output optical splitter. The channels will be **digital only**.

Thus, the TV channels will be COFDM channels with a **C/N<sub>COFDM</sub> = 23 dB**.

SAT channels will be DVB-S2, with a **C/N<sub>DVBS2</sub> = 14 dB**.

The transmitter input level will be the same for TV and SAT: **19 dBmV** (-30dBm).

The bandwidth will be now:

For COFDM:  $BW = 8 \times 10^6 \text{ Hz}$  (8 MHz)

For SAT:  $BW = 27 \times 10^6 \text{ Hz}$  (27 MHz)

As in Example 1, the attenuations are:

- 0.62 miles (1Km) of fiber is 0.4 dB.
- The 32 output optical splitter represents about 16 dB

- The 2 fiber optic connectors represent 0.8 dB.
- Therefore, the total losses of the fiber optics are:

$$0.4 + 16 + 0.8 = 17.2 \text{ dB}$$

(let's take 17 dB for this case, maximum value shown in the table)

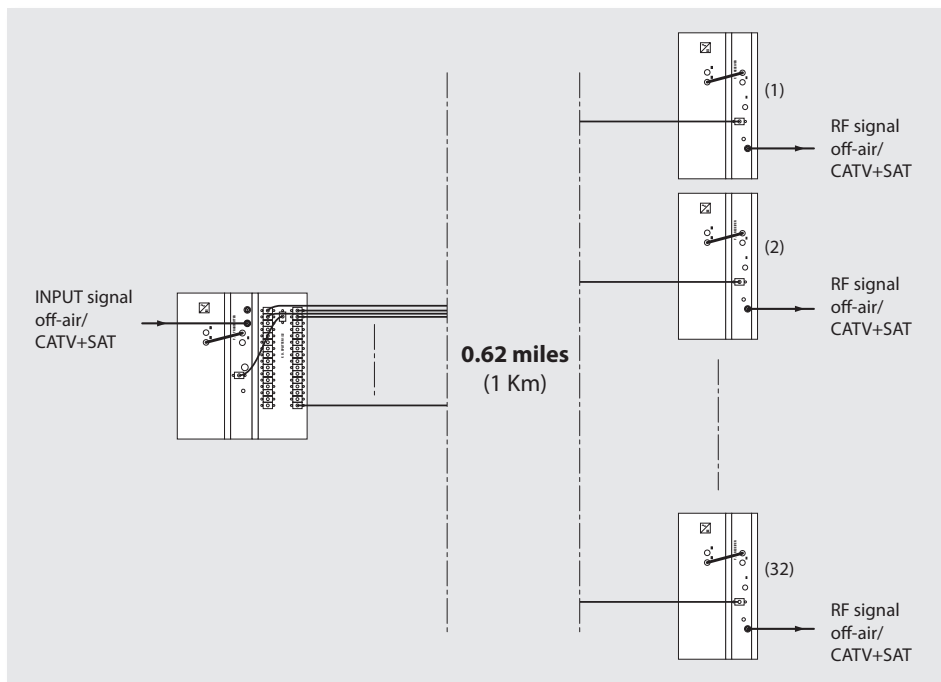
The table provides the following information:

For the off-air/CATV band, in the column *Gain at 807 MHz*

$$EIN_n \text{ (TV)} = -122.8 \text{ dBm/Hz}$$

$$G(807 \text{ MHz}) = -17.3 \text{ dB}$$

And for SAT band, look in the *Gain at 2.1 GHz* column.



$$EINn(SAT) = -125.4 \text{ dBm/Hz}$$

$$G(2.1 \text{ GHz}) = -16.3 \text{ dB}$$

Therefore, the RF signal level delivered by the receiver is:

$$V_{out\_rcvr} \text{ (dBmV)} = V_{in\_xmtt} \text{ (dBmV)} + G \text{ (dB)}$$

This is:

$$V_{out\_rcvr} \text{ TERR} \text{ (dBmV)} = 19 - 17.3 = 1.7 \text{ dBmV}$$

$$V_{out\_rcvr} \text{ SAT} \text{ (dBmV)} = 19 - 16.3 = 2.7 \text{ dBmV}$$

Applying the formula [1]:

$$EIN_{TV} = EINn(TV) + 10 \times \log(8 \times 10^6) \text{ [dBm]}$$

$$EIN_{TV} = -122.8 + 69$$

$$\mathbf{EIN_{TV} = -53.8 \text{ dBm}}$$

And by the formula [2] is obtained:

$$\mathbf{C/N_{TV} = -30 \text{ dBm} - (-53.8 \text{ dBm}) = 23.8 \text{ dB en TV}}$$

Likewise, we calculate the C/N for SAT channels, resulting in:

$$\mathbf{EIN_{SAT} = -51.1 \text{ dBm}}$$

$$\mathbf{C/N_{SAT} = -30 - (-51.1) = 21.1 \text{ dB en SAT}}$$

If the resulting C/N is close to the threshold it is advisable to increase the input levels to the transmitter by one or two dB to ensure enough margin before distortion.

## RETURN CHANNEL

For the return channel transmitter, the table of attenuations, link gain and equivalent noise is:

Link attenuation (dB)	Gain at 30 MHz (dB)	EINn (dBm/Hz)
0	23	-152.5
3	16.6	-149.5
4	14.6	-147.6
5	12.7	-145.7
6	10.7	-143.9
7	8.7	-141.9
8	6.7	-140
9	4.7	-138.1
10	2.6	-136
11	0.4	-133.4
12	-1.5	-132
13	-3.5	-130.5
14	-5.5	-128.5

*Measurements made with a transmitter that delivers 2.9dBm followed by an optical attenuator connected between the transmitter and the optical receiver.*

Use the formulas 1 and 2 for making calculations. The calculation process is the same as in the case of the forward channel.

## 6. Tables for attenuation and gain installations calculation

### Refs. 233306 (TRANSMISSION)

Opt. Link attenuation (dB)	Popt IN in RX (dBm)	Gain at 870 MHz (dB)	EINn (dBm/Hz)	Gain at 1.5 GHz (dB)	EINn (dBm/Hz)	Gain at 2.15 GHz (dB)	EINn (dBm/Hz)
0	6	16,2	-150,4	17	-150,4	17,4	-146,4
2	4	12,3	-148,4	13,13	-148,9	13,4	-145,7
4	2	8,7	-146,6	9,4	-147	9,7	-144,9
4,5	1,5	7,7	-145,85	8,4	-146,3	8,7	-144,6
5	1	6,6	-144,9	7,4	-145,6	7,7	-144,2
5,5	0,5	5,6	-144,1	6,4	-144,8	6,7	-143,7
6	0	4,6	-143,3	5,4	-144,1	5,7	-143,2
6,5	-0,5	3,6	-142,5	4,4	-143,2	4,7	-142,7
7	-1	2,6	-141,6	3,4	-142,4	3,7	-142,1
7,5	-1,5	1,6	-140,8	2,4	-141,6	2,7	-141,5
8	-2	0,6	-139,9	1,4	-140,7	1,7	-140,8
8,5	-2,5	-0,3	-139,1	0,4	-139,8	0,7	-140,1
9	-3	-1,3	-138,2	-0,5	-139,1	-0,3	-139,4
9,5	-3,5	-2,3	-137,25	-1,5	-138,1	-1,3	-138,7
10	-4	-3,3	-136,35	-2,5	-137,2	-2,2	-138
10,5	-4,5	-4,3	-135,4	-3,5	-136,3	-3,2	-137,2
11	-5	-5,3	-134,5	-4,5	-135,5	-4,3	-136,3
11,5	-5,5	-6,3	-133,5	-5,5	-134,47	-5,3	-135,5
12	-6	-7,3	-132,55	-6,5	-133,5	-6,3	-134,6
12,5	-6,5	-8,3	-131,6	-7,5	-132,57	-7,3	-133,7
13	-7	-9,3	-130,6	-8,5	-131,6	-8,3	-132,8
13,5	-7,5	-10,3	-129,7	-9,5	-130,65	-9,3	-131,9
14	-8	-11,3	-128,7	-10,5	-129,67	-10,3	-131
14,5	-8,5	-12,3	-127,7	-11,5	-128,7	-11,3	-130,1
15	-9	-13,3	-126,7	-12,5	-127,7	-12,3	-129,2
15,5	-9,5	-14,3	-125,8	-13,5	-126,7	-13,3	-128,2
16	-10	-15,3	-124,8	-14,5	-125,7	-14,3	-127,3
16,5	-10,5	-16,3	-123,8	-15,5	-124,8	-15,3	-126,3
17	-11	-17,3	-122,8	-16,5	-123,8	-16,3	-125,4

Measurements made using a 6.1 dBm transmitter feeding 3 miles of fiber cable. An optical attenuator was used at the optical receiver's input.

**Refs. 233311, 233411 (TRANSMISSION)**

Opt. Link attenuation (dB)	Popt IN in RX (dBm)	Gain at 870 MHz (dB)	EINn (dBm/Hz)	Gain at 1.5 GHz (dB)	EINn (dBm/Hz)	Gain at 2.15 GHz (dB)	EINn (dBm/Hz)
6	4	7.5	-144.8	8.1	-144.1	6.7	-142.7
6.5	3.5	6.5	-144.2	7.1	-143.6	5.7	-142.4
7	3	5.5	-143.5	6.1	-143.1	4.7	-142
7.5	2.5	4.5	-142.6	5.1	-142.6	3.7	-141.7
8	2	3.5	-142	4.1	-142.1	2.7	-141.2
8.5	1.5	2.5	-141.3	3.1	-141.4	1.7	-141
9	1	1.5	-140.5	2.1	-140.8	0.7	-140.5
9.5	0.5	0.5	-139.8	1.1	-140.2	-0.3	-140
10	0	-0.5	-139	0.1	-139.5	-1.3	-139.2
10.5	-0.5	-1.5	-138.2	-0.9	-138.7	-2.3	-138.9
11	-1	-2.5	-137.4	-1.9	-138.1	-3.3	-138.3
11.5	-1.5	-3.5	-136.5	-2.9	-137.3	-4.3	-137.7
12	-2	-4.5	-135.8	-3.9	-136.6	-5.3	-137
12.5	-2.5	-5.5	-134.8	-4.9	-135.5	-6.3	-136.2
13	-3	-6.5	-133.9	-5.9	-134.7	-7.3	-135.4
13.5	-3.5	-7.5	-132.9	-6.9	-133.6	-8.3	-134.5
14	-4	-8.5	-132.1	-7.9	-132.8	-9.3	-133.7
14.4	-4.5	-9.5	-131.2	-8.9	-132	-10.3	-133
15	-5	-10.5	-130.2	-9.9	-131.1	-11.3	-132.2
15.5	-5.5	-11.5	-129.4	-10.9	-130.1	-12.2	-131.5
16	-6	-12.5	-128.4	-11.9	-129.3	-13.3	-130.6
16.5	-6.5	-13.5	-127.5	-12.9	-128.4	-14.3	-130
17	-7	-14.5	-126.6	-13.9	-127.6	-15.3	-129
17.5	-7.5	-15.5	-125.7	-14.9	-126.6	-16.3	-128.1
18	-8	-16.5	-124.7	-15.9	-125.6	-17.3	-127.3
18.5	-8.5	-17.5	-123.6	-16.9	-124.7	-18.3	-126.2
19	-9	-18.5	-122.6	-17.9	-123.7	-19.3	-125.3

Measurements made using a 10dBm transmitter feeding 3 miles of fiber cable. An optical attenuator was used at the optical receiver's input.

**Ref. 233601 (RETURN)**

Link attenuat. (dB)	Gain at 30 MHz (dB)	EINn (dBm/Hz)
0	23	-152.5
3	16.6	-149.5
4	14.6	-147.6
5	12.7	-145.7
6	10.7	-143.9
7	8.7	-141.9
8	6.7	-140
9	4.7	-138.1
10	2.6	-136
11	0.4	-133.4
12	-1.5	-132
13	-3.5	-130.5
14	-5.5	-128.5

Measurements made with a transmitter that delivers 2.9dBm followed by an optical attenuator connected between the transmitter and the optical receiver.

## Ref. 234305 (TRANSMISSION)

Opt. Link attenuation (dB)	Popt IN in RX (dBm)	Gain at 870 MHz (dB)	EINn (dBm/Hz)	Gain at 1.5 GHz (dB)	EINn (dBm/Hz)	Gain at 2.15 GHz (dB)	EINn (dBm/Hz)
1,7	2,5	14,3	-149,7	15	-148,8	14	-146,6
2,2	2	13,4	-149,3	14	-148,5	13,1	-146,5
2,7	1,5	12,4	-148,8	13	-148,2	12,1	-146,3
3,2	1	11,4	-148,4	12	-147,7	11,1	-146,1
3,7	0,5	10,4	-147,7	11	-147,3	10,2	-146
4,2	0	9,4	-147,1	10	-146,8	9,2	-145,7
4,7	-0,5	8,4	-146,5	9	-146,3	8,2	-145,5
5,2	-1	7,4	-145,8	8	-145,8	7,16	-145,2
5,7	-1,5	6,4	-145,1	7,1	-145,3	6,16	-144,8
6,2	-2	5,5	-144,5	6,1	-144,6	5,1	-144,4
6,7	-2,5	4,5	-143,7	5,1	-144	4,2	-144
7,2	-3	3,6	-143	4,2	-143,4	3,3	-143,6
7,7	-3,5	2,5	-142,1	3,2	-142,7	2,2	-143
8,2	-4	1,6	-141,3	2,2	-141,9	1,3	-142,5
8,7	-4,5	0,5	-140,5	1,1	-141,1	0,2	-141,9
9,2	-5	-0,5	-139,6	0,1	-140	-0,8	-141,4
9,7	-5,5	-1,4	-138,8	-0,75	-139,6	-1,7	-140,7
10,2	-6	-2,4	-137,8	-1,7	-138,7	-2,7	-140
10,7	-6,5	-3,3	-137,1	-2,7	-137,8	-3,6	-139,4
11,2	-7	-4,3	-136,1	-3,7	-137	-4,7	-138,6
11,7	-7,5	-5,3	-135,1	-4,7	-136	-5,7	-137,8
12,2	-8	-6,4	-134,2	-5,8	-135	-6,7	-137
12,7	-8,5	-7,4	-133,2	-6,8	-134,1	-7,7	-136,2
13,2	-9	-8,4	-132,3	-7,7	-133,3	-8,7	-135,3
13,7	-9,5	-9,4	-131,3	-8,7	-132,3	-9,7	-134,5
14,2	-10	-10,4	-130,4	-9,7	-131,4	-10,7	-133,6
14,7	-10,5	-11,4	-129,4	-10,7	-130,4	-11,7	-132,7
15,2	-11	-12,4	-128,4	-11,7	-129,5	-12,7	-131,8
15,7	-11,5	-13,4	-127,5	-12,7	-128,5	-13,7	-130,9
16,2	-12	-14,3	-126,6	-13,7	-127,6	-14,6	-130,1

Measurements made using a 4dBm transmitter feeding 3 miles of fiber cable. An optical attenuator was used at the optical receiver's input.

**Ref. 234311 (TRANSMISSION)**

Opt. Link attenuation (dB)	Popt IN in RX (dBm)	Gain at 870 MHz (dB)	EINn (dBm/Hz)	Gain at 1.5 GHz (dB)	EINn (dBm/Hz)	Gain at 2.15 GHz (dB)	EINn (dBm/Hz)
6	4	6	-142,9	6,2	-142,4	5	-141,2
6,5	3,5	5	-142,3	5,2	-141,9	4	-140,5
7	3	4	-141,5	4,2	-141,4	3	-140,2
7,5	2,5	3	-140,9	3,2	-141	2	-139,7
8	2	2	-140,1	2,2	-140,2	1	-139
8,5	1,5	1	-139,4	1,2	-139,6	0	-138,3
9	1	0	-138,6	0,2	-138,8	-1	-137,5
9,5	0,5	-1	-137,9	-0,8	-138	-2	-136,7
10	0	-2	-137	-1,8	-137,2	-3	-136
10,5	-0,5	-3	-136,2	-2,8	-136,4	-4	-135,2
11	-1	-4	-135,4	-3,8	-135,5	-5	-134,3
11,5	-1,5	-5	-134,5	-4,8	-134,6	-6	-133,5
12	-2	-6	-133,7	-5,8	-133,9	-7	-132,6
12,5	-2,5	-7	-132,8	-6,8	-133	-8	-131,7
13	-3	-8	-131,9	-7,8	-132,2	-9	-130,8
13,5	-3,5	-9	-131	-8,8	-131,3	-10	-130
14	-4	-10	-130,1	-9,8	-130,3	-11	-129,1
14,4	-4,5	-11	-129,2	-10,8	-129,4	-12	-128,2
15	-5	-12	-128,3	-11,8	-128,4	-13	-127,3
15,5	-5,5	-13	-127,4	-12,8	-127,5	-14	-126,4
16	-6	-14	-126,5	-13,8	-126,7	-15	-125,5
16,5	-6,5	-15	-125,5	-14,8	-125,7	-16	-124,6
17	-7	-16	-124,6	-15,8	-124,8	-17	-123,6
17,5	-7,5	-17	-123,7	-16,8	-123,8	-18	-122,6
18	-8	-18	-122,8	-17,8	-122,8	-19	-121,7
18,5	-8,5	-19	-121,7	-18,8	-121,9	-21	-120,7
19	-9	-20	-120,8	-19,8	-120,9	-22	-118,8

Measurements made using a 10dBm transmitter feeding 3 miles of fiber cable. An optical attenuator was used at the optical receiver's input.

## Televes Limited Warranty

- (A) Televes warrants, only to the original Purchaser, all Products be free from any defect in materials or workmanship for a period of two (2) years from the date of original purchase, unless otherwise specified.
- (B) Televes shall, free of charge and in its sole discretion, either repair, replace with a new or factory reconditioned equivalent, or refund the purchase price of the Product(s), that has been determined by Televes to be defective in material or workmanship, subject to the limits of this warranty.
- (C) This warranty excludes any damage or inoperability resulting from:
- (I) use or installation that is not in strict compliance with the written instructions and specifications;
  - (II) any modification or alteration performed by any third party not authorized in writing by Televes;
  - (III) service or repair performed by any third party not authorized in writing by Televes;
  - (IV) misuse, abuse, intentional harm, or lack of reasonable care;
  - (V) fire, ice, snow, rain, wind, water, volcano, excessive heat or cold, lightning, flood, power surge, earthquake, or any other acts of God;
  - (VI) war, crime, strike, riot, electro-magnetic pulse, or any other acts beyond the control of Televes;
  - (VII) shipping.
- (D) All claims under the terms of this warranty must be made in writing, by the original Purchaser, within fourteen (14) days of the defect being known to the Purchaser. Such claims shall be accompanied by a description of any material facts related to the claimed defect and the invoice or other proof of original purchase date and price.
- If Televes so requests, the Purchaser shall, at Purchaser's expense, deliver the claimed Product(s) to Televes, within 14 days of the date of the return authorization. Under no circumstances shall the Product(s) be returned to Televes without a return authorization.
- (E) Any refund to the Purchaser, shall be limited to the purchase price of the Product(s), excluding any applicable taxes, duties, freight costs, removal costs, installation costs, or any other charges incident to the purchase of the product.
- (F) Any damage caused by shipper shall be claimed with the shipper in accordance with the shipper's policies and procedures.
- (G) Televes shall in no event and under no circumstances be liable or responsible for any consequential, indirect, incidental, punitive, direct or special damages based upon breach of warranty, breach of contract, negligence, strict tort liability or otherwise or any other legal theory, arising directly or indirectly from the sale, use, installation or failure of any product acquired by Purchaser from Televes.
- (H) This limited warranty extends to the original Purchaser and cannot be assigned or transferred to any other party without the prior express written permission of Televes, which permission Televes may withhold for any reason or for no reason at all.
- (I) Televes will not assume any liabilities for any other warranties, whether statutory, express or implied, made by any other person.
- (J) Televes reserves the right to modify or discontinue this warranty at Televes' sole discretion without notification. No other warranties are expressed or implied.

### DECLARATION OF CONFORMITY

Per FCC Part 2 Section 2.1077(a)



Responsible Party Name: **TELEVES, S.A.**

Address: Rúa B. de Conxo, 17  
15706 Santiago de Compostela  
A Coruña-Spain

Phone / Fax N°: +34 981522200 / + 34 981522262

#### Hereby declares that the product

Product Name: Optical fiber T0X System.  
Model Number: 233306, 233311, 233411, 233501, 233601, 234305, 234311

#### Conforms to the following specifications:

FCC Part 15, Subpart B, Section 15.107(e) and section 15.109(g)

#### Supplementary Information:

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Representative Person's Name: **José Luis Fernández Carnero**

Signature:

Date : 01/07/2013

televes.com



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