PT2090 block diagram

OPTION PT2762/00 Synthesizer

RF Tuner

OPTION PT2791 Echo Canceler

OPTION PT2754 Adaptive Digital Pre-correction

OPTION PT2740 20 dBm output amplifier

System controller (Local and remote)

OPTION PT2710 Precision OCXO 0.0001 ppm

RS232/RS485 for SCPI control

RJ45 for Weblink & SNMPclient

(RF 30-1000 MHz)

Sense 1

Sense 2

Digital Signal Processing (RF 30-1000 MHz) Sense 1 Sense 2 System controller (Local and remote) OPTION PT2710 Precision OCXO 0.0001 ppm OPTION PT2762/00 Synthesizer RF Tuner OPTION PT2791 Echo Canceler OPTION PT2754 Adaptive Digital Pre-correction OPTION PT2740 20 dBm output amplifier (RF 30-1000 MHz) RS232/RS485 for SCPI control RJ45 for Weblink & SNMPclient
ProTelevision Technologies A/S is proud to present to the market the PT2090 Digital Repeater for re-transmission of a signal received on air. PT2090 Digital Repeater is the result of both theoretical fundamental work in the laboratory and extensive testing in the field on various locations. Especially the field testing has ensured that the algorithms handling signal processing is optimized to handle the unpredictable conditions that often exist outside the controlled conditions of a laboratory. We are confident that you will agree with us that the new Digital Repeater PT2090 offers the same excellent reliability, high performance and ease of operation as known from the other members of the ProTelevision product family.

PT2090 Digital Repeater is equally suitable for on-channel (iso frequency) signal repetition in SFN networks as for transposer operation with different input/output frequencies in MFN networks (transposer operation require only installation of the optional synthesizer module PT2762/00).

The PT2090 is available with an active or blank front panel.

**PT2090/00**: Standard digital repeater function with blank front panel. All operation (configuration and monitoring) is carried out through remote interface (Websevice/HTTP, SNMP Client Get/Set/Trap and RS232/SCPI). This version optimizes the cost further without sacrificing actual performance by omitting the front panel controls that would not be used anyway in an unmanned transmitter installation.

**PT2090/10**: Standard digital repeater function with sophisticated front panel control. All general operation (configuration and monitoring) is supported by the sophisticated front panel interface. The extensive use of dedicated function buttons as well as easily recognized soft key functions provides a truly user-friendly experience.

Full operation is also supported via remote interface (Websevice/HTTP, SNMP Client Get/Set/Trap and RS232/SCPI).

The typical application for the PT2090 Digital Repeater is to work in combination with any third party RF power amplifier and provide a high quality RF-signal in a DVB-T/H, ATSC 8-VSB or ISDB-T network. The PT2090 constitutes in itself a state-of-the-art product with market leading RF-performance. The built-in linear and non-linear pre-corrector function (IMD Buster McTwo SoftClip) included as standard with PT2090 facilitates furthermore easy and efficient optimization of the overall transmitter system performance (repeater plus RF power amplifier and channel/combiner filter) by allowing manual compensation of the nonlinearities usually encountered with any RF power amplifier and analogue RF filter. Addition of the optional adaptive pre-corrector solution PT2754 will enhance the ease of operation further by providing continuous automatic optimization of the transmitter performance (repeater plus RF power amplifier). The automatic optimization includes the RF power amplifier non-linearities (phase and gain response vs. power) as well as non lineairities in the channel/combiner filter following the power amplifier (amplitude and group delay vs. frequency).

The PT2090 supports frequencies in the range from 30 MHz to 1000 MHz in steps of 1 Hz. The frequency agile analogue pre-filtering provided in the specially designed high performance tuner (tracking filters) combined with sophisticated digital filtering in the actual signal processing path provides a superior selectivity which means that in most installations it will not be necessary to add any channel filtering between the receiving antenna and the PT2090 input.
The wanted signal to be repeated is received by the main TRX and transmitted to the digital repeater PT2090 PA. The unwanted feedback signal is fed back to the main TRX and remains isolated from the wanted signal, ensuring that it does not interfere with the repeated signal.
To allow the user to optimize the selectivity against the latency between the input and output of PT2090 the device offers user selection between five different filters (the most selective filter gives an input/output latency of less than 7 micro seconds). In addition the device is prepared for inclusion of a user specific filter characteristic.

The PT2090 is in the basic version intended for repeater operation in a DVB-T/H, ATSC 8-VSB or ISDB-T SFN network (identical input and output frequency). The fact that the input and output frequencies are identical means that the possible gain from input to output in the system is limited by the physical isolation between the receiving and transmitting antennas as the parasitic effect between the transmitting and receiving antennas eventually will cause serious instability. PT2090 provides in the basic form several features for ensuring stable operation (for example user specification of the maximum safe output level accepted). Still, in the basic version of PT2090 the gain repeater plus power amplifier gain must always be kept well below the available isolation between receiving and transmitting antenna to ensure stable operation. In order to enhance the possible gain beyond the actual isolation between input and output antenna the Echo Canceler option PT2791 is available.

When the echo canceler option is installed PT2090 is capable of maintaining stable operation even with a positive loop gain (positive loop gain exists when the gain provided by the repeater plus power amplifier exceeds the isolation between transmitting and receiving antennas). This means that a considerably higher level of amplification is possible when the echo canceler option is installed. Notice though that the signal to be identified and suppressed by the echo canceler when using the PT2090 in an outdoor environment is not only a static contribution originating from the parasitic coupling between the transmitting and receiving antennas; the feedback between the antennas may often exhibit a strong dynamic characteristic caused by such factors as antenna vibration/oscillation due to wind effects, and changing reflections from for example trees, windmills, large vehicles and airplanes. The algorithms used by the echo canceler function in the option PT2091 are optimized and proven for use even in strongly dynamic environments through experience gained from extensive field testing. It’s furthermore important to notice that the power amplifier connected to the digital repeater will be well protected as the echo canceler prevents any form of self oscillation. In addition, a special circuit is preventing the output level from ever exceeding a predefined limit (set by the operator). The user of a PT2090, equipped with option PT2791, can be confident of stable operation in any environment while supporting the highest possible gain. At the same time the amplifier is perfectly protected against excessive levels that would damage or even destroy the amplifier.

By including the optional Synthesizer PT2762/00 the Digital Repeater PT2090 will support also transposer operation characterized by different input and output frequencies. In this operational mode the physical isolation between the receiving and transmitting antennas vs. the possible gain is less critical compared to the iso-channel operation described above as the input and output is separated in the frequency space by at least one channel.

In order to have full flexibility in regards to the use of the Digital Repeater PT2090 (repeater in SFN mode and transposer in MFN mode the unit should be equipped with both the Synthesizer option option PT2762/00 as and the Echo Canceler PT2791 should be installed.

It should also be noted that the PT2090 in addition to processing of RF channels modulated in DVB-T/H, ATSC 8-VSB or ISDB-T format in 8, 7, 6 and 5 MHz bandwidth also is capable of handling analogue modu-
lated television channels (ATV-signal). As the optimal processing for an ATV-signal differs compared to the optimal signal processing of a DVB-/H-signal, the PT2090 can automatically detect if it is processing an ATV-signal or a DTV-signal and based on this, the PT2090 will use the relevant signal processing. If preferred, the choice between ATV and DTV operation can also be done manually through the local or remote management system; PT2090 is therefore also the perfect tool for ATV-networks which are scheduled to convert to DTV for example on a given date or which operate a mixture of ATV and DTV during the 24-hour period.

Remote operation

The remote interface included as standard with PT2090 (webservice and SNMP client) facilitates easy remote control and monitoring both via Web browser and as an integrated solution in a larger management system based on the SNMP clients get, set and trap functions. SW/FW update is furthermore easily carried out from a remote location through the web interface (HTTP and FTP format supported).

The features and the performance make the PT2090 simply the best choice for repeater and transposer applications in any DVB-T/H or ATV network.

General

In addition to the state-of-the-art implementation of the digital signal processing the Digital Repeater PT2090 is characterized by:

- Highly sensitive and selective tuner
- Supports the most cost effective solution for gap fillers without sacrificing performance (SFN iso-channel operation with shared LO for down- and up-conversion)
Optional synthesizer function for seamless integration on the base unit will add full agility with regards to input and output frequency setting (MFN transposer operation)

- Extensive frequency range supported (input/output): 30 MHz to 1 GHz
- Scalable digital filtering for optimization of selectivity vs. latency
- High precision squelch function with programmable hysteresis
- User selection between Automatic and manual gain control with adjustable maximum gain
- Limitation of output level to user specified maximum level for effective power amplifier protection
- Built-in linear/non linear pre-corrector for manual optimization of amplifier performance
- Optional adaptive pre-corrector for linear pre-correction (seamlessly integrated)
- Full control via Ethernet and RS232
- Optional GPS receiver (seamlessly integrated) for precision frequency offset
- Optional echo canceler available
- Built-in Ethernet switch with four ports
- Frequency agile design: no tuned input channel filter is required for neighbor channel suppression
- Ground closure alarm inputs for generation of SNMP traps by external alarm conditions
- User friendly SW/FW update via Ethernet
- Support of DVB-T/H modulated transmissions as well as analogue modulated television
- Fully programmable alarm management including user programmable muting, event logging, e-mail transmission and SNMP trap generation

The PT2090 is based on the new PT2000 platform from ProTelevision, thus taking advantage of a large FPGA, a powerful DSP and a powerful Power PC micro controller running an Open Source Linux operating system.

The PT2090 Digital Repeater assures that the customer gets a reliable partner in the DVB-T/H network for many years of operation.

Spectrum efficiency and purity of the signal are the inspiration for ProTelevision and reflected in our products throughout the years. PT2090 makes no exception of this. One of the secrets behind the astonishing performance is that a noise shaped bandwidth limited clipper is used to control the crest factor.

In addition to this, the importance of the pre-corrector is essential.

In combination by using the pre-correction software IMD-buster, the tools are given to the operator to archive a on-air signal fulfilling the required on-air filter masks with a minimum of additional filtering (in external filter or combiner).
When operating the unit in iso-channel mode (repeater application), the same oscillator will control up- as well as down- conversion. Any discrepancy between the oscillator frequency and the nominal frequency for the specific channel frequency will cause numerically equal but oppositely signed offsets in the down- and up-conversion processes which in effect will cancel each other out. The absolute accuracy of the internal reference (TCXO) is therefore without actual significance to the repeater application.

When PT2090 is used in a transposer application (operation with different input and output frequency enabled by addition of synthesizer option PT2762/00) the inherent independence from absolute frequency accuracy known from the iso channel configuration is no longer existent. For transposer applications where a frequency accuracy better than the accuracy of the built-in standard TCXO is required two options exist; an OCXO with an accuracy of 0.001ppm (option PT2710) and a GPS based reference (option PT2711).

In order to support such requirements, the PT2090 has a in-built high precision GPS-function, option PT2711.

In addition to all the functionality implemented in the standard version of the PT2090, ProTelevision have developed some new features which can be added to the PT2090 as options. The available options are at current stage as follows:

- PT2710 Precision OCXO, 0.0001 ppm
- PT2711 GPS
- PT2740 20 dBm output amplifier.
- PT2754 Adaptive digital Pre-corrector
- PT2762/00 Synthesizer
- PT2791 Advanced Echo Cancellation functionality for DVB-T/H, ATSC 8-VSB and ISDB-T

The extremely high precision OCXO option, PT2710, offers an accuracy of 0.0001 ppm.

The high precision GPS-functionality, option PT2711, integrated in the modulator board eliminates the requirement for an external GPS-unit at the site. Thus a considerable cost saving can be made as well as easier management and faster start up can be obtained. The GPS-unit is prepared for active and passive antennas and is able to handle cables with length of more then 100 meters, type RG213/KX4. The GPS-unit has 10 MHz and 1 pps outputs and is extremely suitable for operating as the common site GPS-central unit.

The manual pre-correction, included as standard with PT2090, is complemented by the option PT2754, an adaptive digital pre-corrector with extraordinary performance. The adaptive digital pre-correction process of PT2754 is extremely fast; the time required for identifying and compensating amplifier and filter related nonlinearities is typically 10-20 seconds. The state of the art signal processing algorithms used by PT2754 in combination with the unique separate handling of the upper and lower side band, ensure an output spectrum with outstanding performance.
**Technical specification**

### Signal inputs

**RF input**
- **Connector:** N
- **Input impedance:** 50 Ω
- **Return loss:** > 16 dB
- **Freq. range:** 30 MHz - 1000 MHz
- **Input level:** 30 - 100 dBuV (-77 dBm to -7 dBm) *
- **Input noise figure:** < 8 dB @max gain (typically 6.5 dB)
- **Immunity to other channels:**
  - adj. ch N±1: analog signal sync/OFDM > 40 dB*
  - digital signal OFDM/OFDM > 30 dB*
  - other ch: analog signal sync/OFDM > 46 dB*
  - digital signal OFDM/OFDM > 40 dB*
- **Selectivity:** > 65 dB attenuation outside ± 4.2 MHz relative to center frequency **

*) Measured as the threshold for QEF reception, mode=8K, 64QAM, CR2/3 (subj. to change)

**) depending on selectivity-filter choice

### 10 MHz input

- **Connector:** BNC
- **Frequency:** 10 MHz ±2 ppm
- **Input impedance:** 50 Ω/ > 1 kΩ selectable
- **Return loss:** > 20 dB (50 Ω)
- **Amplitude:** 100 mVpp - 3 Vpp

### Signal outputs

**RF output**
- **Connector:** N
- **Frequency:** 30 MHz - 1000 MHz
- **Frequency step size:** 1 Hz
- **Spectrum polarity:** Selectable inverted or non-inverted
- **Output impedance:** 50 Ω
- **Nominal output level:** 0 dBm
- **Adjustable rel. to nom. level:** +0 to -10 dB
- **Stability at nom. level:** ±0.3 dB in operating temp. range rel to 25 °C
- **Returnloss:** > 16 dB
- **Output bandwidth:** 24 MHz / ± 3 dB
- **Amplitude flatness:** < ± 0.5 dB, center freq. ±3.8 MHz
- **Spectrum mask:**
  - (Frequencies relative to center freq. are based upon the 8 MHz BW version. In 5, 6 and 7 MHz BW frequencies are scaled down respectively)
  - Figures without adjacent channels:
    - ± 3.8 MHz: 0 dB (ref)
    - ± 4.25 MHz: < -48 dB
    - ± 5.25 MHz: < -56 dB
    - Shoulder level: < -50 dB at nom. level (modulation side bands excluded)
- **Phase noise SSB according to AC106 VALIDATE Deliverable 14**
  - 10 Hz: < -55 dBc/Hz
  - 110 Hz: < -85 dBc/Hz
  - 3 kHz: < -85 dBc/Hz
  - 1 MHz: < -130 dBc/Hz
- **MER value:** ≥ 42 dB in both 2K, 4K and 8K mode

### Harmonics and spurious:
- < -50 dB rel. to wanted signal level (below 1 GHz)
- < -40 dB rel. to wanted signal level (above 1 GHz)

### Side bands:
- Unwanted phase modulation of carriers
  - -40 dBc for f=fo±100 kHz, decreasing with 6 db decade outside ±100 kHz

### 10 MHz ref. clock output

- **Connector:** BNC
- **Impedance:** 50 Ω
- **Return loss:** > 20 dB (5 - 15 MHz)
- **Output:** 1 V ± 0.2 Vpp square wave @ 50 Ω load
- **Risetime:** 3 - 10 ns
- **Stability:** 1.5 ppm in operating temperature range (Internal TCXO, no external locking)
- **Ageing:** 2 ppm pr. year

**Input-to-output performance**

MER degradation vs. RF inp.level and loop gain (typical measurements @ 474 MHz):

<table>
<thead>
<tr>
<th>Loop gain 0 dB {No echo} – EC Option disabled</th>
<th>RF Input level</th>
<th>MER @ RF Input</th>
<th>MER @ RF Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>-27 dBm</td>
<td>46.3 dB</td>
<td>42.6 dB</td>
<td></td>
</tr>
<tr>
<td>-37 dBm</td>
<td>45.1 dB</td>
<td>42.6 dB</td>
<td></td>
</tr>
<tr>
<td>-47 dBm</td>
<td>39.6 dB</td>
<td>42.4 dB</td>
<td></td>
</tr>
<tr>
<td>-57 dBm</td>
<td>39.6 dB</td>
<td>39.9 dB</td>
<td></td>
</tr>
<tr>
<td>-67 dBm</td>
<td>34.0 dB</td>
<td>32.3 dB</td>
<td></td>
</tr>
<tr>
<td>-72 dBm</td>
<td>29.0 dB</td>
<td>27.4 dB</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Loop gain 0 dB {No echo} – EC Option active</th>
<th>RF Input level</th>
<th>MER @ RF Input</th>
<th>MER @ RF Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>-27 dBm</td>
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<tr>
<td>-72 dBm</td>
<td>29.0 dB</td>
<td>27.3 dB</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Loop gain 5 dB {Echo 5 dB above wanted signal} – EC Option active</th>
<th>RF Input level</th>
<th>MER @ RF Input</th>
<th>MER @ RF Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>-27 dBm</td>
<td>46.3 dB</td>
<td>40.5 dB</td>
<td></td>
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<tr>
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<td>39.6 dB</td>
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<td></td>
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<td>-72 dBm</td>
<td>29.0 dB</td>
<td>27.1 dB</td>
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</tbody>
</table>
Loop gain 10 dB (Echo 10 dB above wanted signal) – EC Option active
RF Input level  MER @ RF Input  MER @ RF Output
-27 dBm  46.3 dB  37.5 dB
-37 dBm  45.1 dB  37.7 dB
-47 dBm  39.6 dB  37.7 dB
-57 dBm  39.6 dB  36.8 dB
-67 dBm  34.0 dB  31.5 dB
-72 dBm  29.0 dB  26.9 dB

Shoulder level and MER vs. RF input level (typical measurements @ 474 MHz):

Loop gain 0 dB (No echo) – EC Option disabled
RF Input level  shoulder height  MER @ RF Output measured at tuner output
-7 dBm  53.0 dB  40.6 dB
-17 dBm  53.8 dB  41.4 dB
-27 dBm  53.8 dB  41.9 dB
-37 dBm  53.6 dB  42.2 dB
-47 dBm  49.0 dB  41.7 dB
-57 dBm  40.6 dB  39.9 dB
-67 dBm  30.7 dB  32.0 dB
-76 dBm  21.1 dB  22.1 dB

Selectivity (measurement on CH30 with disturbing signal (DVB-T) on CH31, level of CH30 is -57 dBm):

CH31 level and ratio CH31/CH30  Output MER  Output BER after Viterbi
Ref CH30 only  39.0 dB  0
-57 dBm/ 0 dB  38.1 dB  0
-47 dBm/10 dB  37.6 dB  0
-37 dBm/20 dB  34.8 dB  0
-27 dBm/30 dB  25.7 dB  0
-24 dBm/33 dB  23.0 dB  0
-22 dBm/35 dB  21.4 dB  0
-21 dBm/36 dB  20.8 dB  0
-20 dBm/37 dB  20.2 dB  1.3E-5
-19 dBm/38 dB  19.7 dB  1.7E-4

Control interfaces
Ethernet interface connector
Connector: RJ45 (1 on front, 2 on back)
Protocols: TCP/IP (SNMP, HTTP, SSH)

Serial Control Interface
Function: RS232/RS485 remote control
Connector: Sub-D 9-pin male

SIGNAL PROCESSING
Digital processing
OFDM clipping
• Clipping (limiting) is adjustable between 2 dB and 12 dB rel. to signal RMS level in steps of 0.1 dB
• Filtering of clipping side bands is adjustable from 0% [no filtering] to 100% [full filtering]

Output headroom
Controls the system headroom by adjusting the signal RMS level
• Settings: 12 dB, 15 dB [default], 18 dB, 24 dB

Non-linear pre-correction
• Full I & Q amplitude and phase correction
• Correction data down loadable from serial control interface, Ethernet or automatically using adaptive precorrection
• Individual correction on upper and lower sideband
• 10 programmable settings stored in nonvolatile memory

Linear pre-correction
• Magnitude and Group delay correction
• Correction data down loadable from serial control interface, Ethernet or automatically using adaptive precorrection
• 10 programmable settings stored in nonvolatile memory

Output muting
• RF output can be muted controlled via the serial control interface, Ethernet or the HW mute input
• RF output can furthermore be muted automatically by one or more alarm conditions according to user programming

Test signals
• Single carrier (center frequency) RMS level like normal signal (converter alignment, phase noise, level alignment)
• OFDM PAPR 3 dB

Pre-correction
The pre-corrector option supports non-linear pre-correction (gain and phases vs. power level) and linear pre-correction (level and group delay response vs. frequency). The pre-corrector allows furthermore hard or soft clipping control of the peak power level (range +12 dB to +2 dB peak power relative to average RMS level).

Non-linear correction:
Curve formats: S21 and VO/VI
Amplitude scale: Linear and logarithmic
Correction points: Max 256, user-defined position
Gain correction: Max 12 dB, subject to available headroom
Phase correction: -6 to +30 degrees, subject to available headroom

Linear correction
Correction points: 21
Point spacing: 1/20 of nominal spectrum BW
Amplitude correction: ±10 dB
Amplitude resolution: 0.01 dB
Group delay correction: ±1000 ns
Group delay resolution: 1 ns
**Power supply**
- Voltage: 100 - 240 VAC
- Frequency: 47-63 Hz
- Consumption: Max. 75 W

**Environmental Specification**
- Climatic Temperature range operating: -5 °C to +50 °C (+23 °F to +122 °F)
- Temperature range within specs: +5 °C to +45 °C (41 °F to +113 °F)
- Temperature range storage: -30 °C to +70 °C (-22 °F to +158 °F)
- Humidity operating: max 90% RH
- Humidity storage: max 90% RH

**EMC**
- Compliant to EN50022 (emission) and EN55024 (immunity).

**Safety**
- Compliant to EN60950-1

**RoHS**
- Compliant with directive 2002/95/EC.

**Mechanical Specification**
- Cabinet: 19” wide, 1RU high
- Width: (19”)
- Height: 44 mm (1.75”)
- Depth: 483 mm (19”)
- Weight: 6 kg (16 lbs)
- Cooling: Long life fans, two in parallel with magnetic bearing, to assist natural convection

- Transport and storage: Vibration acc. to IEC Publ.68

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**Basic digital repeater**
- PT2090/00 Digital repeater base unit, blank front 9449 020 90001
- PT2090/10 Digital repeater base unit, with front ctrl 9449 020 90101

**Options, software**
- PT2711 GPS 9449 027 11001
- PT2754 Adaptive digital Pre-corrector 9449 027 54001
- PT2791 Advanced Echo Cancellation functionality 9449 027 91001

**Options, hardware**
- PT2710 Precision OCXO, 0.0001 ppm* 9449 027 10001
- PT2740 20 dBm output amplifier* 9449 027 40001
- PT2762/00 Synthesizer* 9449 027 62001

* Factory installation only.
The Terrestrial Gateway product family from ProTelevision Technologies includes a range of products (Network Elements) that each include one or more interfaces for transmission of DVB-T/H, ATSC 8-VSB, MediaFLO™ or ISDB-T:

**PT2060 Modulator:** Provides an interface/gateway for transmission in ATSC 8-VSB format based on input of transport stream in SMPTE-310 and ASI format (TSoIP interface available as an option)

**PT2070 Modulator:** Provides an interface/gateway for transmission in MediaFLO™ format based on input of transport stream in ASI format (TSoIP interface available as an option)

**PT2077 Transceiver:** provides an interface/gateway for transmission in DVB-T/H format based on input of a DVB-T/H signal delivered via satellite in DVB-S/S2 format

**PT2080 Modulator:** provides an interface/gateway for transmission in DVB-T/H format based on input of MPEG-2 TS in ASI format or (optionally) MPEG2 TS over IP format

**PT2088 Re-modulator:** provides an interface/gateway for transmission in DVB-T/H format based on input of a DVB-T/H signal delivered off-air from another DVB-T/H transmitter (the device is regenerative meaning that the input signal is completely demodulated to MPEG-2 TS format before being remodulated onto a ‘fresh’ DVB-T/H spectrum)

**PT2090 Digital Repeater:** provides an interface/gateway for transmission in DVB-T/H format based on input of a DVB-T/H, ATSC 8-VSB, MediaFLO™ or ISDB-T signal delivered off-air from another DVB-T/H, ATSC 8-VSB, MediaFLO™ or ISDB-T transmitter (the low internal latency through the device makes it ideal for Gap filler applications)

**PT2000 Terrestrial Gateway:** combines all the above listed units into a single device thus providing a universal interface/gateway for DVB-T/H transmission.