Televes®

T.OX SERIES

EN Optical Fiber Transmitter and Receiver with return path channel

Refs. 2333, 2334 2335, 2336

User manual

Televes

Index

Important safety instructions:

General installation conditions:

- Before handling or connecting the equipment, please read this manual.
- Do not obstruct the equipment's ventilation system.
- Please allow air circulation around the equipment.
- Do not place the equipment near sources of heat or in excessively moisture conditions.
- Do not place the equipment where it may be affected by strong vibrations or knocks.

How to use the equipment safely:

- If any liquid or object falls inside the equipment, please contact a specialized technician.
- Do not connect the equipment until all the other connections have been made.

Instructions for the optical connection:

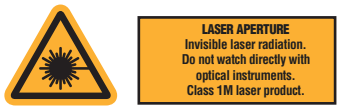
- For the optical connection, a single mode fibre cable is used with an SC/APC-type connector.
- Remove the protective cover from the optical connector on the front panel of the device, and the cap on the connector of the single fibre cable.
- Connect the cable to the device, carefully slotting the guides together for both connectors, pushing the connector all the way in.

Precautionary measures with the connection point:

- 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.
- Avoid turning on the transmitter without having the fibre optic cable connected.

Safety measures

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



According to EN60825-1_ 2007

Caution

- The use of controls or adjustments or any other procedures other than those specified in this manual may lead to exposure to harmful radiation.
- Carefully read and observe the instructions given in this manual, and keep it for future reference.
- Do not use the equipment in any way that does not comply with the operating instructions or in any conditions that exceed the stipulated atmospheric specifications.
- This equipment is not user-serviceable. Should you require assistance, contact our technical service department.
- Never point the laser beam intentionally at people or animals.

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1. Technical specifications

Optical transmitters refs. 2333, 2334

RF Input/Output	Frequency range	Forward channel	MHz	87 - 2150	Equivalent input noise EIN	850 MHz	dBm/Hz	-150.7
		Return channel (3)		1 - 65		2000 MHz		- 145.8
	Max. input level for CSO & CTB >= 60dB (1))	87-862 MHz	dBµV	91	Flatness		dB	± 1.5
		950-2150 MHz		80	Return losses		dB	>= 10
	Input level regulation margin (in 2 dB steps)		dB	0-18	Impedance		ohm	75
	Output level regulation margin (in 2 dB steps) (3)							
	Return channel maximum RF output level		dBµV	112 (2)	Test socket attenuation (typ.)		dB	16
Optical output (forward channel)	Laser		type	MQW-DFB	Output optical power		mW/dBm	4 / 6
	Wavelength		nm	1310 ± 20				
Optical input (return channel) (3)	Optical device		type	InGaAs Pin Photodiode	Detection bandwidth		MHz	1 - 3000
	Wavelength		nm	1200 -1600	Max. Optical power received		mW/dBm	2 / 3
General	Powering/Consumption	12 Vdc	mA	210 / 310 (3)	RF connectors		type	female F
		24 Vdc		104 / 160 (3)				
	Operating temperature		ºC	-5 ··· +45	Optical connectors			SC/APC

(1) Input: 41 TV CH CENELEC and 1 complete satellite transponder. The input attenuator in 0dB position.
(2) Measurement made according to standard DIN45004B.
(3) Only ref. 2334.

Optical receivers refs. 2335, 2336

RF Input/Output	Frequency range	Forward channel	MHz	87 ··· 2150		Equivalent input noise of the return channel, measured at 30 MHz and the transmitter output connected directly to the receiver	dBm/Hz	-152.5
		Return channel (3)		1 ··· 65				
	Max. Output Level for CSO and CTB> = 60dB (1))	87-862 MHz	dBµV	93				
		950-2150 MHz		90		Flatness	dB	± 1.5
	Output level regulation margin (in 2 dB steps)		dB	0-18		Return losses	dB	>= 11
	Max. input level return path (2) (3)		dBµV	95		Impedance	ohm	75
Optical input (forward channel)	Optical device		type	InGaAs Pin Photodiode		Detection bandwidth	MHz	1 ··· 3000
	Wavelength		nm	1200 ··· 1600		Max. Optical power received	mW/dBm	4 / 6
Optical output (return channel) (3)	Laser		type	Fabry-Perot		Maximum ouitput power	mW/dBm	2 / 3
	Wavelength		nm	1310±20				
General	Powering/Consumption	12 Vdc	mA	300	355 (3)	RF connectors	type	female F
		24 Vdc		155	175 (3)			
	Operating temperature		ºC	-5 ··· +45		Optical connectors		SC/APC

(1) Output: 42 TV CH CENELEC and 1 complete satellite transponder. The output attenuator in 0dB position.
(2) According to DIN45004B
(3) Only ref. 2336

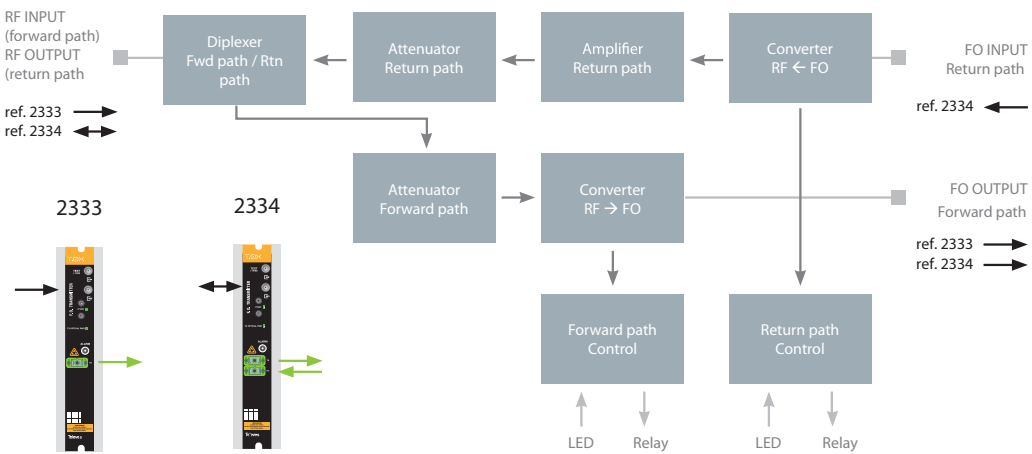
1.5. Amplifiers technical specifications

Amplifier 5575	Frequency range	46 ... 862 MHz	Connector type	"F"
	Gain	44 ± 2,5 dB	Powering	24 V⎓
	Regulation margin	20 dB	Consumption at 24 V⎓:	450 mA
	Output level (at 60 dBc):	105 dBµV (42 CH CENELEC)	Test socket	-30 dB

1.6. Technical specs. Power Supply Unit

Power Supply Unit 5629	Mains voltage	196 - 264 V~ 50/60 Hz	Total max. current (output1 + output2):	5 A (24V⎓)
	Output voltage	24V⎓	Max. current per output	4 A (24V⎓)

1.7. Blocks diagrams



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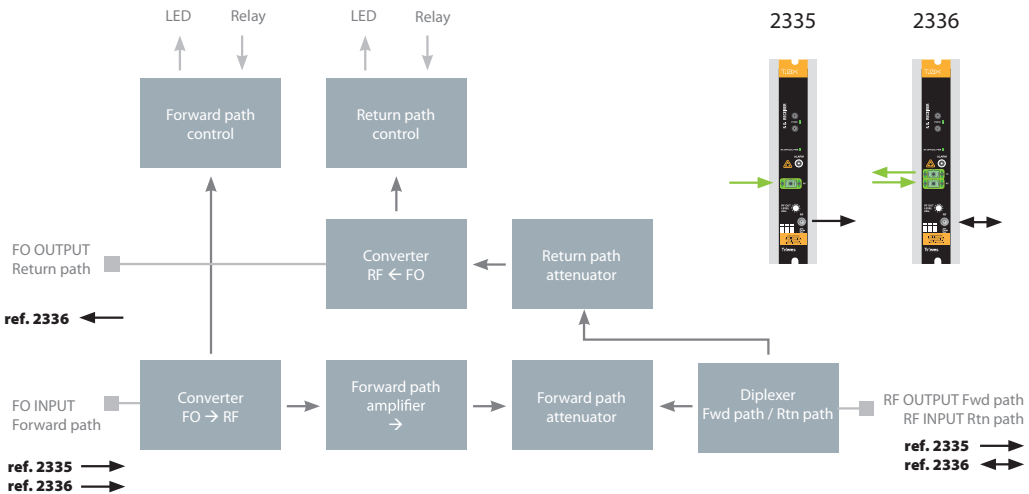

LED
Relay
LED
Relay
2335
2336
Forward path control
Return path control
FO OUTPUT Return path
ref. 2336
Converter RF ← FO
Return path attenuator
FO INPUT Forward path
ref. 2335
ref. 2336
Converter FO → RF
Forward path amplifier →
Forward path attenuator
Diplexer Fwd path / Rtn path
RF OUTPUT Fwd path
RF INPUT Rtn path
ref. 2335
ref. 2336

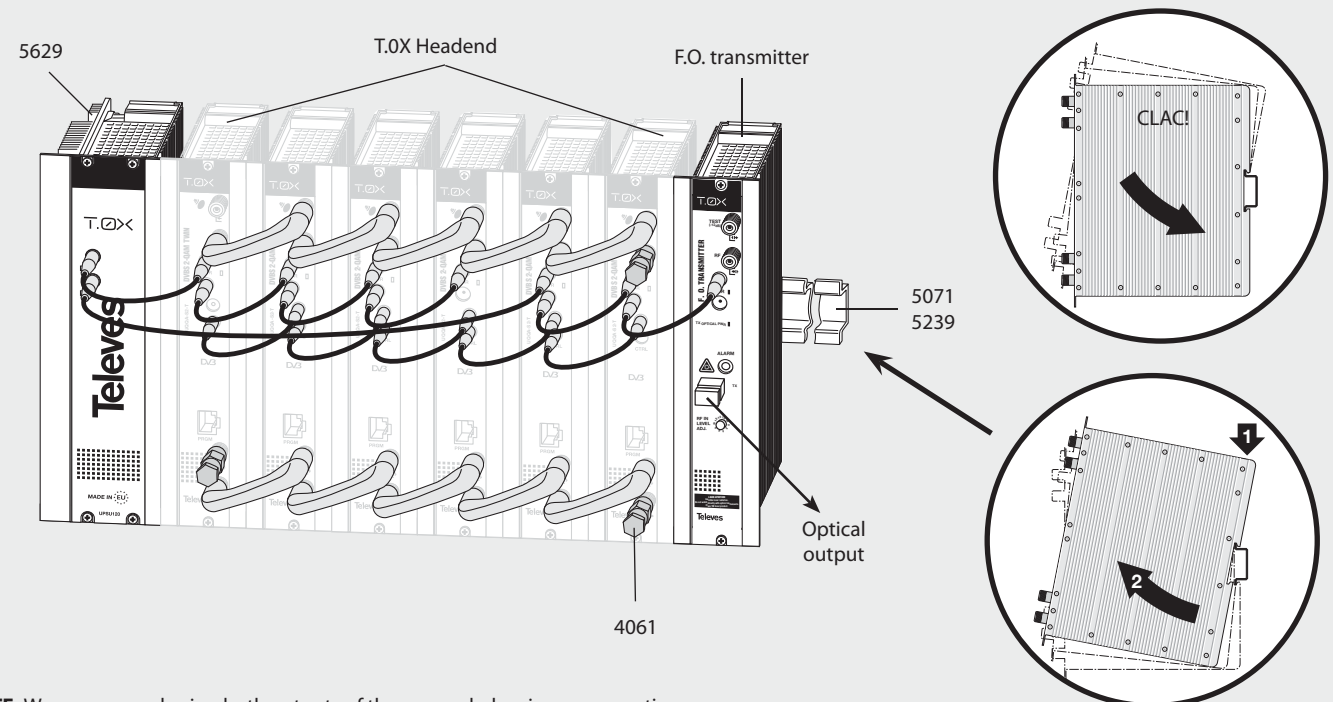
2. Description of references

Product range	
2333	T.0X Optical fiber transmitter 1310 nm
2334	T.0X Optical fiber transmitter 1310 nm + Return channel receiver
2335	T.0X Optical fiber receiver 1200-1600 nm
2336	T.0X Optical fiber receiver + Return channel transmitter
2337	T.0X 2 way optical splitter
2339	T.0X 4 way optical splitter
5629	T.0X Power Supply Unit 24V/5A

Accessoires	
7234	Universal programmer
5071	Wall mounting rail T03-T05-T.0X L=50 cm
5239	Wall mounting rail T03-T05-T.0X (12 modules +PSU) L= 56 cm
5301	19" rack frame
507202	T.0X cabinet with ventilation unit (7 modules + PSU)
4061	F terminal load DC-blocked
4058	F terminal load
422601	T05 to T.0X powering adapter lead L=40 cm
422602	T05 to T.0X BUS adapter lead L=40 cm
422603	Control BUS lead T.0X L=1 m
5673	Face plate 50 mm

3. Mounting

3.1. Wall mounting



NOTE: We recommend using both outputs of the source, balancing consumption.

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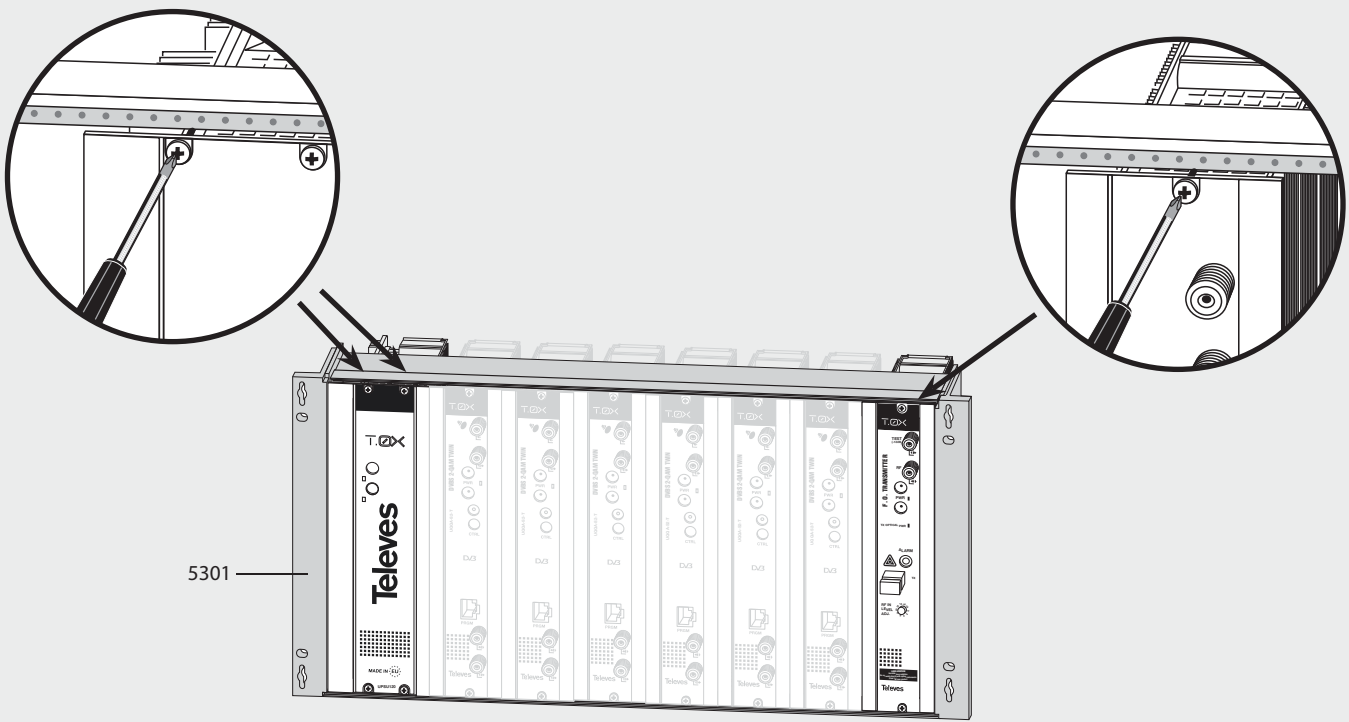
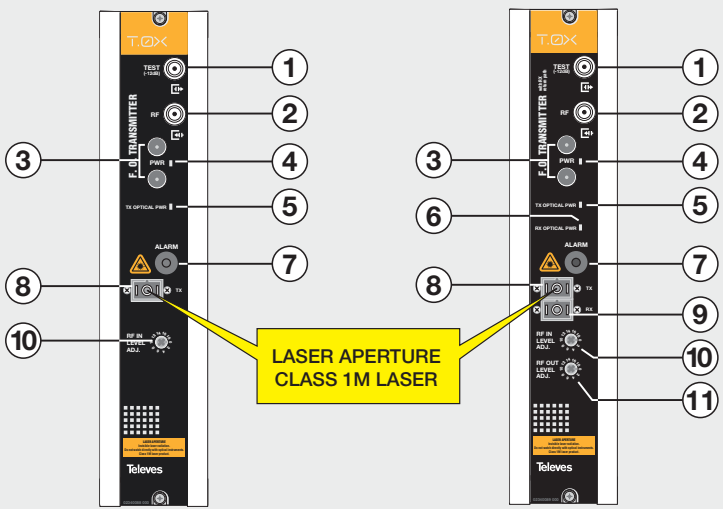
3.2. 19” rack mounting



4. Description of elements

4.1. Optical transmitter



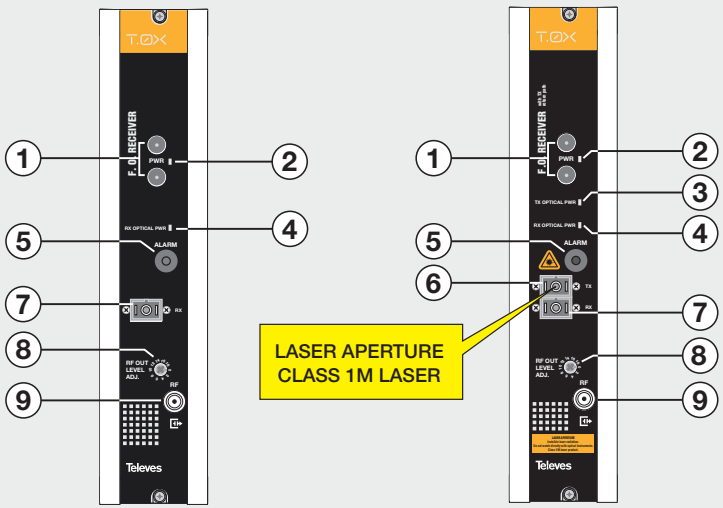
1. Test output (-16dB)
2. RF Input
   87 - 2150 MHz (forward channel)
   5 - 65 MHz (return channel)
3. Powering
4. ON power indicator LED
5. Forward channel power indicator LED
6. Return channel power indicator LED
7. Alarm connector
8. Forward channel optical output
9. Return channel optical input
10. Forward channel RF attenuation
11. Return channel RF attenuation

Masa +12 ... 24V

Caution
The use of control or adjustment devices, or operating parameters other than those specified in this manual, can cause hazardous radiation exposure.

LED ON	Indicates
TX Optical PW	Optical power delivered by the equipment from 5.5 dBm to 6.5 dBm
RX Optical PW	Optical level received by the return channel from 3 dBm to -7 dBm.

4.2. Optical receiver



Ref. 2335 **Ref. 2336**

1. Powering
2. ON power indicator LED
3. Forward channel power indicator LED
4. Return channel power indicator LED
5. Alarm connector
6. Forward channel optical output
7. Return channel optical input
8. Return channel attenuation
9. RF output
   - 87 - 2150 MHz (forward channel)
   - 5 - 65 MHz (return channel)

Caution
The use of control or adjustment devices, or operating parameters other than those specified in this manual, can cause hazardous radiation exposure.

LED ON	Indicates
RX Optical PW	Input optical power on the device from 5 dBm and -10 dBm.
TX Optical PW	Optical level broadcast on the return channel between 2.5 dBm and 3.5 dBm.

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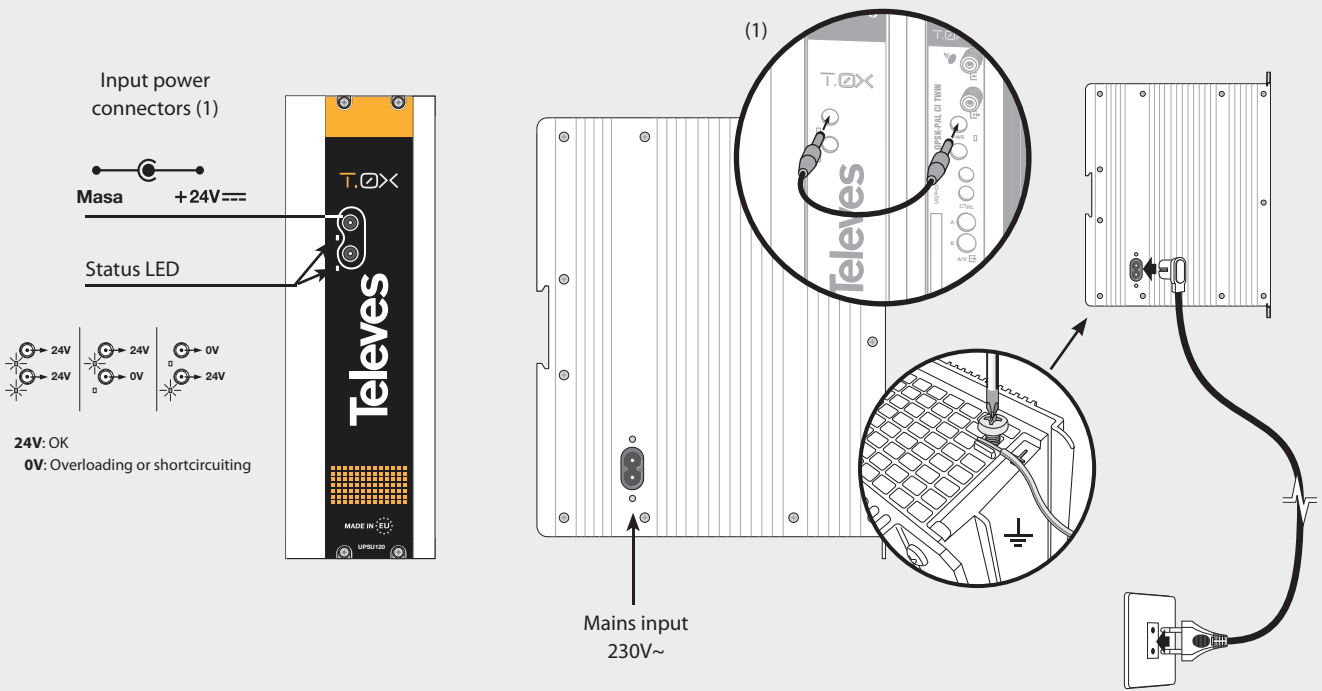
4.3. Power Supply Unit



NOTE: You must use both outputs of the source when consumption exceeds 4 amps on either of them (maximum current for each output)

5. Examples of application

Correct use of the devices.

There are several basic concepts that should not be forgotten. The technical specifications are a set of maximums to be handled with some care.

To calculate the RF level which must excite the transmitter, use the data in the table shown below and the following formulas:

EIN= EINn +10×log(BW) [1]
C/N=Vin - EIN [2]

where:

- **EIN** is the equivalent input noise. That is, the noise in RF, which would have to be present at the input of the transmitter in an ideal optic system that did not add noise, so as to obtain the same level of noise at the output of the receiver of the real system (It 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.

Here are some examples.

Opt. Link atenuattion (dB)	Gain at 807 MHz (dB)	EINn (dBm/Hz)	Gain at 1.2 GHz (dB)	EINn (dBm/Hz)	Gain at 2.1 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

Measurements made with a transmitter that delivers 6.1 dBm, followed by a reel of fiber of 5 km long and an optical attenuator connected between the end of the reel of fiber and optical receiver input.

Example 1

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

This is a link where the optical signal is split between 4 fibers of 1 km, using a splitter ref. 2339. The signal received at the other end is converted back to RF by means of the optical receiver ref. 2335.

The channel levels that excite the transmitter are:

- 83 dBµV (-26 dBm 42CH CENELEC) ***analog channels,*** *TV band.*

- 73 dBµV (-36 dBm) ***digitales channels,*** *SAT band.*

Analog terrestrial channel bandwidth: *5 MHz*

Satellite digital transponder bandwidth: *27 MHz*

On the other hand:

- 1 km 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 TV 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 EINn =-139.9 dB/Hz.

Apply the formula [1] and we obtain:

EIN_{TV}= -139.9 + 10×log(5×10^6)= -72.91 dBm

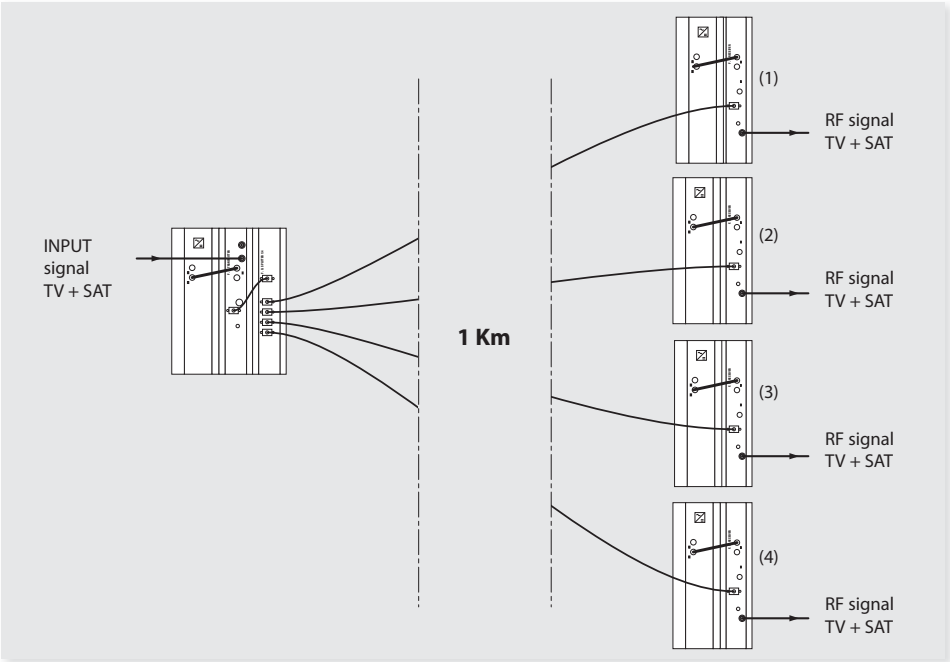
Now apply the formula [2] to calculate the C/N, as follows:

C/N_{TV}=Vin - EIN_{TV}

C/N_{TV} = -26 dBm -(- 65.7 dBm) = -26+65.7

Then, **C/N_{TV} = 46.9 dB**

In practice, having satellite channels, simultaneously with the TV ones, makes the latter worse their C/N in 1 dB.



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 :

EINn= -140.8 dB/Hz

EIN_{SAT} = -140.8 + 10×log(27×10^6) = - 65.7 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 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_{COFDM} = 23 dB.**

SAT channels will be DVB-S2, with a **C/N_{DVBS2}= 14 dB.**

The **level of excitation** of the transmitter will be the same for TV and SAT: **79 dBµV** (-30dBm).

The bandwidth will be now:

For COFDM: BW = 8×10^6 Hz (8 MHz)

For SAT: BW = 27×10^6 Hz (27 MHz)

As in Example 1, the attenuations are:

- 1 km 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 dB

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

The table provides the following information:

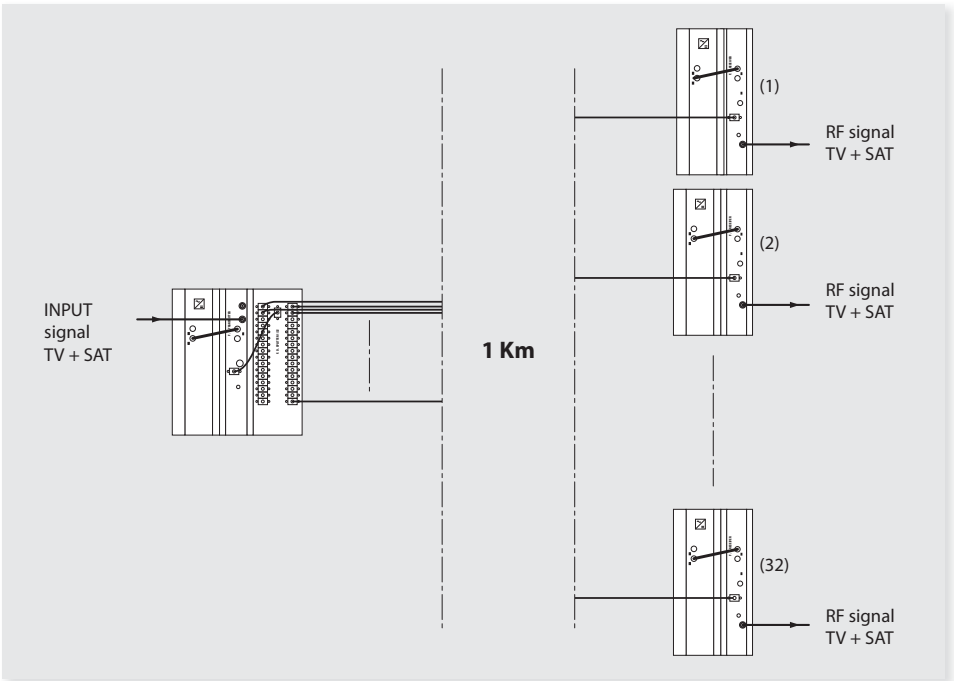
For the TV band, in the column *Gain at 807 MHz*

EINn (TV)= -122.8 dBm/Hz

G(807 MHz)= -17.3 dB

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

EINn(SAT) = -125.4 dBm/Hz



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G(2.1 GHz)= -16.3 dB

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

$Vout_{rcvr}$ (dBµV) = Vin_{xmtr} (dBµV) + G (dB)

This is:

$V_{out\ rcvr}$ TERR (dBµV) = 79 -17.3 = 61.7 dBµV

$V_{out\ rcvr}$ SAT (dBµV) = 79 -16.3 = 62.7 dBµV

Applying the formula [1]:

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

$EIN_{TV} = -122.8 + 69$

$EIN_{TV} = -53.8$ dBm

And by the formula [2] is obtained:

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

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

EIN_{SAT}= - 51.1 dBm

C/N_{SAT}= -30 - (-51.1) = **21.1 dB en SAT**

If we estimate the value of the C / N for TV very tight, you can increase the excitement level of the transmitter a couple of dB, since there is enough margin before the system begins to distort.

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.

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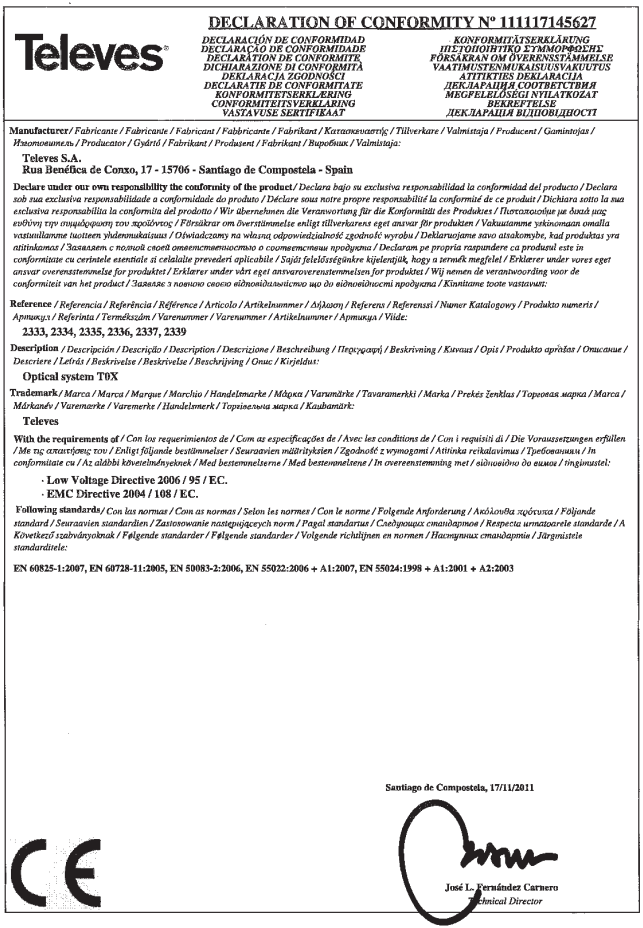
Guarantee

Televés S.A. offers a two year guarantee, beginning from the date of purchase for countries in the EU. For countries that are not part of the EU, the legal guarantee that is in force at the time of purchase is applied. Keep the purchase invoice to determine this date.

During the guarantee period, Televés S.A. complies with the guarantee by repairing or substituting the faulty equipment.

The harm produced by improper usage, wear and tear, manipulation by a third party, catastrophes or any other cause beyond the control of Televés S.A. is not included in the guarantee.



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Declare under our own responsibility the conformity of the product / *Declara bajo su exclusiva responsabilidad la conformidad del producto / Declara sob sua exclusiva responsabilidade a conformidade do produto / Déclare sous notre propre responsabilité la conformité de ce produit / Dichiara sotto la sua esclusiva responsabilità la conformità del prodotto / Wir übernehmen die Verantwortung für die Konformität des Produktes / Πιστοποιούμε με δική μας ευθύνη την συμμόρφωση του προϊόντος / Försäkrar om överstämmelse enligt tillverkarens eget ansvar för produkten / Vakuutamme yksinomaan omalla vastuullamme tuotteen yhdenmukaisuus / Oświadczamy na własną odpowiedzialność zgodność wyrobu / Deklaruojame savo atsakomybe, kad produktas yra atitinkamas / Заявляем с полной своей ответственностью о соответствии продукта / Declaram pe propria raspundere ca produsul este in conformitate cu cerintele esentiale si celelalte prevederi aplicabile / Saját felelősségünkre kijelentjük, hogy a termék megfelel / Erklærer under vores eget ansvar overensstemmelse for produktet / Erklærer under vårt eget ansvarsoverensstemmelsen for produktet / Wij nemen de verantwoording voor de conformiteit van het product / Заявляємо з повною своєю відповідальністю що до відповідності продукта / Kinnitame toote vastavust:*

Reference / *Referencia / Referência / Référence / Articolo / Artikelnummer / Άρθρον / Referens / Referenssi / Numer Katalogowy / Produkto numeris / Артикул / Referinta / Termékszám / Varenummer / Varenummer / Artikelnummer / Артикул / Viide:*

2333, 2334, 2335, 2336, 2337, 2339

Description / *Descripción / Descrição / Description / Descrizione / Beschreibung / Περιγραφή / Beskrivning / Kuvaus / Opis / Produkto aprašas / Описание / Descriere / Leírás / Beskrivelse / Beskrivelse / Beschrijving / Опис / Kirjeldus:*

Optical system T0X

Trademark / *Marca / Marca / Marque / Marchio / Handelsmarke / Μάρκα / Varumärke / Tavaramerkki / Marka / Prekės ženklas / Търговска марка / Marca / Märkanév / Varemærke / Varemerke / Handelsmerk / Торговельна марка / Kaubamärk:*

Televes

With the requirements of / *Con los requerimientos de / Com as especificações de / Avec les conditions de / Con i requisiti di / Die Voraussetzungen erfüllen / Με τις απαιτήσεις του / Enligt följande bestämmelser / Seuraavien määräityksien / Zgodność z wymogami / Attinka reikalavimus / Требованиям / In conformitate cu / Az alábbi követelményeknek / Med bestemmelserne / Med bestemmelserne / In overeenstemming met / відповідно до вимог / tingimustel:*

- **Low Voltage Directive 2006 / 95 / EC.**
- **EMC Directive 2004 / 108 / EC.**

Following standards / *Con las normas / Com as normas / Selon les normes / Con le norme / Folgende Anforderung / Ακόλουθα πρότυπα / Följande standard / Seuraavien standardien / Zastosowanie następujących norm / Pagal standartus / Следующих стандартов / Respecta urmatoarele standarde / A Követező szabványoknak / Følgende standarder / Følgende standarder / Volgende richtlijnen en normen / Наступних стандартів / Järgmiste standardite:*

EN 60825-1:2007, EN 60728-11:2005, EN 50083-2:2006, EN 55022:2006 + A1:2007, EN 55024:1998 + A1:2001 + A2:2003

Santiago de Compostela, 17/11/2011

José L. Fernández Carnero
Technical Director

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