



TST 4045

HF Modem 2.4 Kbps with FEC

The TST 4045 is a high speed, high performance short wave data modem, using latest digital signal processing technology. It can be utilised in high-speed data transmission for accurate and reliable radio communication links. Cipherring of DATA & voice is optionally available.



TST 4045

Short Wave Modem

The TST 4045 is a high speed, high performance HF data modem, using latest digital signal processing technology.

The modem is intended for

- high speed data
- V.24 facsimile
- narrow-band secure digital voice
- slow scan tv
- direction finder data and
- telemetric data.

The TST 4045 uses the serial single tone transmission mode instead of the parallel multi-tone principle of the former one. The transmission protocol is according to the military NATO-standard STANAG 4285.

Operation

The HF Modem TST 4045 can be utilised for high-speed data transmission via HF communication systems to achieve accurate and reliable radio communication links. It can be operated as a stand-alone equipment or in adaptive communication systems.

Description

The TST 4045 allows fast data transmission over HF radio communication systems with high performance, high availability and high reliability of the radio link.

One of the main advantages of the HF Modem is the efficient use of the channel bandwidth as well as of the HF transmitter power.

At the receiving site a decision feed back equaliser (DFE) and a channel matched filter eliminate the typical distortions of the HF channel caused for example by multipath propagation.

During data transmission both modules – transmitter and receiver – are continuously adapted to varying channel conditions.

To cope with fast variations of the channel situation in real time, a high performance algorithm for signal detection and signal equalization is implemented on the powerful digital signal processor. This ensures low bit error rates even in the presence of large multipath propagation and doppler spread.

The forward error correction unit (FEC) eliminates the remaining bit errors.

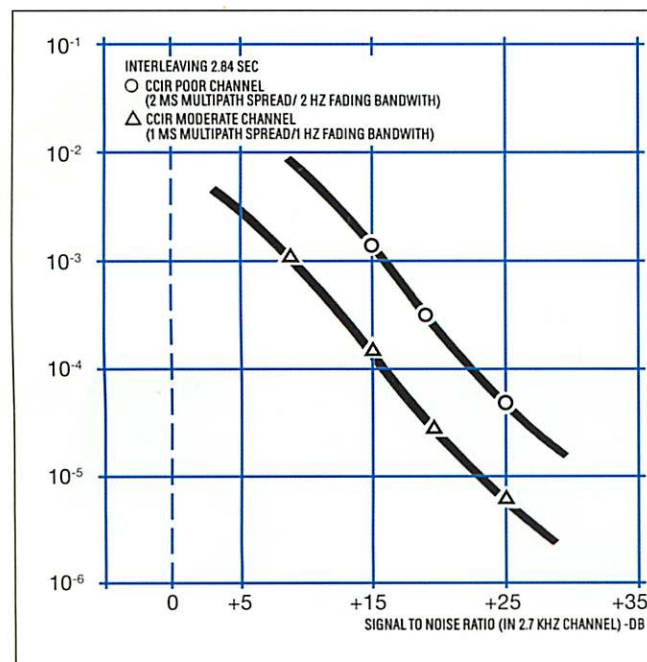
To cope with burst errors the interleaving mode can be selected.

Applications

- Long-distance HF-data communications
- Naval broadcast and ship-shore communications
- Transmission of burst signals, e.g. for control of direction finders
- Transmission of digital ciphered voice signals with TST 7698 crypto device
- Transmission of ciphered digital data with TST 5573 cipher set, built-in the modem

Highlights

- Adaptive echo cancellation, channel matched filter
- Tolerates large multipath and doppler spreads
- Error correction by means of FEC and interleaving
- Full duplex, half duplex or simplex operation
- Adaptive notch filters
- Serial data interface, synchronous and asynchronous transmission, different data rates
- Full remote control by serial control interface
- Mains (AC) or battery (DC) operation
- For stationary, shipboard or mobile operation
- Totally closed 19" cabinet, one height unit, EMC-shielded
- Efficient self-test system (BITE), fault storage in non-volatile memory



○ CCIR POOR:

Parameter	Path 1	Path 2	Path 3	Path 4
Rel. Amplitude	1.0	1.0	-	-
Delay (msec)	0.0	2.0	-	-
Freq. Offset (HZ)	0.0	0.0	-	-
Dopplershift (HZ)	1.0	1.0	-	-

Interleaving depth 2.84 sec, 25 db SNR: BER = $3.0 \cdot 10^{-5}$

Interleaving depth 2.84 sec, 15 db SNR: BER = $1.2 \cdot 10^{-3}$

△ CCIR MODERATE:

Parameter	Path 1	Path 2	Path 3	Path 4
Rel. Amplitude	1.0	1.0	-	-
Delay (msec)	0.0	1.0	-	-
Freq. Offset (HZ)	0.0	0.0	-	-
Dopplershift (HZ)	0.5	0.5	-	-

Interleaving depth 2.84 sec, 25 db SNR: BER = $4.0 \cdot 10^{-4}$

Interleaving depth 2.84 sec, 15 db SNR: BER = $1.2 \cdot 10^{-6}$



TST 4045
Short Wave Modem

Description of Options

Due to the modular design of the TST 4045 a variety of options are available, either software controlled or by adding hardware with software:

● CIPHERING OPTION (-47)

This option comprises hardware and software add-on and provides absolute security for the transmitted data. The TST 10E80 cipher algorithm is implemented, which is approved by government authorities. It's design exhibits both – a provable period of 10E80 and a provable non-linearity together with statistically flat bit distribution. The cipher output depends entirely on the key-variables set up by the user. This option provides a 4-fold key-code hierarchy:

1. Family key with 10E38 variables.
2. Master key with 10E22 variables.
3. 9 different A-keys with 10E18 variables each.
4. Message key with 10E12 variables automatically generated with physical, non mathematical randomness each time the data transfer starts.

The message key is transferred in self enciphered form to the receiver. Key loading is via TST Key Management system by means of a PC/notebook.

The TST 4045 uses stream cipher, bit by bit, and does not produce error propagation.

● SELECTIVE CALL OPTION (-51)

In broadcast networks (shore to ships, press, foreign office) it might be desirable to address one single station only or a limited group of stations. For this purpose the TST selective call offers the possibility to selectively address a single station, a small group, a larger group or all stations. A menu guided operator friendly selection is available as a software package for the PC/notebook.

● VOCODER OPTION FOR PLAIN DIGITAL VOICE (-52)

In many applications it is required to transmit voice digitally over HF. TST offers a hardware module vocoder, that can fit into a TST 4045 and which has been designed for excellent voice recovery and immunity to occasional errors.

● VOCODER OPTION FOR ENCIIPHERED DIGITAL VOICE (-53)

As above, but with strong ciphering algorithm and Key Management (see "TST Key Management") according to TST 7698 (see separate leaflet).

● LONG INTERLEAVER OPTION (-54)

While the standard interleaver is used for quick (RX/TX) change for voice traffic, the long interleaver is selected for HF links with deep fading when error free data transfer is required.

Built-in Test Equipment (BITE)

The TST 4045 runs in a system check-up, testing all components after the power is applied to the equipment.

A test pattern generator and bit-error rate analyzer for determination of the channel bit error rate and the channel's S+N/N ratio is standardly built-in, and accessible via the built-in control interface.

Details of Electronics and Construction

The TST 4045 is constructed in modular technique using multilayer PC boards. The Digital Signal Processor board TST DSP 45 uses PALS and high speed S-RAMs. The signal processors are 10 MIPS, 16 bit floating point TI 320C25's. All integrated circuits are of C-MOS design for high reliability and low power consumption. The TST 4045 receives 5 V DC and +/- 12 V DC at a maximum of 25 W. The power supply can produce the voltages from either an AC power supply or a DC/DC converter 18 ... 32 V DC (see "Specifications").

Maintenance and Service

The high reliability of the TST 4045 makes maintenance and service unnecessary, usually for the complete lifecycle of the equipment. However, diagnostic fault isolation software is provided, indicating the source of failure by LED lamps or by showing it on the display for fast rectification.

Training

Courses are available for users operating the TST 4045 either at the TST training center in Tutzing / Munich or at the user's location.

Nomenclature, Options & Accessories

TST 4045	HF Modem 2.4 Kbps effective throughput with FEC and 90 ... 250 V AC power supply
Option -46	18 ... 32 V DC power supply instead of AC power supply
Option -47	High security ciphering option / for V.24
Option -51	Selective call option for DTE software
Option -52	Built-in vocoder option for digital voice
Option -53	Built-in vocoder option for digital <u>secure</u> voice (TST 7698, see separate leaflet)

Accessories V.24 cable to DTE, 1.5 m
Audio cables for transmitter and receiver, 2.5 m ea.
Mounting tray for mobile use with shockmounts

Specifications

Technical Data

Modes	simplex, half- or full-duplex
Data rates	75, 150, 300, 600, 1200, 2400, 3200 bit/sec
FEC Coding	convolutional coding, soft decision
Interleaving	short / long
Modulation	2 / 4 / 8 PSK convolutional
Carrier frequency	1800 Hz
Multipath tolerance	up to 6 msec
Bandwidth	-25 dB: max. 3 kHz, (0.3...3.3 kHz) -3dB: max. 2.4 kHz (0.6...3.0 kHz)
Correctable frequency	± 75 Hz start value
Offset / shift	up to 3.5 Hz/sec tracking
Demodulation	coherent with channel matched filter and equalizer
Notch filter	adaptive

Interfaces

Data interface	EIA RS 232C, DIN 66020, CCITT V.24/V.28
Control interface (inside connector)	EIA RS 232C, DIN 66020, CCITT V.24/V.28
Interface data rate	75, 150, 300, 600, 1200, 2400, 4800, 9600 bit/sec asynchronous

AF Radio Interface

Level (In/Out)	0 dBm
Input level	-20 dBm to +6 dBm, adjustable

Impedance (In/Out)	600 Ohms, 2-wire, balanced
PTT output	acc. DIN 66020 V.28

Set-up time	adjustable, 3 msec to 10 sec
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Power Supply

Mains operation	93 to 255 V AC, 47 to 400 Hz, ≤25 W
Battery operation	18 to 32 V DC, ≤25 W

Dimensions

H x W x D mm	44x484x465 (with grips), 19"-rack
Weight	app. 4.5 kg
Temperature	-10 to +55°C operation -30 to +70°C storage

Environmental conditions

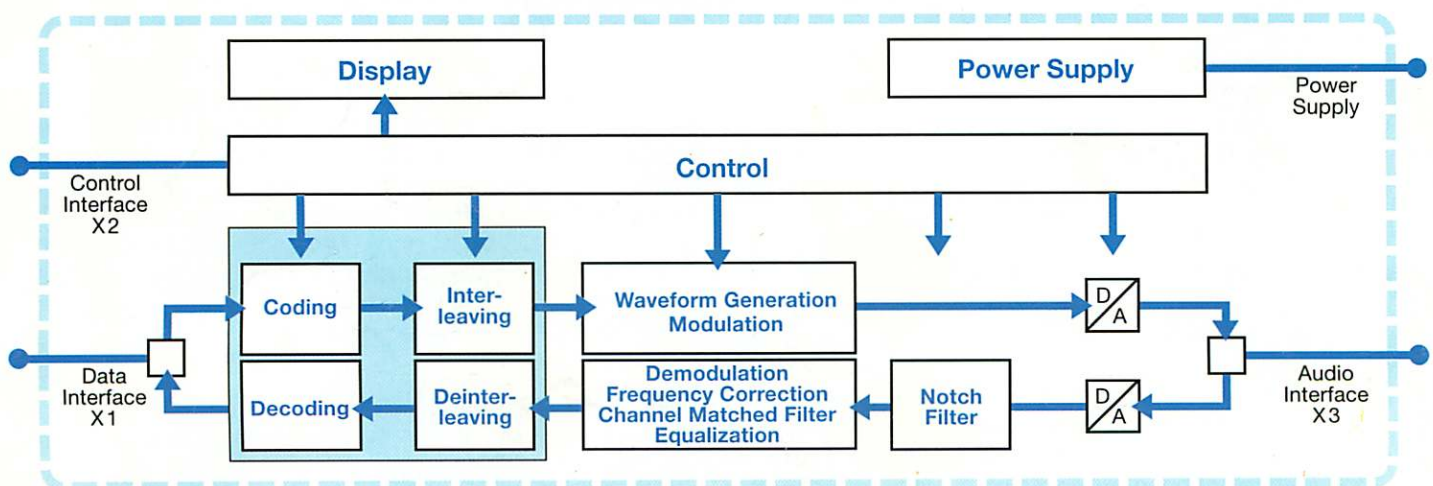
Humidity	≤75% rel. humidity on annual av. ≤90% on 30 days of a year
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Display and control elements

Displays	LEDs for transmit / receive and status (GO / NOGO). LCD-display for mode, signal quality, parameter settings and test results
Control elements	push-buttons for ON/OFF, TEST and operation / parameter setting

Specifications and appearance may be changed without prior notice.

Block Diagram TST 4045



TST since 1970
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