

# TUWH4000E<sup>®</sup>

WHET<sup>®</sup> Wideband High Efficiency Transmitters

HIGH EFFICIENCY · ULTRA-WIDEBAND

UHF TV Transmitters  
Air cooling system

Maximum return on  
investment



**Egatel**

**COMSA**  
CORPORACIÓN

# TUWH4000E Series<sup>®</sup>

## UHF TV Transmitters

### Air cooling system

The TUWH4000E series represents a step ahead in the technology of air cooled transmitters. Provides the optimal solution for development or extending a digital broadcast network with HDTV, DTV and mobile TV channels globally. They offer an efficiency up to 42% in COFDM standards and 45% in ATSC, providing broadcasters with a high economic benefit.

They are equipped with the most advanced technology in signal processing and Asymmetric Doherty wideband -high efficiency power amplifiers. They offer a power range from 570Wrms to 4.7KWrms for all modulations standards (DVB-T/T2/H, ISDB-T/Tb) and ATSC).

They feature a power-to-size and performance-to-reliability ratios that allow the signal broadcasting with the highest quality. Its compact and modular design as well as its high energy efficiency facilitate the installation and maintenance, thus significantly reducing the total expenditures over the life of the transmitter for the broadcast operator.

Table of models						
TUWH4000E * Series	TUWH4601E	TUWH4602E	TUWH4603E	TUWH4604E	TUWH4605E	TUWH4606E
Power (before the filter) COFDM	570 Wrms	1140 Wrms	1.65 KWrms	2.2 KWrms	2.7 KW	3.3 KWrms
Power (before the filter) ATSC	800 Wrms	1600 Wrms	2.35 KWrms	3.1 KWrms	3.9 KW	4.7 KWrms
Number of amplifiers	1	2	3	4	5	6
Maximum of Tx per rack	6	3	2	1	1	1
Maximum N+1 systems per rack	4+1	2+1	1+1	N/A	N/A	N/A
Output RF connecto	7/16 o EIA 1 5/8"	EIA 1 5/8"	EIA 1 5/8"	EIA 1 5/8"	EIA 1 5/8" (COFDM) EIA 3 1/8" (ATSC)	

(\*) The models are referenced according to standard: TUWH46xxE - DVB-T/H/T2, TUWH46xxEB - ISDB-T/TB, TUWH46xxEA - ATSC  
Example: TUWH4606EB - 3.3 KWrms ISDB-T/TB. Other configurations of output power and number of amplifiers, on request.

# Benefits and key features

## 1. Leading efficiency wideband transmitters

- Asymmetrical Doherty Technology
- Advantages of asymmetric Doherty vs the symmetric
- Economic benefit

## 2. Flexible configurations, compact design

- TE9000 Series Exciter
  - Advanced integrated features
  - QoS analyzer
  - Adaptive Digital Precorrection
  - TSolP Inputs
  - Spectrum Analyzer
- CCU9000 Control Unit
- AUWH601E Power Amplifier

## 3. Quick start-up and easy operation

- Instantaneous configuration via SD card
- Powerful Web Server to manage and monitor the transmitters

## 4. High reliability

- Redundant configurations
- Redundant power supplies removable from the front panel
- Optimum cooling system design

## 5. Service and support

- Rigor and professionalism

# Leading efficiency wideband transmitters



TUWH4000E Series  
 Model: TUWH4602E  
 Configuration: 2+1 & Dual Drive

## Asymmetric Doherty Technology

Transmitter's energy efficiency is a key factor for network operators by the time of selecting TV transmitters. The main reason is the energy cost, since after ten years of operation it can represent up to three times the initial investment.

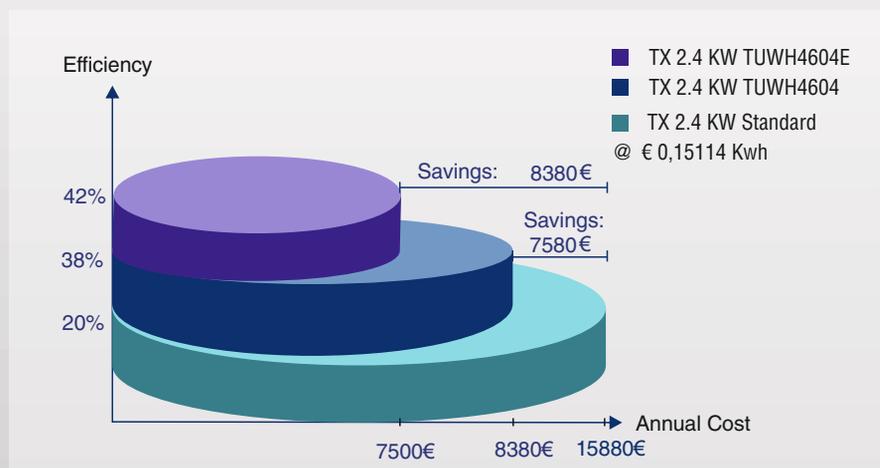
With the option of Asymmetric Doherty Technology in wideband, it was possible to boost energy efficiency values up to 42%, for COFDM ad 45% for ATSC, representing an improvement of almost 50% over traditional technology transmitters.

Furthermore, higher energy efficiency leads to an enhancement of other important aspects that also have an impact on the network cost. By dissipating less energy, the cooling system load is reduced and so the transmitter form factor. Thus, more amplifiers can be integrated in a single rack. In other words, more power in less space.

The series is Doherty asymmetrical broadband, it covers all the UHF band (470 to 700MHz). Due to the provision of transistors allows better energy efficiency compared to the previous Doherty (AWH601), allowing to build a high-power transmitter with excellent performance and efficiency.

## Energy efficiency improving in wideband TV transmitter

The arising costs from electricity bill can be up to three times the equipment acquisition cost after ten years of operation.



## ■ Asymmetrical Doherty vs Symmetrical

In the new Asymmetric Doherty amplifier (AUWH601E), like its predecessor the symmetrical Doherty (AUWH601), its design is based on ultra-wide band technology, which means no adjustment or replacement of the power amplifier is required to change the RF channel of operation, therefore channel changes remain a simple setup task. This also simplifies and reduces costs in the management of spare parts.

The new TUWH4000E series transmitters reach an energy efficiency of up to 42% for COFDM and 45% for ATSC standards, cooling system included. The amplifier (AUWH601E) consists of 4 amplifier stages, which are made up of compact pallets making service and maintenance very simple.

The frequency range in Asymmetric Doherty is limited to 700MHz (470 – 700MHz) in consistency of current regulation the UHF band for Digital Terrestrial Television worldwide.

The amplifier uses "multi-step dividers" at the input of the amplifiers in this way, it prevent the overexcitation of one "pallet" respect to the rest. In addition, it does not reach high temperatures in the output lines through the use of the strip-line and maintains control of the dissipated power.

On the rear panel, this amplifier has two power samples, one is to perform a non-linear adaptive digital precorrection and the other is calibrated for the QoS option.

Equipped with Doherty broadband technology, all TUWH4000E transmitters comprising an N+1 system are identical, mains and reserve. Thus, the power consumption of the whole system is optimal and homogeneous. Furthermore, working with just a unique reference leads to reduction in the maintenance and logistics cost.

## ■ Economic benefit

The high energy efficiency of the transmitters provides an immediate economic benefit to operators. As an example, taking a transmitter of 2.4kW with a standard efficiency of 20% as the basis and considering the average price of industrial energy in Europe (0,15114€/Kwh), then the cost related to the annual consumption is approximately 15.880€.

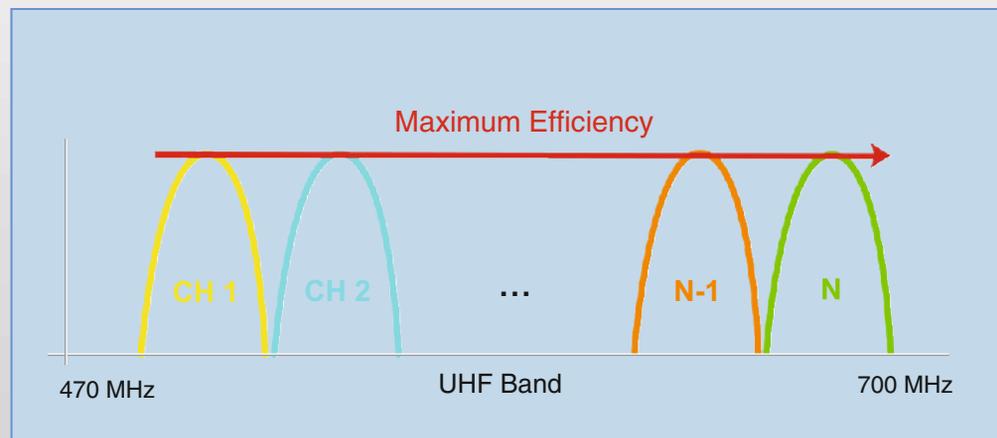
The same transmitter operating in high efficiency mode with Asymmetrical Doherty amplifiers and featuring additional techniques for crest factor reduction may reach an efficiency of 38%. This means that in this new situation, the cost of the annual consumption of the transmitter is 8.380€. Therefore, the savings are approximately 7.500€ per year. If we compare with Asymmetric Doherty amplifiers, with an efficiency of 42%, the cost of the annual consumption of the transmitter is 7500€, therefore, the savings are approximately 8380€ per year.

Obviously, the savings are greater with the new Asymmetric Doherty amplifiers.

We can conclude that network operators save money as soon as the TUWH4000E transmitters enter in operation.

### Efficiency optimization throughout the UHF band

The arising costs from electricity bill can be up to three times the equipment acquisition cost after ten years of operation.



# Flexible configurations and compact design

The TUWH4000E series provides maximum versatility and flexibility. Customers can choose from a multitude of different configurations to get the one that best suits their needs.

The LDMOS-50 volts transistors technology, the optimum design of the amplifier stage and adaptation networks allow achieving excellent power density, allowing each amplifier to deliver an output power of 570W COFDM (870W ATSC) for all TV standards. A single rack of 42U can accommodate 3.3KW<sub>rms</sub> COFDM (4.7KW ATSC) transmitter.

This power density relaxes the space requirements for installation, a crucial aspect, in those locations with not so many space available. Taking into account the cost per square meter, saving space also means saving money.

## ■ TE9000E8 Series Exciter

### Advanced integrated features

The exciter is ready to work with the major international TV standards: DVB-T/H, DVB-T2, ISDB-T/TB, ATSC. They are equipped with the most advanced technology in signal processing and with an automatic efficiency optimization system, providing the most economical operation possible for all operating scenarios.

The TE9000E8 series supports two modulation engines. Up to two standards can be simultaneously stored in an exciter, offering network operators planning to combine or migrate, for example from DVB-T to DVB-T2, a high flexibility level.

### Adaptive Digital Precorrection

The adaptive digital precorrection system enables the equalization of the signal easily and quickly. It can be activated manually, by the programmed trigger or it can run continuously and adaptively. The processing power of the precorrector allows to achieve unbeatable Shoulders and MER values, ensuring the highest quality in the transmitted signal.

### Spectrum Analyzer

TE9000E8 series includes an additional feature of great utility "Spectrum Analyser" that includes the graphics: Spectrum analyser and the impulsive response.

This information is available remotely or locally in real time without extra measurement equipment.

## TE9000 Series Exciter

It integrates a HW demodulator to provide with Shoulders, MER, BER and PER values



## TSoIP Inputs

The exciter has an integrated Transport Stream over IP receiver able to manage two ASI streams over a Gigabit Ethernet bus. The switching between the two inputs is fully automatic and Seamless. Thus, operators get both economic and space savings avoiding the installation of an external receiver.

## QoS analyzer (DVB-T/T2 and ISDB\_T)

The exciter integrates a HW demodulator to provide with Shoulders, MER, BER and PER values. This feature allows to evaluate the quality of the signal in real time and to access this information remotely through the Web server or an SNMP client. Therefore, it saves unnecessary trips to unattended sites and the use of an external analyzer to check the output signal of the transmitter.

## ■ CCU9000 Control Unit

All of the components of the transmitter have been designed following a policy of design focused on ensuring an always-on-the-air TV service. Transmitters optionally can incorporate a Control Unit. It manages and monitors the operation of the entire transmitter and redundant systems, both Dual Drive and N+1 system, as well as the liquid cooling system.



The CCU9000 Control Unit can control and monitor Egatel transmitters as well as transmitters from other manufacturers. With a footprint of only two units, it manages and monitors the operation of the entire transmission chain, switching between exciters / amplifiers / transmitters manually or automatically, as needed.

It includes a high resolution TFT graphical display to check at a glance the transmitter status. In addition it can be modified any configuration parameter of transmitter, either locally or remotely.

The CCU9000 monitors and controls the liquid cooling system. The main window of either Control Unit or the Web Server shows a graphical representation of the refrigeration unit and all information related to its operation.

One or more authorized users may monitor and manage the transmitters remotely using a powerful Web Graphical user Interface or an SNMP agent.

## ■ AUWH601E Power Amplifier

The design of power amplifiers of the TUWH4000E transmitters family is based on LDMOS 50-volt transistors technology. They provide a compact design, high efficiency and excellent linearity, getting high energy savings. To increase the efficiency offered by Broadband Assymmetric Doherty configuration, the supply voltage of the transistors can be adjusted through the exciter or the control unit increasing the efficiency for all digital standards. This mechanism is considerably boosts efficiency when working at reduced power.



The amplifiers are self-protected by having circuits that control the input level, output power and other critical parameters such as the temperature of the amplifier or the reflected power. The protection system automatically lowers the output power of the amplifier any time the default threshold is exceeded, preventing an amplifier damage. Those parameters, along with the values of consumption of the transistors as well as the generated alarms are sent through a data bus to both the exciter and the control unit (if any), where they can be checked at any time through the display, making the monitoring and maintenance tasks easier.

They have a redundant power supply system composed by up to three power supplies hot-swappable from the front, so that the fault of up two of one does not suppose any output power reduction.

Each amplifier includes two redundant fans that allow a correct transmitter operation without an exhaust air unit and an innovative cooling system that prevents air flow through the electronic components, providing full immunity to corrosion.

# Quick start-up and easy operation

## ■ Instantaneous configuration via SD card

Both the exciter and the control unit include an SD card to store the whole configuration of the transmitter, so the start up of a new transmitter or the configuration of a spare unit is done in seconds. It is also particularly useful to put in operation N+1 systems quickly.

## ■ Powerful Web Server to manage and monitor the transmitters

The flexibility and versatility present in the design of all modules is revealed once again allowing the transmitters to be fully managed remotely.

In this way, a single IP address is enough to control and monitor the transmitter status.

For this purpose, besides the SNMP protocol, the exciter integrates the most powerful and friendly Web Server on the market. The Graphical User Interface (GUI) divides the screen into two parts. All the blocks that make up the transmitter chain are shown in the upper half. A simple color coding is used to check instantly the status of individual blocks. To read or modify any parameter, just click and drag the corresponding block to drop it in the bottom of the screen, where the parameters of up to three different blocks can be displayed. The GUI has been designed to never lose sight of the transmitter status.

The screenshot displays the Egatel TE9000E8 Exciter Webserver GUI. At the top, navigation tabs include Home, System, Users, and Close session. The main interface is divided into several functional areas:

- EXCITER STATUS:** Shows 'Out: ON' and real-time power metrics: Output frequency (550,000,000 Hz), Forward Power (3600 W), and Reflected Power (1.0 W).
- TRANSMITTER CHAIN DIAGRAM:** A central flow diagram showing the signal path from RECEPTION through INPUT, MODULATION (CODER, OFDM), PRECORRECTION (Linear, Non Linear, Adaptive), RF (RF Output LEVEL: 0 dBm), and finally to the AMPLIFIER STAGE (3 x AUWH1500).
- SYSTEM MONITORING:** Displays CPU TEMP: 67.80 °C and various control buttons like TEST MODE, EXT, and Output Quality.
- PARAMETER CONTROL PANELS:**
  - INPUTS:** Includes TS A Selection (ASI1), TS B Selection (TSolP2), TS Commutation (AUTO), TS Priority (EQUAL), and Bit Rate Check (YES).
  - TRANSMITTER STAGE CONTROL:** Features ON/OFF (ON), Nominal Power (3600 W), Power Control (0.05 V), and a Reset Amplifier button.
  - RF OUTPUT:** Shows Output frequency (550000000 Hz), Pout Exciter Attenuation (5.0 dB), Bandwidth (8 MHz), and Measures (Pout Exciter (dBm) = 1).

Exciter Webserver

# High reliability

## ■ Redundant configurations

The transmitters can optionally include the CCU9000 Control Unit to set up N+1 and / or dual drive redundant configurations. The extremely compact design concept allows to integrate N +1 systems in the same rack.

The Control Unit is equipped with a high resolution graphical display through which is easy to locally set or change any parameter and to perform an assesment of the transmission chain at a glance. Similarly, the control unit provides remote access to the transmitters through a powerful Web GUI or via the SNMP protocol.

## ■ Optimum cooling system design

The transmitters feature an innovate cooling system that prevents air flow through the electronic components, providing full immunity to corrosion. This is a critical point in transmitter sites located in areas with high salinity in the air. This aspect contributes greatly to increase the lifetime of the amplifiers.

Each amplifier includes two redundant fans that allow a correct transmitter operation without and external air conducting unit. Fuththermore, the fans can be easily and quickly hot-swapped during maintenance tasks.

## ■ Redundant power supplies removable from the front panel

With the aim of maximizing ease of maintenance and ensuring service availability, the amplifiers include up to three redundant power supplies plus a redundant unit. In case of a power supply fails, it can be easily replaced by opening the front cover of the amplifier and pulling the faulty unit out.

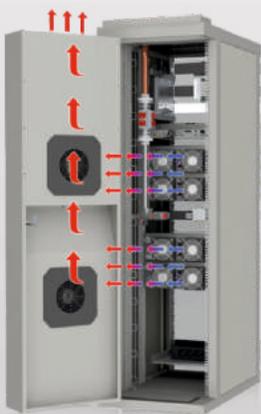
Furthermore, this process can be performed during the normal operation of the transmitter. Thus, by avoiding uncomfortable access to the rear part of the rack or to switch off the amplifier, the maintenance tasks are significantly simplified without interrupting the TV service.

### AUWH601E Amplifier

To replace any power supply just need to open the front cover of the amplifier and pulling the faulty unit out

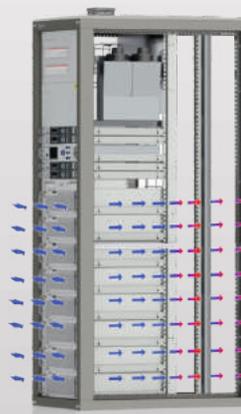


### Cooling system options



With extraction unit. Air extraction through ducting unit installed on rear door

No extraction unit. Air goes directly to the room where the transmitters is installed



TUWH4600E series are aircooled. Egatel offers different cooling systems :

- Natural cooling: vented rear door to ease the cooling of transmitter.
- Rear duct unit. In this case, the rotation speed of the fans of the extraction unit is regulated by a microcontroller according to the needs of refrigeration at all times, further increasing the energy efficiency of the equipment.
- Optionally it can be supplied with methacrylate front door with double filtering system (dust and anti-humidity filters)

# Service and support

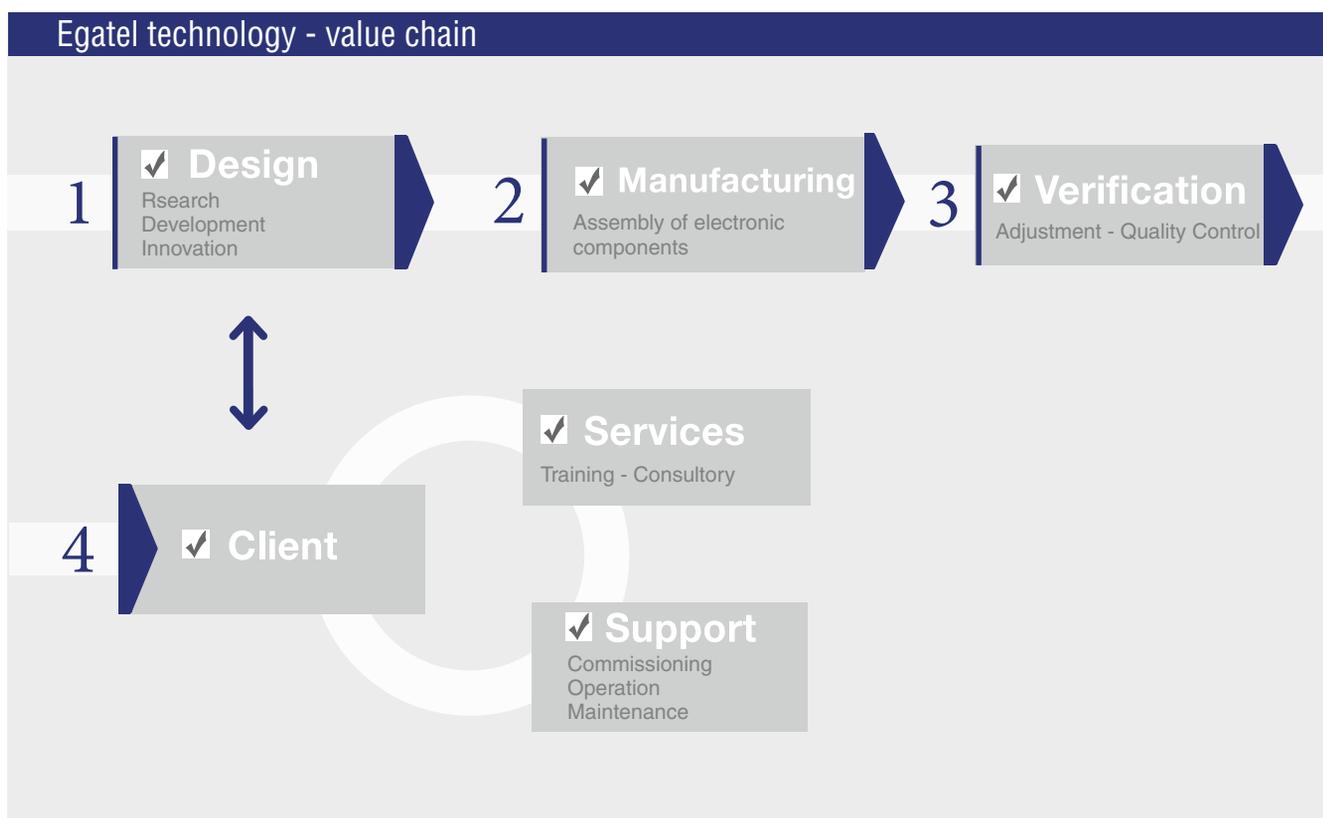
## ■ Rigor and professionalism

All processes that add value from the design stage to the manufacturing of the transmitters are carried out in-house. The company owns dedicated facilities for the mount of electronic components with several production lines equipped with the most advanced machines on the market. Therefore, the quality control throughout the production process is kept in Egatel, reaching the maximum reliability.

The international recognition achieved by the company is due not only to the supply of high technology products, but also to the wide range of services offered. They go a step beyond, with dedicated staff to provide full assistance during commissioning and normal operation or to offer qualified training, adding value and completing the process that begins when a customer trust in Egatel.

Each project is undertaken with the maximum level of commitment, accomplishing the delivery times and adapting to the demands of each customer, being aware of the importance of a professional attitude in their loyalty.

Egatel is integrated in Comsa-Emte, which is one of the biggest industrial groups in Spain within the sectors of infrastructure and technology. The group has a strong activity all around the five continents and it is established in 18 countries. The customers benefit from this wide international presence and the stability provided by a multinational company, guaranteeing local support and the purchase of Egatel equipment as a safe investment.



## Technical specification

Exciter	
<b>DVB-T/H/T2</b>	
Standard	EN300744, EN302304, EN302755, TS 102831, TS 102 773 (T2-MI)
Inputs	2xASI BNC (F), 75 ohm / TSoIP 10/100/1000 RJ45.
FFT size	1K (DVB-T2), 2K, 4K, 8K, 16K (DVB-T2), 32K (DVB-T2)
Code rate	1/2, 2/3, 3/4, 5/6, 3/5 (DVB-T2), 4/5 (DVB-T2)
Guard interval	1/32, 1/16, 1/8, 1/4, 19/256 (DVB-T2), 19/128 (DVB-T2), 1/128 (DVB-T2)
Constellation	QPSK, 16QAM, 64QAM, 256QAM (DVB-T2). Rotadas y no rotadas (DVB-T2)
<b>ATSC</b>	
Standard	ATSC A/53, A/54, A/64, A/153, A/110B, A/110: 2011, SMPTE-310M
Inputs	2xSMPTE BNC (F), 75 ohm - 2xASI BNC (F), 75 ohm
Constellation	8VSB
Symbol rate	10.76 Msimbolos/s
Data rate	19.39 Mbits/s
Trellis coding	2/3
Reed-Solomon coding	207 / 187 / 10
<b>ISDB -T/Tb</b>	
Standard	ARIB STB-B31, TR-B14
Inputs	2xASI BNC (F), 75 ohm
FFT size	2K, 4K, 8K
Code rate	1/2, 2/3, 3/4, 5/6, 7/8
Guard interval	1/4, 1/8, 1/16, 1/32
Carriers spacing	4 KHz, 2 KHz, 1 KHz
Hierarchical modulation	Up to 3 layers
Constellation	QPSK, 16QAM, 64QAM, DQPSK
<b>Clock and synchronization</b>	
Internal clock	10 MHz
External reference	10 MHz BNC (F). Impedance = 50 ohm / high (configurable). Level = -5 to +10 dBm
1pps reference	BNC (F). Impedance = 50 ohm / high (configurable)
SFN	Resolution SFN = $\pm 100$ ns. SFN configurable delay = $\pm 500$ ms
<b>Local and remote control</b>	
Keyboard and display	Local operation through the display and keyboard located on the front panel
RJ-45	Interface Ethernet network management for local and remote operation via SNMP agent and / or Web Browser
Parallel interface	Floating contacts for messages and commands
General	
Frequency range	UHF: 470 - 700 MHz (resolution: 1Hz)
Channel bandwidth	6, 7, 8 MHz plus the 1.7, 5 and 10 MHz for DVB-T2   ISDB-T/T , ATSC: 6 MHz
Cooling	Liquid
Power supply	Three-phase: 400VAC +/- 15%, 47 to 63Hz
Max. installation altitude	Up to 3000 m (> 3000 m on request)

**Remark:** To comply with the out-of-band regulations and with the required shoulder attenuation, the RF output of the transmitters must be connected to an appropriate filter.



**EGATEL.SL**

Web: [www.egatel.es](http://www.egatel.es)

e-mail: [egatel@egatel.es](mailto:egatel@egatel.es)

#### HEADQUARTERS

Edificio Egatel  
Av. Ourense, 1  
Parque Tecnológico de Galicia  
32901 Ourense  
Phone : +34 988 368 118  
Fax: +34 988 368 119

This document and all information contained therein is owned by Egatel S.L.  
It should not be copied, published or reproduced in whole or in part without our express consent



**Egatel**

**COMSA**  
CORPORACIÓN