

TST7698

Highest Security Mini-Voice-Coder-Cipher Set

Digital - voice coding
Narrow-Band - ciphering
0.3-3 KHz - transmission
Two Coding Processes - Optimized for all
link conditions

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NOTE:

If your equipment outputs a warning warbling 30 Hz tone after taking it into operation, this is an indication that the set has been emergency erased (EE). The set now requires new keys. Proceed as per page 31 ff.

MINI - VOICE - CODER CIPHER SET

CONTENTS

	Page
Product Description	3
Cipher and Security	4
Application	5
Details of Electronics and Construction	6
Requirements in Respect to Telephone or Radio Connections	6
Maintenance and Service	7
Training	7
Options and Accessories	7
Specifications TST 7698	8
Connection to the Telephone System	10
Telephone Operation	11
Connection to Radio Equipments	12
Suggested Circuit to Connect TST 7698 to PRC-77 Radio	12
Keys: Structure - Loading - Management	15
1. Family Key	15
2. Master Key (loading by key injector or manually)	16
3. Auxiliary Key I	16
4. Message Key	17
Setting up a Network	19
Cryptography	20
Cryptographic Considerations	20
Mechanical Construction	21
Functional Description	22
1. Send Preamble-Start Sequence	22
2. Receiving	23
3. Block-Diagram of TST 7698	24
4. Parameter Setting, Manual	25
5. Parameter Set-up, Automatic	27
6. Functions of the Frontpanel LED	27

	Page
Operation	28
1. Charging (only with Option -31)	28
2. Initial Programming of the Family Key	28
3. Normal Use	28
4. Emergency Erase	30
5. Key Insertion Using the Frontpanel Switch	31
5.1 Key Insertion After the Emergency Erase	31
5.2 A-Key-Insertion	31
5.3 M-Key-Insertion	31
6. Key Setting Using the Key-Injector TST 0700	32
6.1 General	32
6.2 Master and Auxiliary Key-Insertion	
Using the Key-Insertion Unit	32
Handset Wiring and Specifications	33
Frontpanel Wiring TST 7698	34
Maintenance and Adjustment	36
Warranty	36
Important Note	36

PRODUCT DESCRIPTION

The TST 7698 is a Mil-spec miniature voice coder with highest security ciphering and integral voice band modem operating on -telephone, VHF-UHF radio links and, at a reduced speech quality, also in -HF radio communication systems.

The first coding process, which produces close to "telephone quality" speech, uses a TST-proprietary algorithm based on "Residual Excited Linear Prediction" principles producing a 9.6 Kbit data stream. After being enciphered, this data stream is modulated by the integral automatic adaptive PSK modem.

The bandwidth required is 0.3.....3.0 KHz, the signal to noise ratio (S/N) must be better than 20 db. This is standardly found in the telephone, VHF and UHF connections.

The second coding process is based on advanced LPC⁺ vocoder, which produces a somewhat synthetic, however easy to understand voice quality - incl. speaker recognition - at a 2.4 Kbit data stream. After being enciphered, this data stream is modulated by the PSK modem, which now only requires a bandwidth of 0.52.6 KHz with a signal to noise ratio (S/N) of only 8 db. This permits the use of the TST 7698 in HF-SSB connections of good to medium quality. Both processes are built-in and are front panel selectable.

The set is built up entirely of custom-made ICs, mostly C-Mos type, for low power consumption and highest reliability.

The set features a DC power supply from 10.....32 V DC at 7 W consumption max. at greatly reduced standby current.

The extremely small size and low weight of this complex set, along with the universal selectable coding process and the highest cipher security obtainable today, make this set the military communication security set of the future.

A duplex version for 4-wire operation is also available.

CIPHER AND SECURITY

The TST 7698 uses a new method of ciphering, made possible by the proven 1080 non linear cryptologic concept, which is also used in the total of the TST product-range, however, the output bits, usually 5, are reduced to 1 output bit, as only 1 is required for bit by bit encryption as used in the TST 7698 voice cipher set. The keystream generator sequence length is 10^{71} years !!!!!

1. The family key of the individual sets is invisibly programmed (option -87) at headquarters (EPROM).
2. The master key is fed into the set by means of a key-injector or manually by authorized personnel.
3. The auxiliary key is an independant separate key and is also injected with a key-gun, or manually.

1 master key and 9 different A-keys can be stored in the TST 7698 when a key-insertion unit is used and can be selected by the frontpanel switch.

1 master key and 7 auxiliary key are stored in the TST 7698 being inserted by the frontpanel switch in a sequential manner.

4. The message key is generated automatically at random each time the sets are synchronized.

The 4 different keys permit flexible system configuration and highest security.

A self test program continuously supervises the correct operation of ciphering.

Emergency erase of all keys is performed, when the frontpanel switch is set to 0, the PTT of the handset is depressed and the set switched off and on. After an emergency erase, a warning tone is heard in the handset, and it is possible to insert new keys.

If no key information is available, the set is completely blocked and cannot be used except in clear-mode.

APPLICATION

The excellent security, good speech quality and easy speaker recognition of the TST 7698 render it useful to secure strategic and tactical military voice communications, as well as political and diplomatic conversations.

The new fact that the TST 7698 is a full digital voice cipher set operating both in telephone grade circuits and in low-grade links (previously only possible by use of bulky, expensive, power consuming Vocoders) makes it particularly useful in highest security applications. The powerful cipher principles employed result in unbreakable voice security. Good speaker recognition permits the unambiguous identification of the partner.

Standard interfaces allow trouble-free connection to manpack portable radios or to stationary radio equipment. Mounting trays are available for manpack and vehicle installations.

The clear voice feature enables the user to continue clear communications through the voice cipher set at reduced power drain, when this is required. The excellent user-interface makes the set easy to operate and quick to learn.

DETAILS OF ELECTRONICS AND CONSTRUCTION

The TST 7698 is entirely built-up with custom-made integrated circuits, mostly C-Mos types. The technical expertise of the TST 7690 military voice cipher set and the TST 7695 duplex voice coder/cipher set is combined and improved. The total integrated transistor cells are more than 3 million.

The set uses 5 modules, easily replaceable:

- voice coder module with A/D and D/A converters
- cipher and control module with key-storage memory (5 years)
- PSK modem module, automatic adaptive
- 10 ... 33 V power supply module
- front panel + RFI filter module

REQUIREMENTS IN RESPECT TO TELEPHONE OR RADIO CONNECTIONS

The TST 7698 is the first small-size cost effective digital voice cipher set operating in both VHF, UHF and HF-SSB radio networks, also where analogue repeaters are in use, since the bandwidth requirement is only 300...3000 Hz. **No costly replacements of repeaters are necessary.**

The TST 7698 can work well in all **dial-up or leased-line** telephone circuits. Its dynamic range of 40 db as well as the automatic digital adaptive equalizer of the modem receiver provide troublefree, highest security voice secrecy.

MAINTENANCE AND SERVICE

is facilitated by rapid exchange of the 3 printed circuit boards, the power supply module or the front-end-connector module.

All circuits are contained on PC-boards, no coils or other adjustable components are used. All parts used are of MIL-spec-type, pretested and with 168h burn-in at 125°C. This results in reduced maintenance and increased reliability.

The use of TST-proprietary VLSI-circuits reduces greatly the number of components and facilitates repair.

TRAINING

courses are available for engineers and technicians upon request at the TST training center near Munich/Germany.

OPTIONS AND ACCESSORIES

TST 7698 -31 built-in battery compartment (NiCad or AA cells),
 1 h cipher operation, 5 h in clear per charge for NiCad,
 4 h cipher operation, 20 h clear for AA-cells

Note: with -31 the TST 7698 is not waterprotected!

- 33 AC adapter to operate TST 7698 with telephone coupler
- 42 full sealing acc. to MIL-spec 810C, 512.1
- 50 600 Ohms radio interface cable set
- 51 telephone coupler and interface cable set
- 53 radio interface cable for PRC 77
- 55 mounting tray for PRC 77
- 57 mounting tray for vehicle installation
- 87 family key programmer with adapter-socket
- 89 key injector TST 0700 for electronic key-insertion
- 92 VOX, voice operated transmit switch with microprocessor controlled noise cancelling

SPECIFICATIONS TST 7698

Input voltage:	10....32 V DC, polarity protected, - to chassis potential
Cipher mode input power:	5 VA DC
Clear mode input power:	0.75 VA DC
Voice input/output:	handset, dynamic capsules
Voice coding - process 1:	TST-proprietary process with 9.6, 7.2, 4.8 Kbit data rate (RELP-2), selectable via front panel
- process 2:	TST-proprietary process with 2.4 Kbit data rate (LPC 10+), selectable via front panel
Cipher method:	digital voice ciphering with digital narrow band transmis- sion, bit by bit cipher under control of cipher processor
Key generator:	nonlinear key generator
Family key:	10 EXP 45 variables (EPROM)
Message key:	10 EXP 13 variables
Master key:	10 EXP 8 variables
Auxiliary key:	10 EXP 8 variables, 7 keys stored manually, 9 keys stored when using key injector
Number of front panel selectable keys:	9
Emergency erase:	possible
Key period:	10 EXP 80
Total delay of speech:	60 msec turnaround
Line coupling:	600 Ohms, 0...-40 dbm (AGC) input, 0 / -10 dbm PEP over spectrum output, switchable from front panel

Radio coupling: 4 mV PP into 5.6 kOhms for PRC77

Audio response: 300...2400 Hz

Bandwidth required: 300...3000 Hz, CCITT telephone requirements

Channel requirements

- process 1: 16 db S/N with +/- 7 Hz max. frequency offset
- process 2: 8 db S/N with +/- 15 Hz max. frequency offset

Voice quality factor

- process 1: telephone quality
- process 2: synthetic, good readability

Sync time: 320 msec initial

Sync indication: bright LED

Resync: sync packets in programmable intervals

Modem type: PSK, 2.4/4.8, 7.2, 9.6 Kbit
300...3000 Hz spectrum

Clear send and receive: by front panel switch,
reduced power drain

Microprocessors: 4 each used

1. TST signal processor for voice coding
2. TST cipher processor
3. TST signal processor for analogue modem functions
4. TST processor for modem control and sync correlation

EMI/EMC: MIL-spec 461 and VDE 0871-0875-0877,
Vfg 478, 1115

Shock and vibration: MIL-spec 516.2, 514.2

Sealing: standard 0.1 m water/24 h
with option -41 MIL-spec 512.1
(pressure testing available to 2 bar)

Operating temperature: -20°C....+71°C, MIL-spec 501.1, 502.1

Dimensions: 22 x 10.5 x 4.5 cm

Weight: 1.3 kg

Reliability: 25.000 h MTBF

Specifications and appearance subject to change

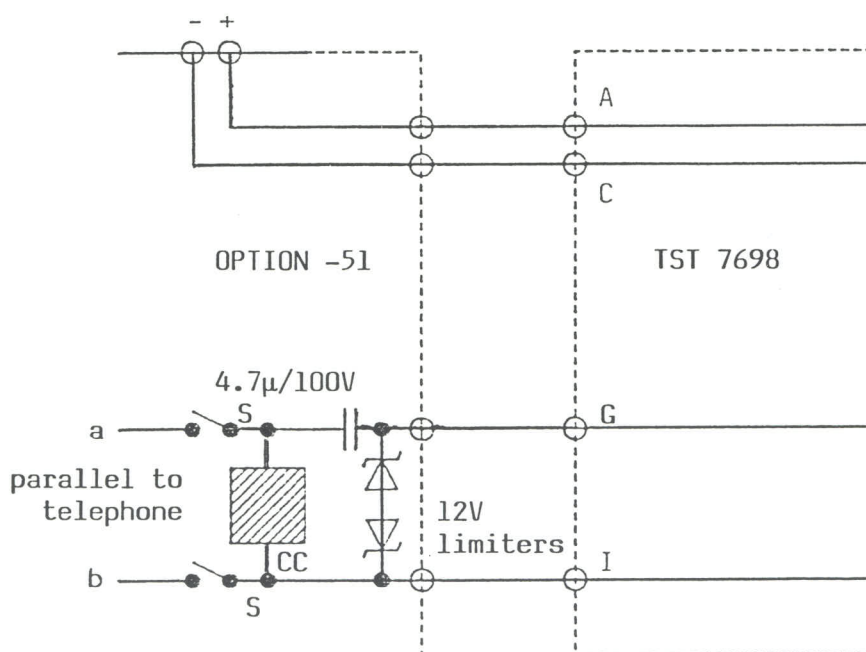
CONNECTION TO THE TELEPHONE SYSTEM

Since the TST 7698 is a narrow band full digital voice cipher set, it can communicate through the dial-up telephone network or unconditioned leased-line. At the beginning of each transmission the modem-processors conduct a "training-sequence" with automatic equalizer-setting, so that different line characteristics are adjusted for a minimum error-rate.

The TST 7698 can be connected to the telephone system using the option -51 telephone interface.

It consists of a constant current network to provide line current to the PTT and a capacitor to decouple the high voltage from the set, built into a small insulated box. The DC-supply wiring is routed to this interface box, where a miniature connector connects to the AC adapter, option -33.

10 ... 32 V DC in from AC adapter (option -33)



○ switch open

● switch closed

TELEPHONE OPERATION

After communication is established via the normal telephone, switch "S" is closed (see drawing on previous page) and the receiver of the normal telephone is put on hook.

Line current will flow through the constant network "CC" and communication will now be through the handset of TST 7698.

The output level of the TST 7698 can be reduced from 0 dbm to -10 dbm to suit the PTT's requirements, the input level may vary from 0 dbm to -43 dbm (AGC).

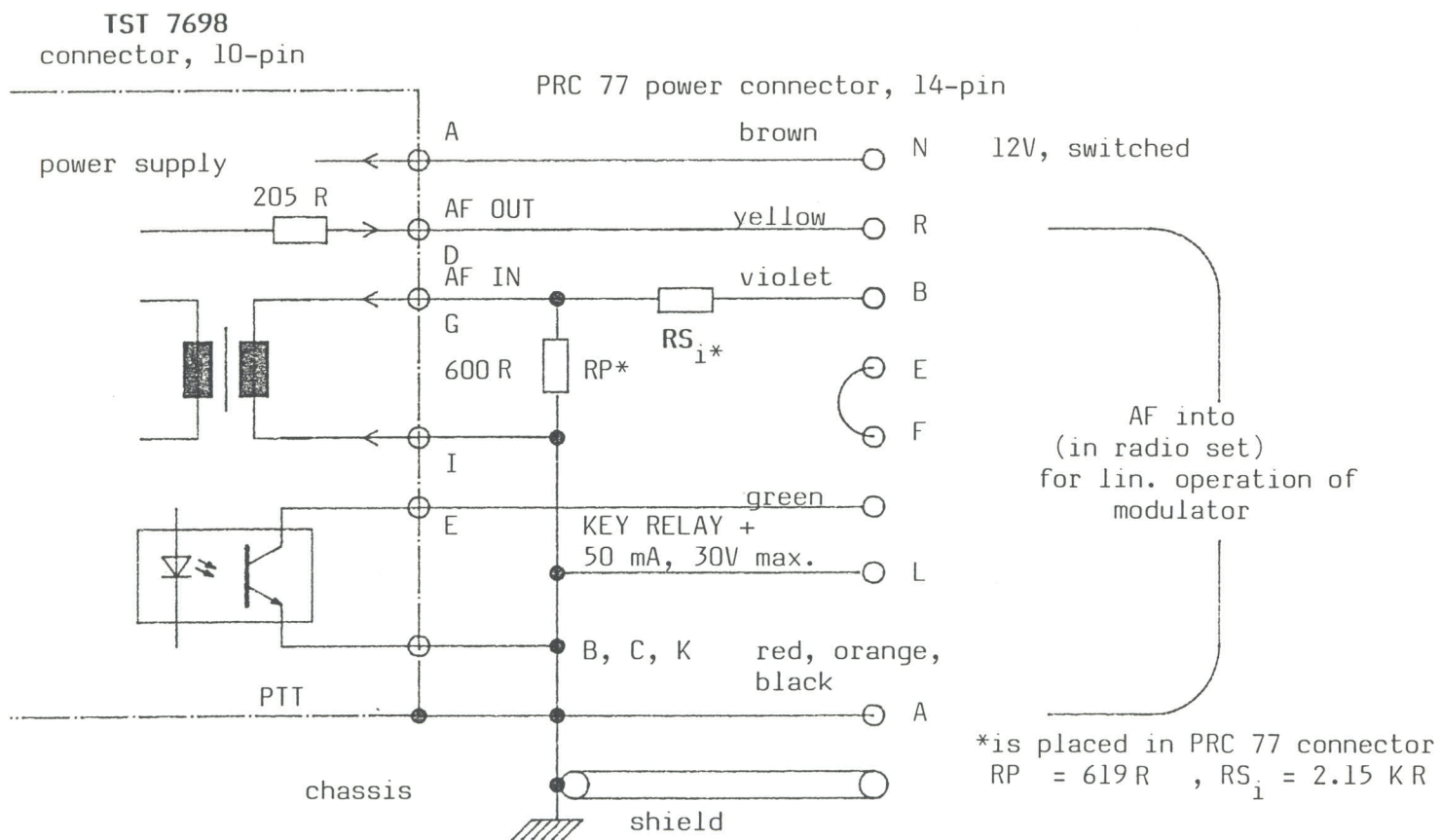
A microprocessor noise cancelling voice operated transmit switch (VOX) is available as option -92, a small cigarette-sized box, that connects between the TST 7698 and the handset.

When this is used, the set is automatically switched to the transmit mode, when voice signals are present, even in presence of high level of environmental noise (traffic, aircon, airplanes, office machines ...). This enables fluent telephone or point-to-point radio conversation in the quasi duplex mode, similar to the satellite communications form of operation.

CONNECTION TO RADIO EQUIPMENTS

TST 7698 can be coupled to all radio sets using the option -50 radio interface cable set. This is ready wired with 10 wires on the side of the TST 7698 and is open ended on the radio's side.

This connects the handset's key relay to key the transmitter and a 0 dbm input to the handset output (speaker capsule). A high impedance audio output is connected to the radio set's mike input, permitting parallel operation of two audio inputs.



Suggested circuit to connect TST 7698 to PRC-77

The bridge B, C, K is placed in the TST 7698 connector.

All inputs and outputs of TST 7698 are RF-filtered to prevent radiation to enter the set.

In the vicinity of antennas, however, the connecting cable to the radio equipment must be shielded. The shield must be connected to ground.

Please note that the level into the radio's microphone amplifier must be just right. An **excessive** input level will cause limiting and malfunctioning of the modem receiver, a **low** input will decrease the modulation index and thus reduce the radio's range.

In each application adjust for proper level with an optional resistor RS.

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KEYS: STRUCTURE - LOADING - MANAGEMENT

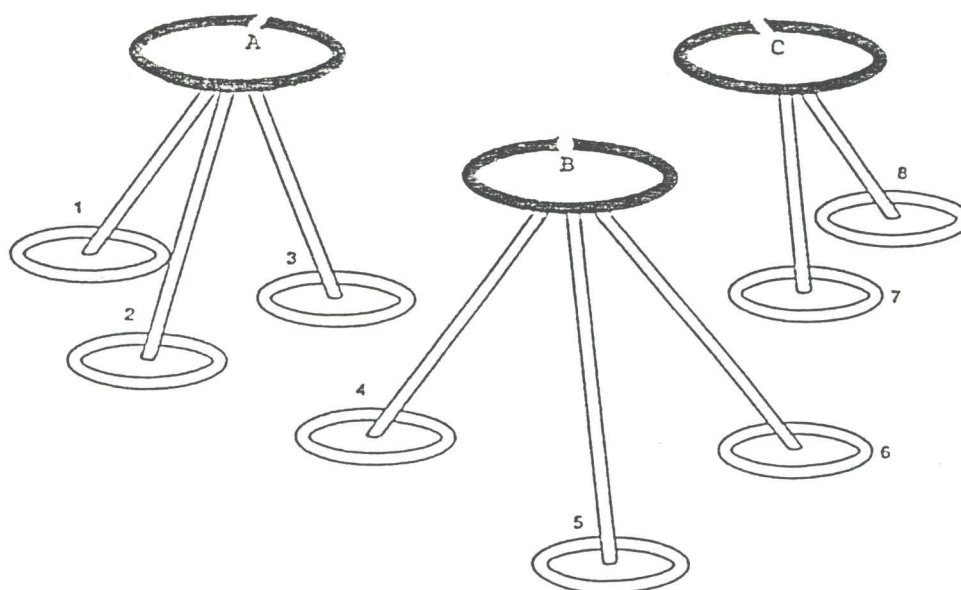
TST 7698 has a 4-fold key structure.

1. Family key

The family key is programmed at the user's headquarter (see opt. -87 operational manual). If the family key is different, the same master and auxiliary keys will not produce the same keystream and thus, the sets cannot operate together.

This permits grouping of sets.

User group A, B, C with different family key



Example shows 3 headquarter stations operating with 3 groups of users. Communication within groups is possible, but from one group to the other is not possible.

If groupings are not required, the family key must not be programmed. Master and auxiliary key (2^{48} ea. of which 2^{32} in actual use) provide sufficient key variety.

2. Master key (loading by key injector or manually)

The master key can be loaded with the field key setting unit TST 0700. The selector switch inside the battery compartment of the key-injector set to "M".

The master key is the second completely independant key of TST 7698. It sets variables in the generator registers and look-up-tables (see cryptography). The master key consists of 48 binary bits, so its variety is 2^{48} . Of these 48 bits, only 32 are used. The key-injector is then connected to the TST 7698 and the key is sent over.

A burst of flashes from the control lamp of TST 7698 indicates proper loading of the new master key.

The TST 0700 miniature key insertion set has the size of a pack of cigarettes. The key number is set up with switches and then injected by depressing the red button.

Additionally, the M-key can be loaded in a sequential manner by using the front panel switch (see page 32).

3. Auxiliary key I

Auxiliary key I can be loaded with the field-type key insertion unit TST 0700 with its inside selector switch set to "A".

It is completely independant from family and master key and defines variables in the key generator algorithm (see cryptography).

The auxiliary key consists of 48 bits, resulting in a variety of 2^{48} . Of these 48 bits, only 32 are used by the key insertion unit.

The selected key number is set up on the key injector and subsequently sent over to the TST 7698.

Flashing of the control lamp and beep tones in the handset indicate proper loading of this key.

9 different keys can be stored in the TST 7698. When the front panel switch is set to 1, the first A-key is loaded, set to 2, the 2nd A-key etc. ...

If no key injector is available 7 A-keys can also be manually set up; these A-keys will then be stored in memory locations 1 to 7 (see page 31).

4. Message key

Message key is generated at Random by the TST 7698 and sent to the counter-station(s) at start of talk in digital form. This preamble also contains synchronization bits and takes 0.21 seconds. Before it is sent out, it is enciphered by an algorithm defined by family and master key. It consists of 32 bits, 2^{32} variables.

This message key sets variables in the key generator's algorithm and determines its starting position within the 10^{80} bit sequence.

The split-up of 3 user-set keys (family, master and auxiliary key) permits an efficient key-management. The 4th key, the message key, is automatically generated at random.

The family key provides grouping.

Master key can be loaded by special authorized persons only (Signal Corps Officer).

Auxiliary key I is changed more frequently (daily or weekly key).

The self enciphered **message key** guarantees effectively that never the same key is used throughout the life of the equipment.

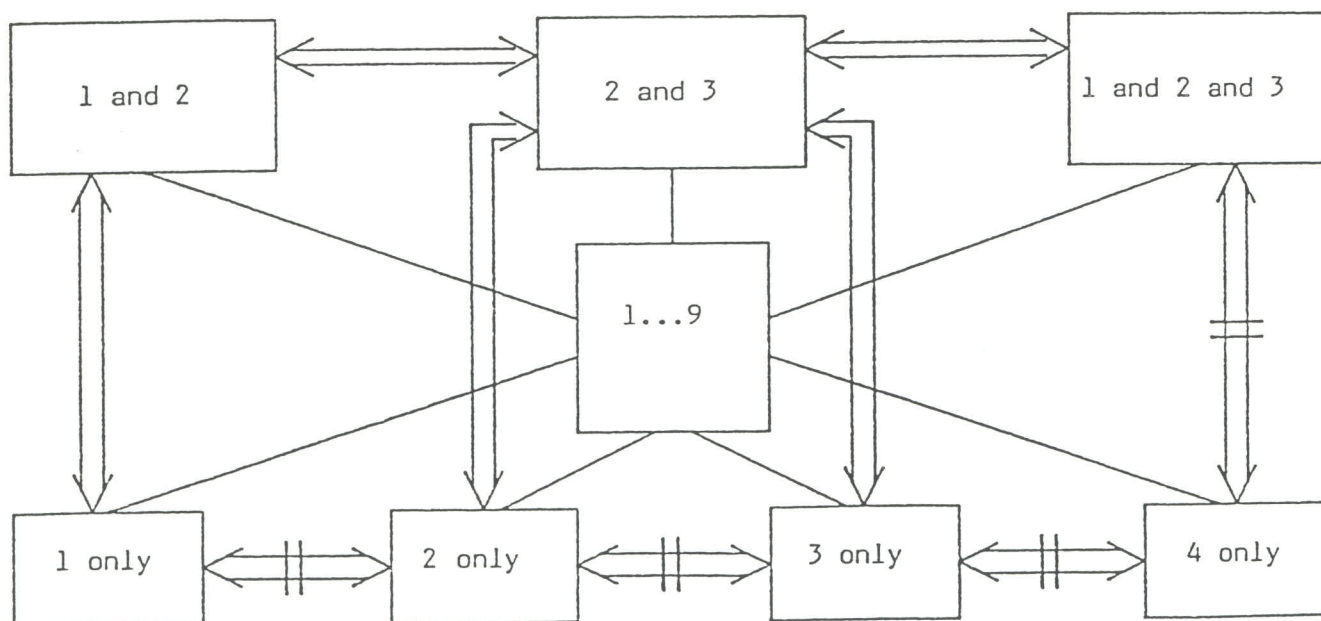
SETTING UP A NETWORK

The TST 7698 has up to 9 selector key-switch positions.

In networks, where access to all 9 is desirable, every one of 9 user groups agrees on one position.

In networks, where a headquarter's station wants to address one of 9 different groups, but does not want the groups to inter-communicate between them, in the groups sets 8 of the selector-keys are inhibited, the sets use only one.

Similarly, commanders can be given 2 or 3 keys to intercommunicate with neighboring units. This is done by injecting only the required keys.



CRYPTOGRAPHY

TST 7698 is controlled by one of the most powerful 8-bit single chip microprocessors. The encryption algorithm is contained in a custom-made VLSI. The operating program is contained in C-mos ROM. No special circuits are used for cryptographic purposes. The processor performs a test routine every 10 seconds to verify the correct operation of the key generator. The cryptography of TST 7698 is based on the proven key generator concept with a key period of 10^{80} , also implemented in series 1, 2, 3 and 9 of TST equipments.

The 4-fold key structure (family-, master-, auxiliary-key and message-key), the ease and speed of key loading and the TST technology of providing both a very high key period together with extreme non-linearity, render the cryptography of TST 7698 the most secure one.

CRYPTOGRAPHIC CONSIDERATIONS

The cryptographic program simulates 5x5 non linear data shift registers of length, 107, 89, 61, 59, 49 stages and 5 linear shift registers which control the non linear stepping of the 5x5 data registers, by means of addressing look-up-tables.

The setting of the look-up-table is defined by the key. Data are fed back crosswise within the 5x5 non linear registers to provide best distribution. Non linear feedback is achieved by use of 16 different look-up-tables.

The key defines the feedback connections and the look-up-tables and the presettings of the registers.

The set performs a prerun of many cycles before actually ciphering in order to premix all the key variables. The amount of premix cycles is defined by an algorithm, on which all key variables take influence.

MECHANICAL CONSTRUCTION

The TST 7698 is housed in a robust extruded aluminium box, being splashwater protected and sandtight.

8 screws fasten front and back panel.

Mil-type connectors interface in with handset and line.

A miniature solid state lamp indicates the operational status of the set by various colours and blinkings: The electronics are built on 3 PC-cards. They are interconnected by a 40 pin flatcable connector.

The frontpanel wiring assembly in form of a flexible printed circuit plugs into the masterboard. It also contains part of the necessary RFI filters.

To open, unscrew the 4 screws around the front panel, using the special tool delivered, then lift it carefully straight up. Take care not to pull the wiring connecting the front panel to the PC board. The motherboard slides out of the housing.

The bottom part of TST 7698 contains a sealed power supply, or, with option -31, a 5-cell NiCad or AA cell battery compartment.

FUNCTIONAL DESCRIPTION

1. Send preamble-start sequence

At the beginning of each communication, after depressing the PTT, the set sends out a binary 0,1 bit pattern, which is used to synchronize the sending and the receiving modems. Also, it is used by the receiving modem to automatically set these adaptive equalizer taps leading to the minimum bit-error rate (receiver training sequence). Then, a very short pause follows. Subsequently, the start recognition word, then the message key of 32 bits is sent out in self-enciphered form and error correcting code.

During this short time, the operator hears a low humm-tone in the handset. After this is off, speech communication can be started.

EPT + send delay	synch + training	short pause	self-enciphered message key	speech
0 to 990 msec selectable	Mode 5 - 0,4,8 943 msec Mode 5 - 1,5 708 msec Mode 5 - 2,6 253 msec Mode 5 - 3,7,9 253 msec		256 bits	

The audio from the handset is amplified by an AGC amplifier and fed to the voice coding processor. Thereafter it is enciphered by the cipher processor, which is under the supervision of the control processor. Then the digital bits are applied to the modem, which produces a 300 ... 3000 Hz spectrum which can be sent through any audio-communication system.

2. Receiving

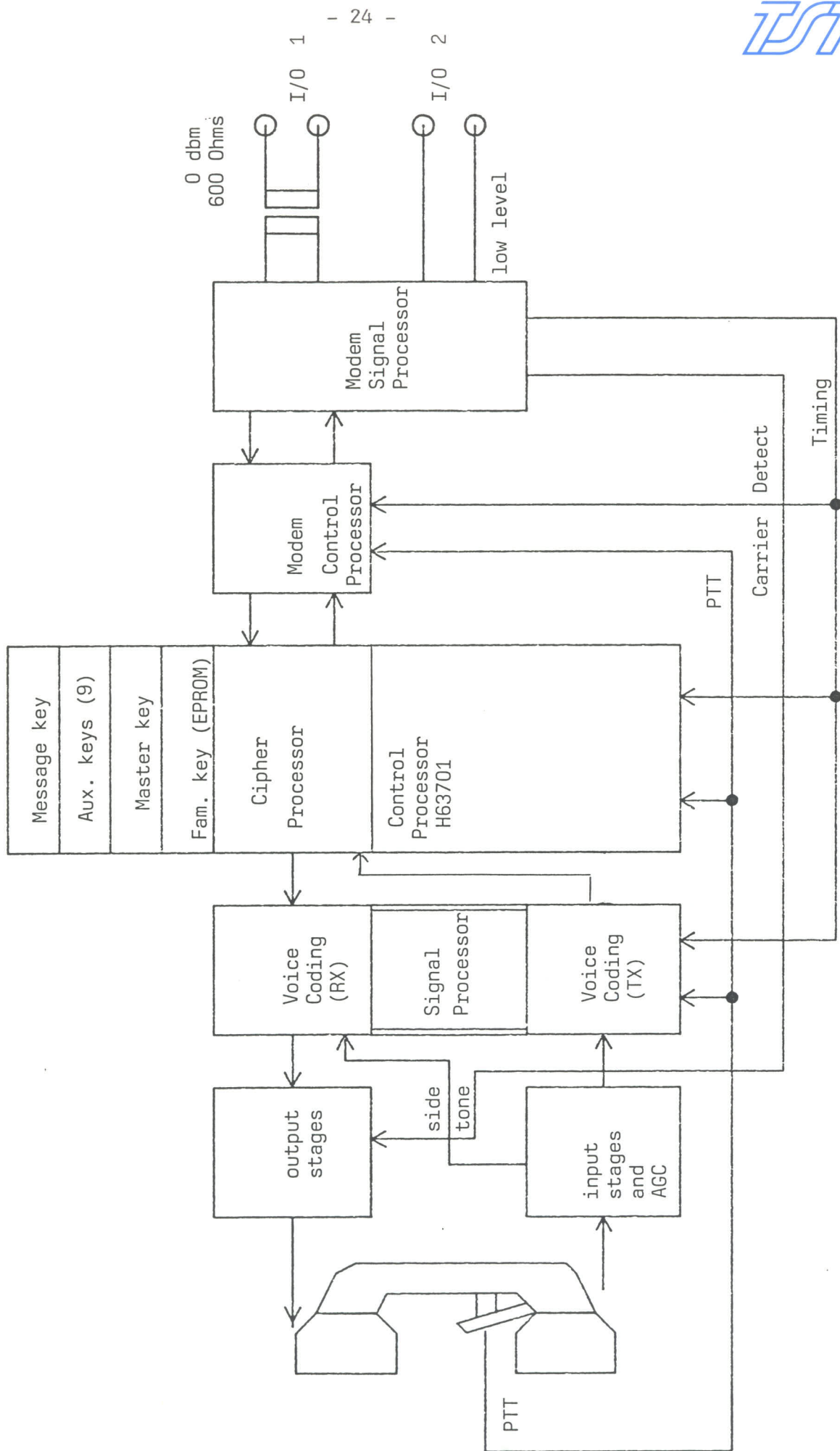
When the receiver is in the idle (non-synchronized) state, the modem's signal processor is in its preset equalizer position.

Upon reception of the sync-pattern, this will be routed from the input transformer to the signal processor of the modem, where it is filtered and routed to the demodulator. A data regenerator circuitry recovers the binary serial bitstream and delivers it to the control processor. Together they equalize for amplitude changes and differential phase delays to improve the operation. After sync data, the cipher processor recognizes the message key and presets the respective variables of the key-generator.

If they do not match between sending and receiving sets, due to receiving errors or different key-settings, the cipher processor will output the resulting false decipherment in form of digital noise.

If the modem has properly synchronized, but the message key was received wrongly (no error correction possible) the LED will be constant green and blinking red.

BLOCK DIAGRAM OF TST 7698



4. Parameter setting, manual

The TST 7698 can be used in a great variety of operational conditions. Depending on these, various parameters can be optimized for best communication results (lowest Bit Error Rate, BER):

a) Parameter Setting (8)

Various speeds and VOX can be selected. The lower the speed, the sturdier the transmission, but the recovered voice quality is reduced.

TX/RX equalizer II (8 - 6)

To adjust a hard-set equalizer in the modem section for best (lowest BER) operation, you may select one of these settings.

Send Delay (8 - 7)

If a transceiver is used it is possible that it takes some time to switch from receive to transmit mode. Therefore it can be necessary to set a delay time between PTT and starting the preamble of the TST 7698. Using parameter 7, a delay time between 0 and 990 ms can be selected. Any other delay time other than 0 ms produces also the EPT (Echo Protection Tone), which is used on noise channels without squelch to start the receiving modem.

Enter two digits. The first digit determines the delay in 100 ms and the second digit in 10 ms.

Output level (8 - 8)

The output level can be switched between 0 dbm and -10 dbm.

Link equalizers 8 - 9

Receive and send link equalizers can be selected to adjust the modem to existing telephone line conditions.

b) Emergency erase (EE)

Use parameter 0.

c) Manual input of auxiliary keys

Use parameter 1 to 7.

d) Manual input of master key

Use parameter 9.

e) Test mode 8 - 4

If set on both ends, a 1.1 kHz tone is transmitted with 1 V or 0.4 V pp (depending on the output level setting) by pushing the PTT, for testing of line leveling and frequency offset. The receiver indicates the correct reception by green LED.

Procedure for manual parameter setting

- switch set off
- depress PTT, and hold it depressed
- switch the selector switch to the desired parameter number
- switch set on, still holding PTT depressed
- then release PTT, rotate selector switch to the desired value/function and depress PTT again
- the set then reverts to the normal standby mode

Tables/parameter numbers:

0 -	perform emergency erase for all keys	
1...7	enter the 8-digit auxiliary keys 1...7	
8	Enter the parameter setting mode	
8 - 4	Test mode (0.4 / 1 V pp, 1.1 KHz	
* 8 - 5 - 0	2.4 KBit	no vox
8 - 5 - 1	4.8 KBit	no vox
8 - 5 - 2	7.2 Kbit	no vox
8 - 5 - 3	9.6 KBit	no vox
8 - 5 - 4	2.4 kBit	vox
8 - 5 - 5	4.8 Kbit	vox
8 - 5 - 6	7.2 KBit	vox
8 - 5 - 7	9.6 KBit	vox
8 - 6 - 0	0 km EQ	
8 - 6 - 1	1,8 km EQ	1 EQ tap/bit
8 - 6 - 2	3,6 km EQ	
8 - 6 - 3	7,2 km EQ	
8 - 6 - 4	0 km EQ	
* 8 - 6 - 5	1,8 km EQ	
8 - 6 - 6	3,6 km EQ	1/2 EQ tap/bit
8 - 6 - 7	7,2 km EQ	
8 - 7	enter the 2-digit send delay and EPT	(* 0 sec)
* 8 - 8 - 0	output - 10 dBm	
8 - 8 - 1	output - 0 dBm	
* 8 - 9 - 0	link EQ off	
8 - 9 - 1	receiver line EQ on	
8 - 9 - 2	transmitter line EQ on	
8 - 9 - 3	rec./transm. line EQ on	
9 -	enter the 8-digit M-key	

Note: EQ = equalizer, * = default settings

5. Parameter set-up, automatic

The TST 7698 is controlled by 4 custom-built microprocessors and one standard 8 bit processor. After receiving the set ex factory or after any emergency erase, the operating parameters are reset to the standard values automatically (see also previous chapter).

These are: all set to their 0 - values (mode I, 0 km equalizer)

6. Functions of the frontpanel LED

The LED is either off, red, green or yellow, either steady or blinking at various speeds.

This permits the operator to see the functions of the set:

- standby: 

red blinking very slow, when in cipher mode
green blinking very slow, when in clear mode

- sending: 

red blinking very fast for cipher mode
green blinking very fast for clear mode

- receiving: 

red blinking fast for cipher mode
green blinking fast for clear mode

various other modes of blinking are explained in "Parameter setting, manual" and "Key input" chapters.

OPERATION

1. Charging (only with option -31)

TST 7698 should be charged at regular intervals. Its built-in NiCad batteries of 0.4 AH will power the set and have to be recharged at regular intervals.

The charger is controlled electronically to provide 80 % of the capacity within 4 h. After this time, it will slowly charge up to 100 % within the next 10 hours. The charger also permits continuous float charge. When the set is used in the office, the charger may always be left connected to have the set fully charged when required.

After long times of being unused, the battery has to undergo a few charge/discharge cycles to regain its full capacity.

As the NiCad-batteries are of standard AA-size, they can be replaced by normal AA-dry cells. Operating time may then can be longer than with NiCad cells, depending on the quality of the batteries.

2. Initial programming of the family key

A standard family key is programmed at the factory for every user. If the user does not require grouping of his set, it is not necessary to reprogram the family key.



If the family key is to be reprogrammed, the option -87 programming set with adapter socket for TST 7698 has to be purchased. Further instructions to load the family key are delivered with this option.

3. Normal use

After depressing the PTT at the handset, wait a little before starting to talk. During this time the synchronization and transfer of message key takes place and the voice audio is blocked. A low tone is being heard in the handset.

Then talk not too loud and not with low voice. The AGC amplifier will maintain a constant output level for normal variations.

When finishing, tell the other station "over" so that it is clearly known that an answer is now expected. At the end of the conversation, say "end".

When using the telephone interface set, establish a call in clear using the normal desk telephone, then close the switch on the adapter box () (option -51), see "Telephone connection" and put the handset back on hook. The interface set now simulates off-hook condition. Now talk and listen as previously explained, using the TST 7698 handset. When terminating, just flip the switch to off (), to provide on-hook condition and free the telephone line.

If your telephone now in use is not acc. to the minimum standards (CCITT) required for the modem or if the line level is too low (less than -40 dbm), the sets cannot synchronize. In this case, dial again.

NOTE: It is absolutely necessary to put the handset of the normal telephone on hook. Otherwise the impedance matching is incorrect and the sets cannot work properly!

The telephone coupler provides a 0 dbm output to the telephone line. If your local PTT requires lower levels, this can be software programmed (see parameter setting, manual).

Using TST 7698 with radios

When using the sets with radios, care should be taken to have the connecting cables well shielded to prevent electromagnetic radiation. Great care must be taken to adjust the transmit-audio level for nonlimiting operation of the transmitter (see "Connection to radio equipments" and "Parameter setting, manual").

4. Emergency erase

With the TST 7698, all keys can be erased immediately in case of emergency to prevent the enemy to gain access to the secret elements, the keys.

To erase, proceed as follows:

1. Switch the set off
2. Set the frontpanel selector switch to 0
3. Depress the PTT at the handset firmly
4. Switch the set on, keeping the PTT depressed. Then switch set off and on again. Now the lamp will not blink as usually, also a **warning tone** will be heard to indicate the erasure of the master and auxiliary key.
5. Release the PTT, the warning tone is present until you set up your key. If the set is switched off before a complete new key is set up, the warning tone will appear on again and the set is not operational in ciphermode until the keys are set up.

5. Key insertion using the frontpanel switch

5.1 Key insertion after the emergency erase

After EMERGENCY-ERASE the set waits for the set-up of the master-key (M-KEY). During M-key-insertion you will hear a lower tone (300 Hz), whenever you depress the PTT to enter a digit. The LED will glow continuously.



Now enter 8 decimal digits, (0 ... 8) one after the other, e.g. your key number is 45802187. Set switch to "4", then depress the PTT quickly. During the selection of the digits, each digit (0 - 9) will produce a specific tone between 400 and 760 Hz. This permits easy checking of the key input. Then turn the switch to "5", depress "PTT" again ... As soon as the 8 digits for the M-key have been entered, a red/green flicker of the LED is produced, and a low tone of 180 Hz is audible in the handset.

The set now waits for the set-up of the auxiliary-key. During A-key-insertion you will hear a higher tone (950 Hz) when depressing PTT for key entry. The LED will blink slowly in green colour.



After the 8 digits for the A-key have been entered, a low tone is heard and the LED will blink quickly red/green, the set is operational and then the LED-lamp flashes regularly to indicate standby/ready mode.

5.2 A-key-insertion

If only the A-key is to be changed, switch the set off, select one position between "1" to "7" for the A-key 1 to 7 at the selector switch of the set, press "PTT" and switch set on, keeping "PTT" depressed! Now the set waits for the insertion of the A-key (see above).

5.3 M-key-insertion

If only the M-key is to be changed, switch the set off, select position "9", press "PTT" and holding it depressed, switch set on. Now the set waits for the insertion of the M-key (see above).

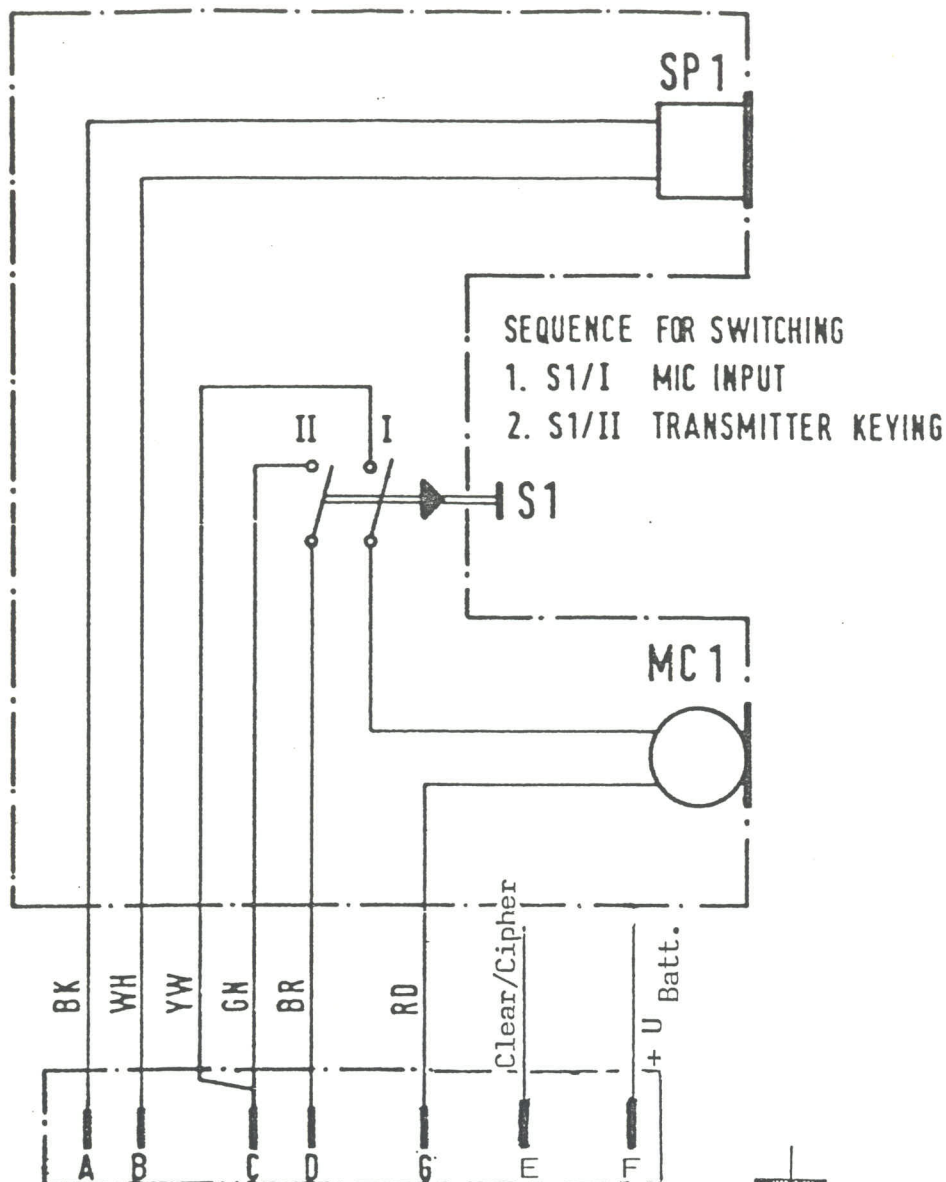
6. Key setting using the key-injector TST 0700

6.1 General

Since both key handling methods - manual and with key injector - are fully compatible, mixed networks with manual setting or key insertion by use of the key insertion unit are possible.

6.2 Master and auxiliary key-insertion using the key-insertion unit

- A) Switch the TST 7698 on.
Select the A-key position by using the frontpanel selector switch.
- B) Select **master** or **auxiliary** key at the inside switch of TST 0700.
"A" or "M", in the battery compartment.
- C) Set up your key in the key insertion set, **use only numbers 0 to 8**, connect it instead of the handset and load the key by depressing the red button on the key insertion unit.
- D) Hold it depressed until the LED-lamp on the TST 7698 goes off for a moment.



TST handset H-1088/GY wiring schematic

Specifications:

Speaker SP 1

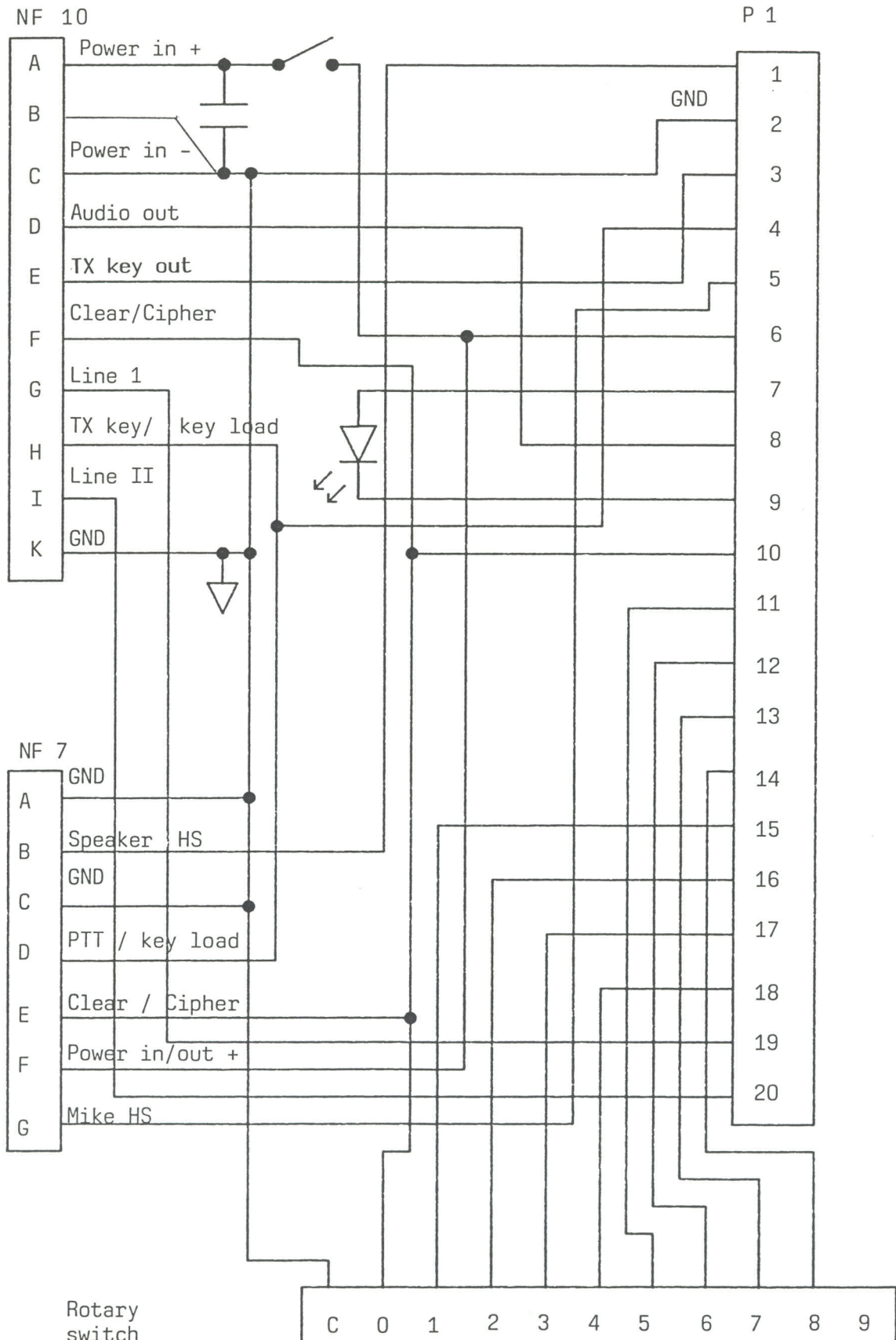
impedance : 300 Ohms
 frequency resp: 0,3-3,5 KHz
 max. power : 50 mW

Microphone MC 1

impedance : 150 Ohm
 frequency resp: 0,3-3,5 KHz
 6db preemph.
 sensitivity : 1,4 mV at 150 Ohms
 with 103db
 oper. temp. : -20°C/+75°C
 waterresistant: splashwaterproof

HANDSET WIRING AND SPECIFICATIONS

FRONT PANEL WIRING TST 7698



All interface signals to and from the TST 7698 are routed via the 10 pin connector, according to the following specifications.

Pin	Name	Function	Remarks
1	A	Power +	Input power, 10 ...32V DC or battery charger (opt. -33)
2	B	Chassis grd, power - key relay -	Input power and grd for AF signals
3	C		
4	D	Audio out	
5	E	TX key out +	via opto coupler (30 V, 50 mA max)
6	F	Clear/ cipher	Ground for clear operation
7	G	Line 1	600 ohms, 0 dbm line interface
8	H	TX key in	TX CTRL max. 50 mA, 30V DC
9	I	Line 2	600 ohms, 0 dbm line interface
10	K	Chassis grd, power -	Input power and grd for AF signals

10 pin connector mating the TST 7698 front panel connector is type
"Schaltbau NF 10A1LOA7 14350585249".

Interface connector definitions

MAINTENANCE AND ADJUSTMENT

The TST 7698 does not require any preventive maintenance.

In case of a defective unit, open the front cover by using the special tool delivered with the equipment. Since this front cover is sealed by 2 rubber seals, it is very difficult to remove it without special tools.

In cases this has to be done, proceed as follows:

Open the 4 screws around the front end and slowly move the front cover outwards. Take care not to pull the cabling connecting from front cover to the PC boards. Find out the faulty PC-board by exchange. Repair is only possible by using a TST 7698 test-set and after having had a TST training course. If this is not available, just change the module and send it to TST for repair. It will be returned to you after 10 working days (freight time not included). Before closing the cover apply some silicone oil to the rubber seal.

The set is extensively software controlled.

No internal adjustments are provided.

WARRANTY

The manufacturer warrants TST 7698 equipments for the period of 12 months after shipment from factory to be free of design errors and to be of best available commercial quality.

Defective parts or modules will be replaced or repaired during this time at factory free of charge. Exceptions are: mechanical damage, the effects of applied overvoltage, overcharge/undercharge or overheat/undercool. In case of attempted repair, warranty is void.

The manufacturer cannot be made responsible for consequential damages resulting from proper or improper operation and use of the equipments.

The warranty regulations require free of charges shipment to the factory. Return of equipment will be covered by TST.

IMPORTANT NOTE

When equipments are put to storage for emergency use or back-up, they have to be switched on at least twice per each year for 24 hours ea. for regenerating the chemical compounds in the tantalum-capacitors!