TONE EQUIPMENT
STORNOPHONE 700

"FOR INTERNAL USE ONLY"

Tone transmitter TT7812

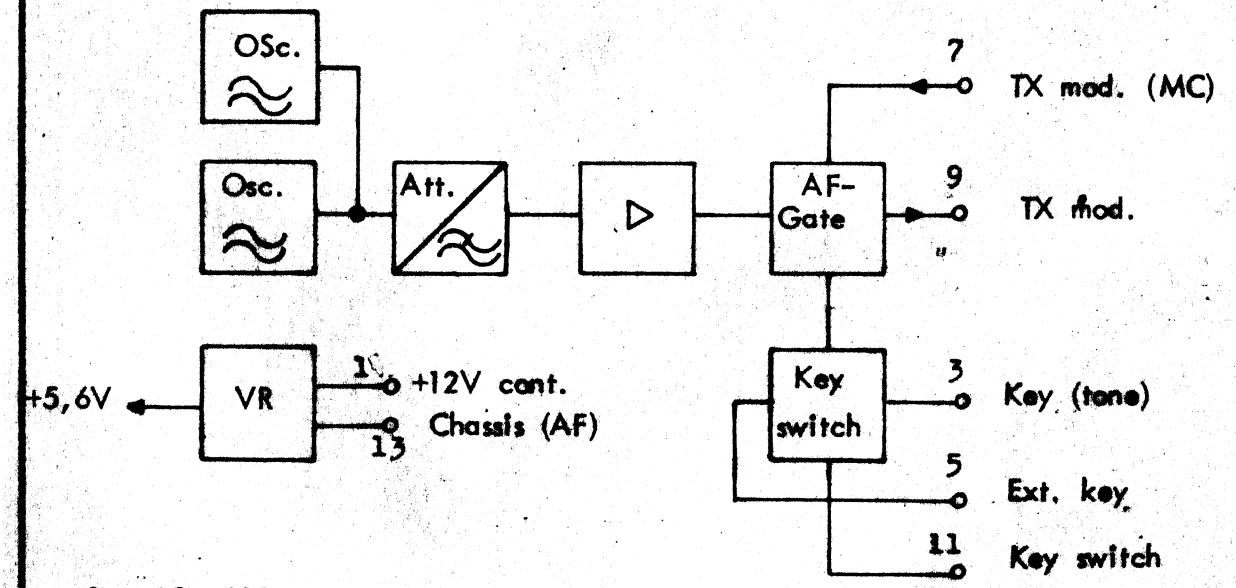
Description

1. General description

The tone transmitter TT7812 is intended for use in "Stornophone 700" radioequipment. TT7812 can be employed both as a single - or as a double tone transmitter.

Blockdiagram

Ref diagram TT7812



2. Oscillator

Principally the tone oscillator is a Hartley circuit, with Q1 and Q2 in a differential arrangement. The supply voltage is stabilized with a zenerdiode to keep the oscillator output constant. The oscillator can be set for 12 different standard frequencies, switching a a lead between the terminals of the tone coil. At single tone transmission, the feed back winding of one of the oscillator coils must be short-circuited at the print board.

3. Level adjustment and dc-emphasis

Between the oscillator and the output stage is inserted a combined dc-emphasis - and attenuator stage Q5.

4. Output stage

The emitterfollower Q6 provides a low output impedance corresponding to the input impedance of the modulator.

5. AF-gate

The AF-gate Q9 switches off the microphone signal, during the tone transmission.

6. Transmission

At stand-by, transistor Q7 is on, via R21 and E5, and transistor Q8 is hold off. When the tone key is depressed, Q7 is hold to chassis via E6, and therefore Q8 switches on and activates the transmitter, as long as the tone key is depressed.

"FOR INTERNAL USE ONLY"

Tone transmitter TT7812

Data

1.	Power supply	10,5 V - 16 V
2.	Current consumption	
	Stand-by	6 - 10 mA
	Activated	16 - 33 mA
3.	Temperature range	
	Data observance	-25°C - +60°C
	Function capability	-30°C - +80°C
4.	Tone frequencies	1060, 1160, 1270, 1400, 1530, 1670, 1830, 2000, 2200, 2400, 2600, 2900 Hz.
5.	Frequency accuracy	≤ 0,5%
6.	Frequency stability	≤ 1%
7.	Frequency response	Falling according to a RC-function with cut-off frequency at 1000 Hz.
8.	Output impedance	600 Ω ± 20%
9.	Output level	
	Single tone	-17 dBm +1/-0 dB (110mV) at 1000 Hz
	Double tone	-17 dBm +1/-0 dB (110mV) at 1000 Hz (Each tone 55 mV)
10.	Distortion (tone modulation)	≤ 3%
11.	AF-gate attenuation	≥ 50 dB
12.	Distortion (voice modulation)	≤ 5%
13.	Mechanical dimension	$\frac{17"}{10}$ x $\frac{22"}{10}$ x 24 mm

Tonereceiver TR782

Description

1. General description

TR782 is a selective tonereceiver developed for the "Stornophone 700" radiotelephone equipment. TR782 is essentially a doubletone receiver but can also be employed as a single-tone receiver.
When an appropriate tone signal has been received for a period of 700 mS a "call lamp" will light up and the "AF-muting" will be suspended, further will the "key lock" function be made operational.
The vehicle's traffic horn can (via an auxiliary relay) be connected to TR782, such that the horn will sound for a period equal to the time the appropriate tone signal is received in exeedence of 700 mS.

By pressing a push button "LS IN/OUT" opening or shutting of the loudspeaker and suspension of the key lock function can be accomplished manually.

As the key lock function is linked with the turning ON and OFF of the loudspeaker it is impossible to let the radiotelephone's transmitter go on the air before the loudspeaker has been opened and hence checked whether the radiochannel is free.

Besides the above mentioned features the TR782 is also fitted with an "occupied lamp" which is governed by the radiotelephone's squelch system in such a way, that a RF signal present at the antenna input terminal will cause the "occupied lamp" to light up, indicating that the radiochannel is not free.

2. Circuit description

2.1. Preemphasis stage

The preemphasis stage Q1 compensates for the linear distortion introduced by deemphasis in the radiotelephone. The preemphasis ratio follows a RC function with cross-over at 1000 Hz.

2.2. Amplifier and amplitude limiter

Transistor Q2 amplifies linearly the incomming signals until the diodes E1 and E2 commence to conduct.
Complete limiting will occur approx. 8 dB above min. trigger level for a double tone receiver and approx. 3 dB above min. trigger level for a single tone receiver (i.e. V_{IN} = -29 dBm or -23 dBm, 1000 Hz).
Limiting the amplitudes of all frequencies together with the band pass characteristic of the subsequent Q-multiplier, adjacent tones will be unable to trigger the tonereceiver, providing there frequencies differ from the resonant frequency by 4.5 pct. or more.

2.3. Driver

The transistors Q3 and Q4 are coupled in such a manner that an extremely low output impedance is achived (order of 1 ohm), which results in negligible loading of the Q-multiplier.

2.4. Q-multiplier

The Q-multiplier contains a parallel resonant circuit which is very loosely coupled to transistor Q5, for the sake of maintaining a constant Q over the entire tone range. C8 in the resonant circuit is grounded through the output impedance of the driver and the relevant terminal(s) of the resonant coil L1 alternatively grounded through the AF-gates Q19 and Q20 (see section 2.5). By means of a feedback winding in the collector circuit of Q5 part of the tone signal is again applied to L1 in phase, in order to give rise to the natural Q of L1 by a factor of approx two.
To neutralize the effect of temperature on the Q of L1 a NTC resistor (R20) is inserted in the emittercircuit of Q5. This resistor will, in conjunction with R19 and R21 give an approx. flat temperature response from -30°C to +80°C

2.5. Astable MV and AF-gates

The astable MV consists of Q21 and Q22 which in turn drives the AF-gates Q19 and Q20. When the collector voltage of either Q21 or Q22 is LOW the base of Q19 or Q20 is grounded respectively. This results in an alternate turning on and off of Q19 and Q20.

The pulse repetition time is approx. 500 mS.

2.6. Amplifier, emitterfollower and detector

Q6 amplifies the tone signals after the Q-multiplier. To avoid loading of the Q-multiplier the input resistance is bootstrapped to a high value.

Q6 is succeeded by an emitterfollower Q7 which in turn feeds the DC detector. The DC detector is a conventional voltage doubling circuit, where R25 is inserted for the sake of maintaining linearity for larger amplitudes.

R25, C13 and R26/R27 forms a low pass filter for the tonesignal components, with sufficiently large timeconstant for this purpose and on the other hand a short timeconstant compared with the 250 mS half periods of the astable MV, -so should one of the tones fail the DC voltage will drop almost to ground level before the next tone is present.

The DC output level can be set by adjusting R27.

2.7. Schmitt-trigger and diode gate

The Schmitt-trigger Q8 and Q9 is a conventional current coupled trigger circuit, designed for negligible hysteresis (approx. 0.1V) and intended for opening and shutting of the succeeding DC gate E5. In series with E5 - R32 is inserted for the purpose of gaining approx. 40 mS hang-time before the subsequent delay circuit is discharged through E5 and Q9 in the absence of trigger signal on the base of Q8.

The above mentioned hang-time is justified by the fact that the build-up time in the Q-multiplier is approx. 20 - 30 mS between gate shifts and the timeconstant in the DC detector is relative fast in conjunction with the negligible hysteresis in the Schmitt-trigger circuit.

1) Q18 goes ON, connecting terminal 34, "AF-muting", to chassis through diode E12 whereby the loudspeaker amplifier is made operational.

2) transistor Q17 goes ON, "call lamp", terminal 47, is lighted

3) transistor Q15 goes ON, "key lock", terminal 51, is released and operating the radiotelephone transmitter made possible

When the tonecall is no more at present at the input terminal the state of the bistable MV may be altered manually.

3.1. Squelch gate

When an adequate RF level is present at the radiotelephone receiver's antenna input terminal, the squelch system will feed a DC voltage (approx. +5 V EMK, R_G = 1 kΩ) to terminal 41 which causes the "occupied lamp" (terminal 45) to light up.

3.2. Automatic muting

For the sake of avoiding retransmission a relay may be connected to terminal 49 so the vehicle's entertainment radio may be suspended as long as the "key lock" is operational.

Tonereceiver TR782

Data

1.	**Power supply**	10,5 V - 16.0 V, nom. 13.6 V
2.	**Current consumption**	
	Stand by	nom. 45 mA
	Activated	
3.	**Temperature range**	
	Data observed	-25°C - +60°C
	Function capability	-30°C - +80°C
4.	**Input impedance**	> 6 kΩ, asymmetrical
5.	**Nominal input level**	-23 dBm/1000 Hz

6. **Equalization**

   Preemphasis by RC function, f_c = 1 kHz

7. **Signal code**

   2 preset tonefrequencies, simultaneously received for min. 700 mS.

8. **Signal frequencies**

   615, 675, 735, 805, 885, 970, 1060, 1160, 1270, 1400, 1530, 1670, 1830, 2000, 2200, 2400, 2600, 2900 Hz.

9.	**Frequency accuracy**	
	With coil adjuster set for 1060 Hz	≤ 0,3%
10.	**Frequency stability**	
	Typically ≤ 0,5%	≤ 1,0%

2. 8. 700 mS delay circuit + inverter

When the Schmitt-trigger is activated and thereby E5 turned off - C14 commences to charge through R34, when this charge has rised approx. 0,6 V above the level set by the ratio of R38 to R37, Q10 turns ON, instantly also turning ON the inverter Q11.

2.9. Alarm gate

When Q11 has been turned ON, Q12 will inevitably turn ON and form a shortcircuit between the alarm terminal (37) and chassis. Q12 remains ON as long as the correct tonecombination is present at the input terminal.

3.0. Bistable MV and outlet switches

The bistable circuit consists of transistors Q13 and Q14 It is governed in two different ways 1) automatically by reception of a correct tone call and 2) manually.

By pressing a push button placed on the front of the radiotelephones control head terminal 32 is connected to chassis and thereby a pulse is formed by the differentiating coupling condensers C15 and C16 causing the bistable circuit to change state.

Regardless of the state of the bistable circuit a correct tonecall will (see section 2.9) cause that Q12 goes ON and hereby connects the base of Q13 to chassis through E6, meaning that Q13 goes OFF (collector voltage high), as is seen the tonecall has higher priority in operating the bistable stage than has the manual control.

Whenever Q13 is OFF the following will happen:

11. Selectivity

Frequencies differing from f_o by 4.5% or more are unable to trigger the tonereceiver.

Q-multiplier nom. Q = 28.

12. Max. current loading

Terminal 37,	"ALARM"	100 mA
Terminal 47 + 49	"CALL"	100 mA
Terminal 45,	"OCC."	60 mA
Terminal 51	"KEY LOCK"	60 mA
Terminal 34	"AF MUTING"	5 mA

13. AF muting

In conjunction with AA7xx ≥ 60 dB.

"FOR INTERNAL USE ONLY"

Tone Sequence Transmitter ST7845

Description

1. General

ST7845 is a tone sequence transmitter developed for the "Stornophone 700" radiotelephone equipment. ST7845 can be employed as a four or five tone sequence transmitter. When the tone key buttun is pressed, ST7845 gives off seven consecutive pulses, each of 70 msec. duration. The first two or three pulses are unmodulated, and the last five or four pulses are modulated.

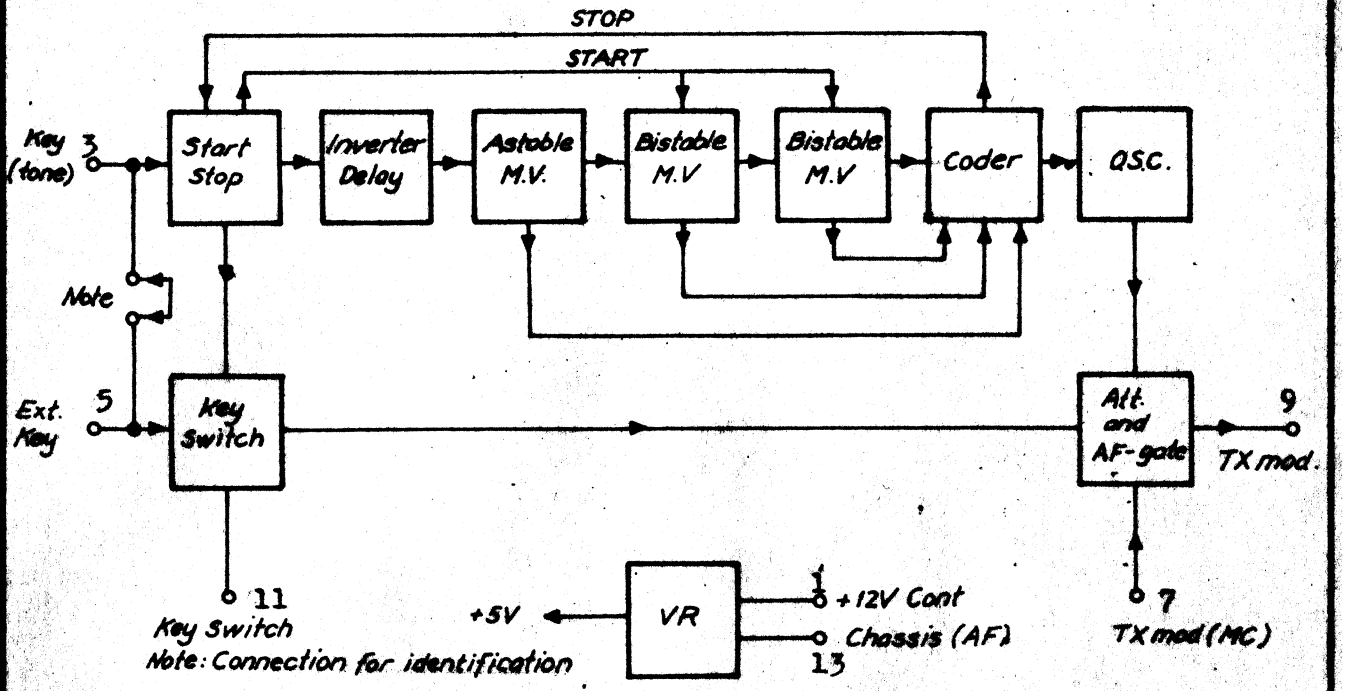
An AF-gate blocks the voice modulation during the sequence, and the transmitter is keyed through the key switch. After transmission of the seventh sequence pulses, approx. 490 msec., the transmission stops even if the tone key button remains depressed.

The entire tone sequence will be transmitted even if the tone key button is pressed for less than 490 msec. There is a possibility for identification, by short-circuit terminal 3 and 5. The tone sequence will then be transmitted each time the transmitter is keyed.

2. Mode of operation.

Blockdiagram

Ref. diagram ST7845



a. Start-Stop and key Switch

The start-stop circuit is a R-S flip-flop, existing of transistors Q1 and Q2. In the non-operating condition Q1 is on and Q2 off. When the tone key is activated, E1, C1 and E2 will cause a negative going pulse to reach the base of Q1, and Q1 will switch off. This causes the R-S flip-flop to shift, and the key switch transistor Q18 to switch on, witch activate the transmitter during the sequence. In the same time the AF-gate Q16 is switched off, via E9 and Q17, and blocks the voice modulation. To ensure that the two bistable multivibrators are in the right position, a clear pulse is lead to the clear inputs. After the sequence the base of Q2 receives a stop pulse from the coder, via C6, and the R-S flip-flop shifts back again. When this happens, Q17 and Q18 will switch off and Q16 on, and the start-stop and key switch is back in the non-operating condition.

b. Inverter (delay)

The inverter circuit consists of transistor Q3. In the non-operating condition Q3 is hold on via R9 and E4. In the Standard version, there is no delay, but if it is wanted, C2 is connected. C2 together with R10 can give a delaytime from 0,1 sec. to 1,5 sec before the first tone is transmitted.
R10 must not be smaler than 10 kΩ and C2 not bigger than 47 µF.

c. Astable multivibrator

The astable multivibrator consists of transistors Q4 and Q5 and their associated components.
The multivibrator generates square-wave pulses with a repetition time of approx. 140 m sec. In the non-operated condition, transistor Q4 is off, via E5 and Q5 is on. When the sequence starts, Q3 switches off, E5 blocks, and Q4 switches on. When Q4 switches on, C4 will feed a negative pulse to the base of Q5, which then will switch off. Transistor Q5 will be cut off during an interval determined by R13//R14 and C4. At the end of this interval Q4 will switch off and Q5 on. The length of the interval during witch Q4 is switched off is determined by R15//R16 and C5. From the collector of Q5 the square wave pulses are feed to the first bistable multivibrator.

d. Bistable multivibrator (flip-flop circuit)

The bistable multivibrators are identical. Bouth are built together in a dual-in-line. It is two J-K master-slave flip-flop. The J-K inputs, witch are not used, is connected to +5V via R18. The square wave pulses are feed to the clock input of FF1, and from the non-inverting output the pulses are feed to the clock input of FF2. The repetition frequency will be halved at the outputs of each flip-flop.

e. Coder

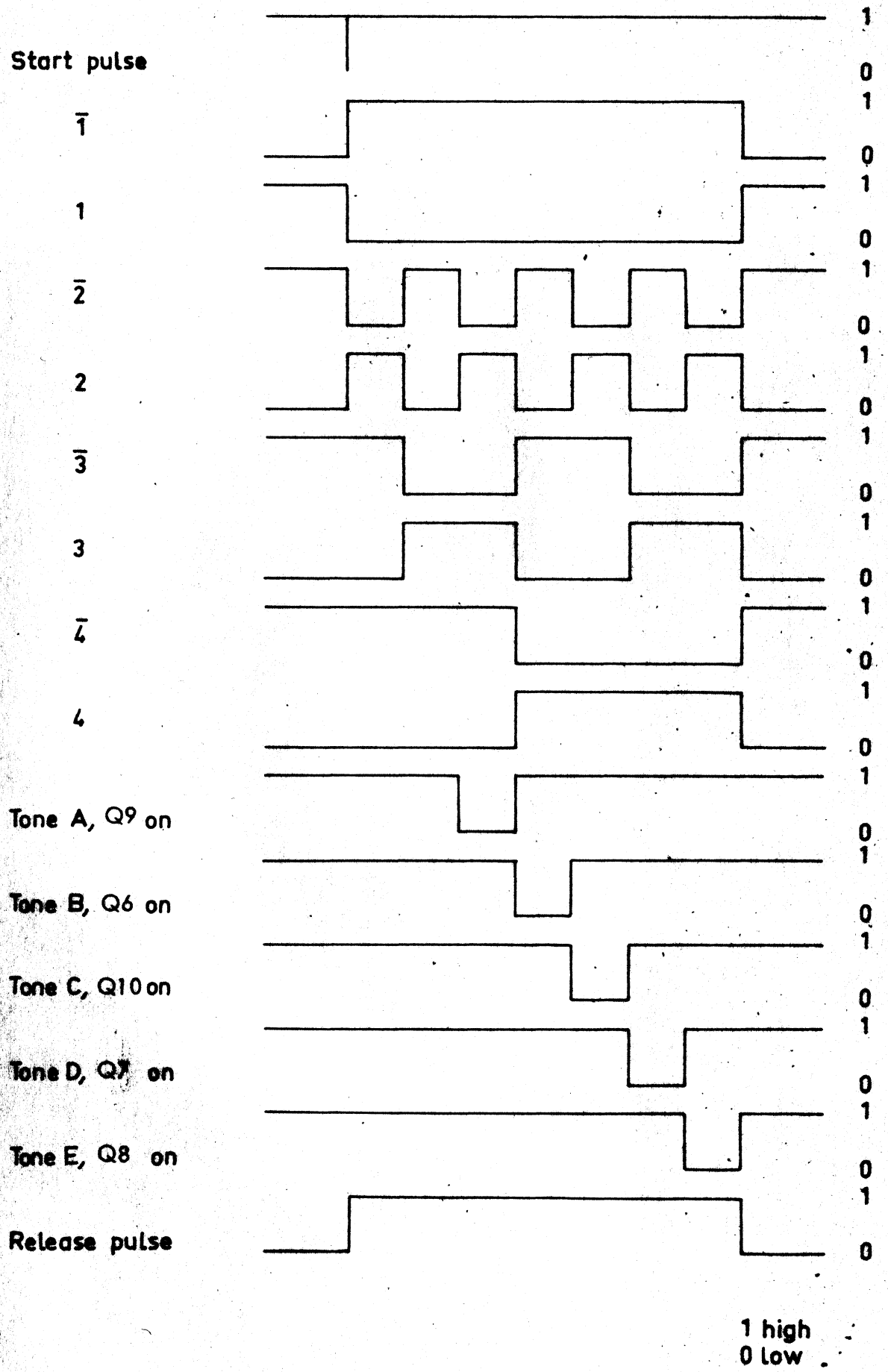
The coder consists of six NAND-gates built together in two dual-in-lines, resistors R19-R23 and transistors Q6-Q10. It is the coders business to connect the desired coil taps in a preciously determined sequence. The oscillator is in operation when one of the transistors Q6-Q10 are on. This occure when all the inputs of the NAND-gate is high, then the output will be low, and the transistor will switch on. If just one of the inputs is low, the output will be high, and the transistor will be switched off. The input potentials are controlled by the three multivibrators. All the steering pulses are shown here. See page 5.

f. Oscillator

The oscillator comprises transistors Q11 and Q12 and their associated components. A Hartley oscillator, with a differential amplifier, is used. A differential amplifier is used, to ensure big feed back at all frequences.

g. Attenuator and AF-gate

The attenuator and AF-gate comprises transistors Q13, Q14 and Q16, and their associated components. The attenuator Q13 steps the oscillator signal down to the desired level, and the emitter follower Q14 provides the desired output impedance. R36 and C9 in the collector of Q13 provides the desired frequency characteristic, and R34 in the emitter adjust the output level.
When the tone sequence transmitter is inoperative, Q16 is on, and the last stage of the microphoneamplifier is able to draw current through Q16. When the tone sequence transmitter is operating, E9 is connected to chassis through Q17, Q16 switch off, and the voice modulation is cut out. The tone sequence is lead to terminal 9 .



Description			
CE/ 5230	17.3.71	Storno	Tone sequence transmitter ST7845

h. Voltage Regulator

The voltage regulator comprises transistor Q15 and associated components. Its function is to keep the voltage konstant at +5 V ± 5%. When the battery voltage varies between +10,5 V and +16 V.

"FOR INTERNAL USE ONLY"

Tone sequence transmitter ST7845

Data

1. Power supply	10,5 V - 16 V. nom. 13,6 V.
2. Current consumption	
Stand-by	32 - 44 mA
Activated	42 - 54 mA
3. Temperature range	
Data observed	-25° - +60°C
Function capability	-30° - +80°C
4. Pulse sequences	
4-tone sequence	3 pulses (unmodulated), 70 m sec. ±15 m sec. each. 4 pulses (modulated), 70 m sec. ±15 m sec.
5-tone sequence	2 pulses (unmodulated), 70 m sec. ±15 m sec. each. 5 pulses (modulated), 70 m sec. ±15 m sec.
5. Tone frequencies	970, 1060, 1160, 1270, 1400, 1530, 1670, 1830, 2000, 2200, 2400, 2600, 2800 Hz.
6. Frequency accuracy	≤ 0,5%
7. Frequency stability	≤ 1%
8. Frequency response	Falling according to a RC-function with cut-off Frequency at 1000 Hz.

9. Output impedance	600 Ω ±20%.
10. Output level (at 1000 Hz)	-17 dBm + 1/-0 dB
11. Distortion (tone modulation)	$\leq$ 3%
12. AF-gate attenuation	$\geq$ 50 dB
13. Distortion (voice modulation)	$\leq$ 5%
14. Mechanical dimension	$\frac{17"}{10}$ x $\frac{22"}{10}$ x 24 mm

Tone Sequential Receiver SR7841

Description

1. General description

SR7841 is a tone sequential receiver for selective calling developed for "Stornophone 700" radiotelephone equipment. The frequencies are the Storno row: 970 Hz - 2800 Hz.
SR7841 can be employed for one of the following 6 combinations:

a. 4 or 5 tone receiver, individual.
b. 4 or 5 tone receiver with 1 group figure.
c. 4 or 5 tone receiver with 2 group figures.

When a correct sequence signal has been received the result will be as follows:

a. Individual call

A "call lamp" will light up and the "AF-muting" will be suspended, further will the "key lock" function be made operational.
The vehicle's traffic horn can (via an auxiliary relay) be connected to the alarm terminal, such that the horn will sound for a period approx. 1 sec. By pressing a push button LS IN/OUT opening of the loudspeaker and suspension of the "key lock" function can be a acomplished manually.
As the key lock function is linked with the turning on and off of the loudspeaker, it is impossible to let the radiotelephone's transmitter go on the air before the loudspeaker has been opened and hence checked whether the radiochannel is free.
Besides the above mentioned features the SR7841 is also fitted with an "occupied lamp" which, together with the key lock function is governed by the radiotelephone's squelch system in such a way, that a RF signal present at the antenna input terminal will cause the "occupied lamp" to light up, indicating that the radiochannel

is occupied and thereby avoiding unintended transmissions.
The loudspeaker will remain open after an indv. call.

b. Group call

Activation of the Alarm circuit is not possible.
The other functions are the same as mentioned for individual calling.

The "call lamp" and the "AF-muting" indications will automatically be deleted, when the carrier disappears. The function is governed by the squelch system.
When the radio carrier disappears after a group call, the loudspeaker will automatically be switched off.

2. Mode of operation

Block diagram.

The logic is defined in terms of standard "positive logic" using the following definitions:

∿ 0V = low voltage = logical "0"
∿ 5V = high voltage = logical "1"

If the received sequence is identical to those tones to which the receiver is tuned, the following will happen:

a. Individual calling

1.a. Decribed for 5-tones

As to coding and strapping see description.

Tone 1 is received at the input stage, which gives the wanted frequency response, level and impedance convertion, and is then

fed to the Q-multiplier 1.
In the stand by the tag for tone 1 is engaged by means of the AF-gate a.
The AF-signal is selected, amplifier (Amp.1), and rectified (detector 1).
The schmitt-trigger 1 therefore goes ON, output "1". This causes the clear function to be activated output "1", and the clear function is thereby suspended for the Indv. counter FF1-FF3 and the group counter FF5. Further the clock Indv. is activated output "1", with a delay about 25 mS, measured between the S.T. 1's output "1" and the clock's output "1". By the end of tone 1 the S.T. 1 changes, output "0". Thereby the clock Indv. goes to "0". The Indv. counter FF1 changes and the decoder adjusts itself in such a manner that the next AF-gate b is engaged.
After the S.T. 1 has changed from "1" to "0" the clear gives output "1" for abour 40 mS. The next tone must be received within that time or the clear function will reset the counter and the decoder will go back to stand by, i.e. ready for receiving tone 1.

With regard to the functions of IC1 - IC10 see appendix.

The passage of the next four sequential tones is the same as mentioned above.

Only by receiving the five tones and after the end of tone five, the decoder IC7C gives output "0" to the alarm, thereby connecting TERMINAL 37 to ground and the traffic horn will be activated for about 1 sec.

Further the output of IC7C governs the clear of the read-out gate FF4, 4 and 5 outputs "0" and "1", respectively, causing the call-lamp to light up and opening of the loudspeaker, connecting TERMINAL 47 and TERMINAL 34 to ground.
These two functions can only be detected manually by means of the push button LS IN/OUT, TERMINAL 32.

Indication of a carrier, i.e. the channel occupied, is performed by means of a DC voltage from the squelch system of the radio receiver to TERMINAL 41, hereby activating the occupied switch, grounding TERMINAL 45, and the "occupied lamp" will light up.

The VR of the radio transmitter is muted by means of the key-lock switch. The transmitter can only go on the air when TERMINAL 51 is at ground. The condition for transmitting is as follows:

AF-muting deleted. Call-lamp ON. TERMINALS 34 and 47 grounded.

Approximately 40 mS after the last tone in the sequence, the clear output goes "0" clearing the indv. counter FF1 - FF3 and the AF-gate a is set for a new call.

The pulse sequence is shown on page 5.

b. 4-tone sequential receiver

As to coding and strapping see description.

The output from the clear function governs the preset of FF1. Hereby the indv. counter now adjusted in such a manner that the decoder engages the AF-gate b for stand by.
The sequential passage and the read-out functions are the same as described for 5-tone sequence.

The pulse sequence is shown on page 6.

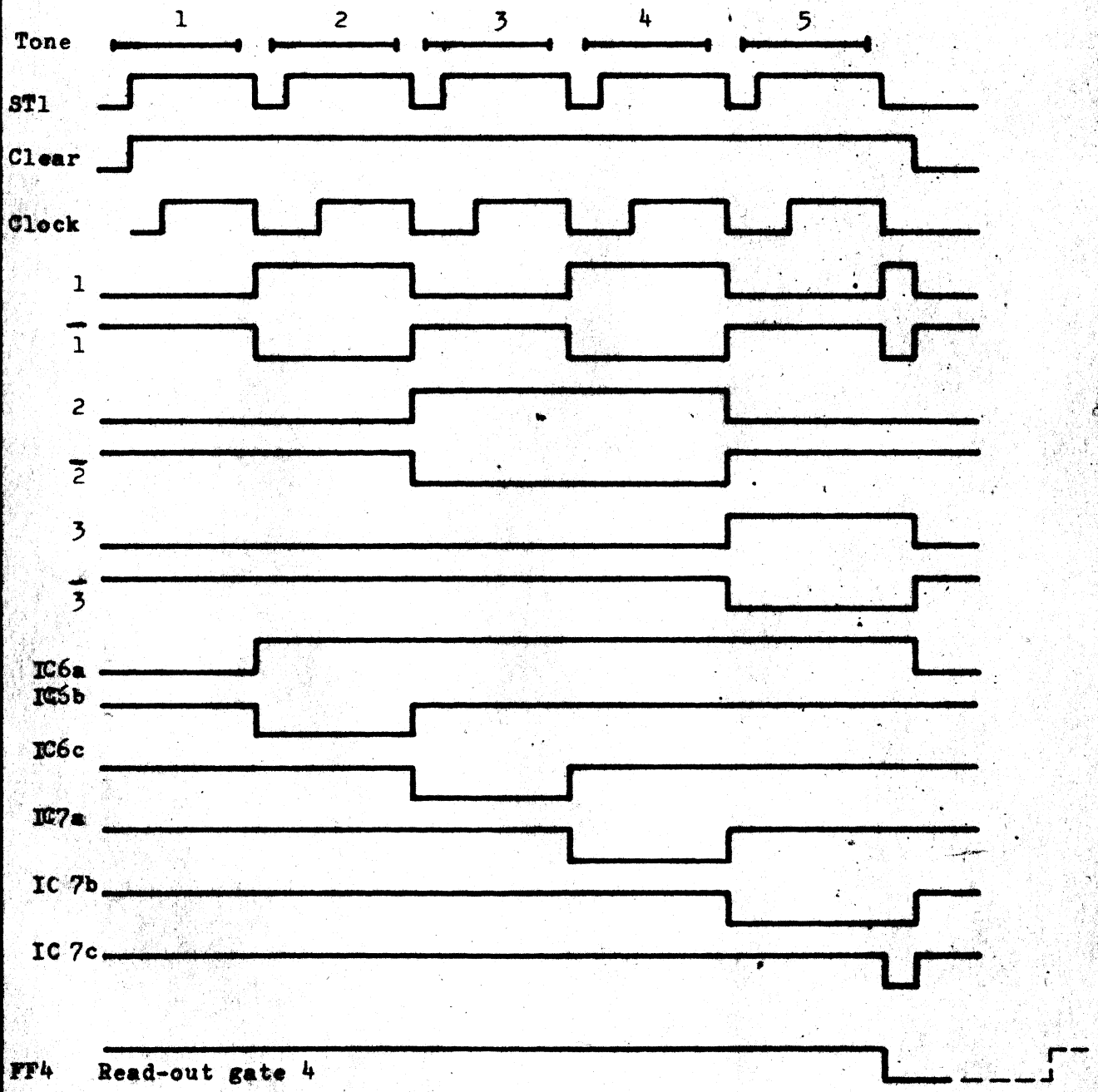
c. Group call 1 group figure

As to coding and strapping see description.

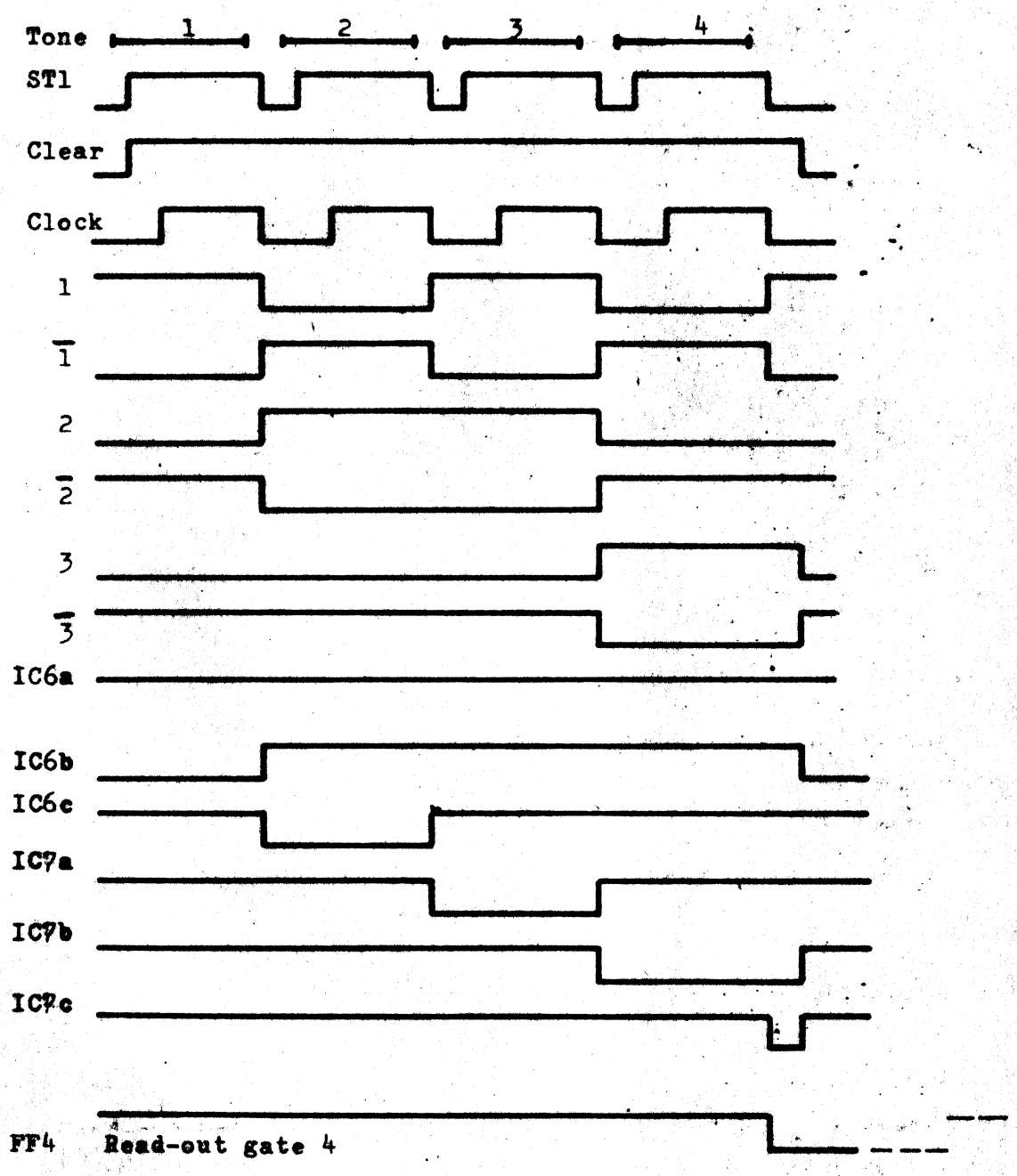
Described for 5-tones

The receiving of the first 4 tones is as mentiones for indv. call.

Pulse sequence 5-tone indv.



Pulse sequence 4-tone indv.



After the four tones the receiver is ready for the last tone. In that position the AF-gates e and g are both engaged but on each of the coils L1 and L2, respectively. If the received tone-frequency is identical with that the Q-multiplier 1 (L1) is set for the result will be an indv. call. If the tonefrequency is the same as that which set on the Q-multiplier 2 (L2), the following will happen:
The group chain, the built up of which is identical with that of individual chain, is activated. Thereby the schmitt-trigger 2 goes "1". This function governs the clear and the clock group. Therefore the clear is still suspended for the Indv. counter FF1 - FF3 and the group counter FF5.
Further the group clock is activated,output "1", with a delay about 25 mS, measured between the S.T. 2's output "1" and the clock's output "1". The clock group feed information to the clock Indv. by means of the transistor Q27, i.e. the output of the clock Indv. follows the output of the clock group. Therefore the clock indv. output goes "1".
After the end of the fifth tone the S.T.2 goes to "0". The group counter changes as follows: $\overline{5}$ output "0", $\overline{6}$ output "0" and 6 output "1".

The FF6's k input is fed by means of the group gate, which always has the output "0", both by indv. and group call. Therefore, after a group call, the output of FF6 will remain in the same position, independently of the logical state of its clock input.
See appendix page23.

The alarm muting is now activated and thereby blocks the alarm.

The decoder (IC70) goes "0" at the end of the last tone,as the indv. conter also changes and governs,as mentioned before,the clear of the read out gate FF4, output 4 "0" and $\overline{4}$ "1", causing the call lamp to light up and opening the loudspeaker; i.e. connetting TERMINAL 47 and TERMINAL 34 to ground.
The functions can be detected manually by means of the push button LS IN/OUT connected to TERMINAL 32.

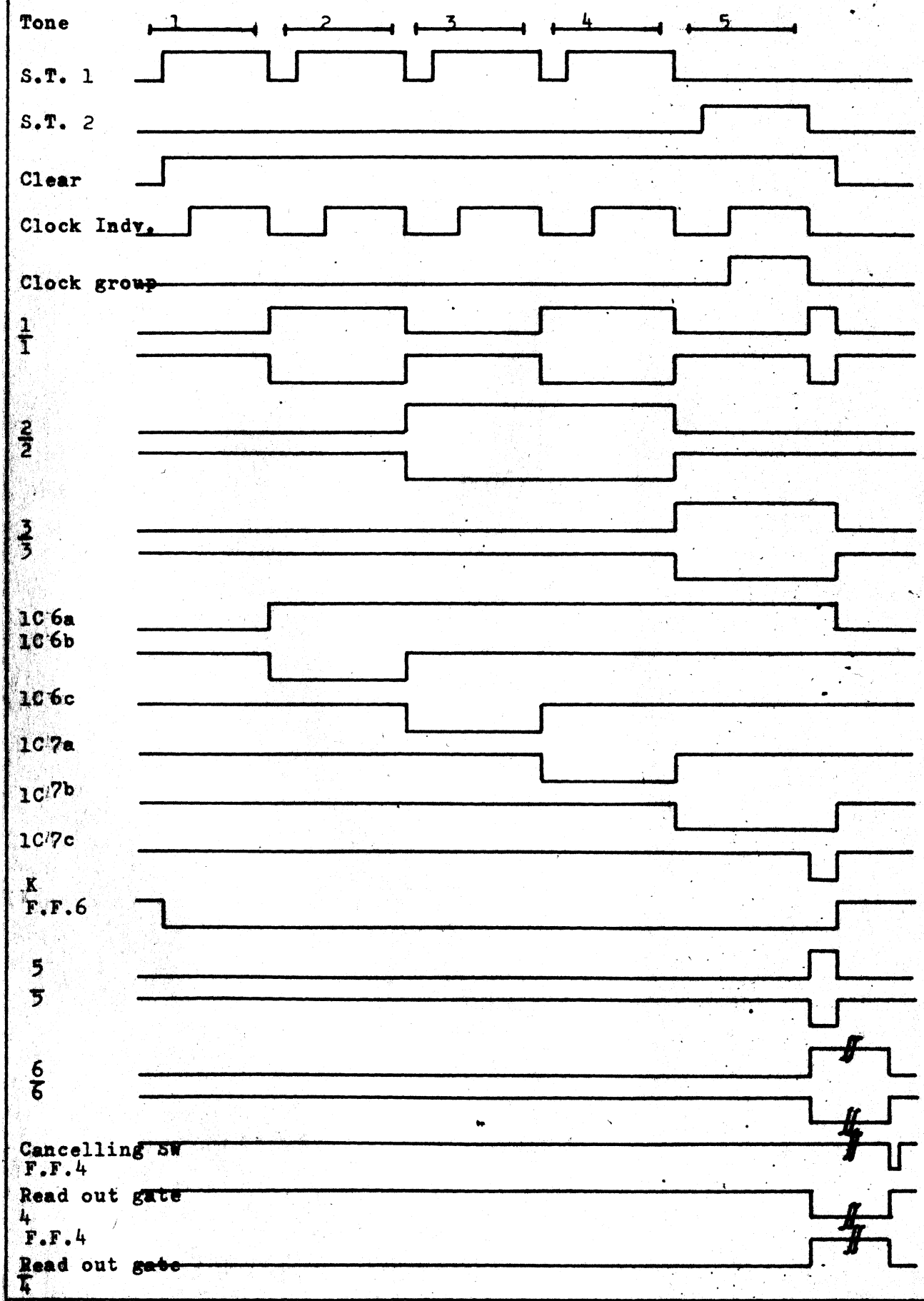
Approximately 40 mS after the last tone in the sequence the clear function goes "0", the indv. counter FF1 - FF3 and the group counter FF5 clears. The AF-gate a is set for a new call.

By receiving a radio carrier the TERMINAL 45 goes "0". By means of the information from the output of FF6 ($\overline{6}$) the cancelling switch only gives response for a group call. After the call $\overline{6}$ has output "0", and the cancelling switch is thereby suspended. When the radio carrier disappears TERMINAL 45 goes high (∿13,6 V), causing the cancelling switch to feed a pulse "0" to the preset of the read out gate FF4 output 4 "0" and $\overline{4}$ "1". The call is detected, i.e. the call lamp switch suspended and the AF muting activated. The same pulse is also fed to the clear of FF6, which clearas, outputs 6 "0" and $\overline{6}$ "1".
To overcome fading problems this change is delayed about 300 msc. measured from TERMINAL 45 goes high to the cancelling switch gives a "0".

The tone receiver is ready for a new call.

The pulse sequence is shown on page 9.

Pulse sequence 5-tones with 1 group figure



d. Group call 2 group figures

As to coding and strapping see description.

Described for 5-tones

The receiving of the first 3 tones is as mentiones for indv. call. The receiver is now ready for tone 4. In that position the AF-gate d and f are both engaged, but on each of the coils L1 and L2 respectively.
If the received last two tone frequencies are identical with those, which are set for on the Q-multiplier (L1), the result will be an indv. call.
If the two tone frequencies are the same as those which are set for on the Q-multiplier 2 (L2) the following will happen:
The fourth and the fifth tone activate the group chain. The S.T.2 feeds the clock group and the clear. The output of the clock group governs the output of the indv. clock as mentioned under sect. c. Thereby the same functions are obtained for indv. and group call with one figure.
After the end of the fourth tone the AF-gate e is disengaged by the output of IC7b, which remains "1" by means of FF5.
At the end of the fourth tone FF5 changes output 5 to "1" $\overline{5}$ to "0" respectively, and the AF-gate g is engaged. At the end of the last tone FF6 output 6 "1" and $\overline{6}$ "0".

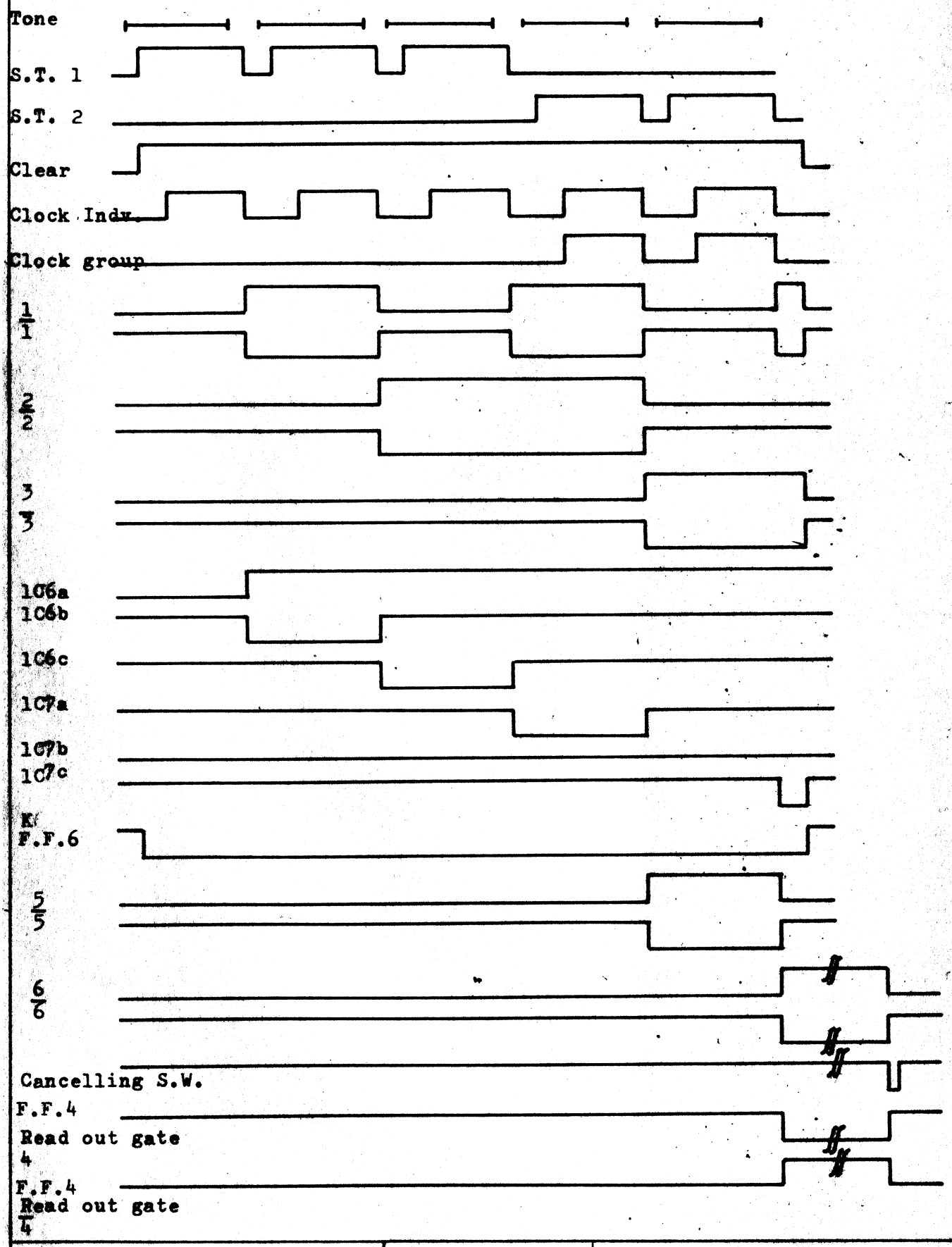
The alarm-muting has now been activated and thereby blocks the alarm.

The decoder goes "0" at the end of the fifth tone and the same functions are obtained as mentioned under sect. c.

When the radio carrier disappears, the read-out gate changes as described under sect. c and thereby deletes the call indication.

The pulse sequence is shown on page 11.

Pulse sequence 5 tones with 2 group figures



3. Circuit description

a. The input stage

Comprises of Q1, IC1, Q2, Q3 with associated components.

The input stage serves the following purposes:

The preemphasis stage Q1 compensates for the linear distortion introduced by deemphasis in the radiotelephone. The preemphasis ratio follows a RC function with cross-over at 1000 Hz. (R 4 and C4).
IC1 is a linear amplifier which amplifies the incomming signals until the output swing is limited by the power supply (+5 V) and ground. Complete limiting will occur approximately 6 dB above min trigger level. (i.e. V_{in} = 110 mV).
The gain is determined by R8 and R5. The output's DC level is adjusted by means of the voltage devider R6 and R7.
Limiting the amplitudes of all frequencies together with the band pass characteristics of the subsequent Q-multiplier adjacent tones will be unable to trigger the tonereceiver, providing their frequencies differ from the resonant frequency by 4,5 pct. or more.

The transistors Q2 and Q3 are coupled in such a manner that a low output impedance is achieved (order of 1 ohm) which results in negligible loading of the Q-multiplier.

b. The Q-multiplier

Comprises of Q4, L1, C9 with associated components.

The Q-multiplier contains a parallel resonant circuit, C8 and L1, which is very loosely coupled to the transistor Q4. By means of a feedback winding in the collector circuit of Q4 part of the tone signal is again applied to L1 in phase in order to give rise to the natural Q of L1 by a factor of approx. two.
The multiplier is temperature stabilized by means of a NTC resistor

which gives an approx. flat temperature response from -30°C to +80°C. C 8 in the resonant circuit is grounded through the output impedance of Q3 and the resonant coil L1 is alternatively grounded through the AF-gates Q15 - Q19.

By connection of the AF-gates to the relevant terminals of the coil L1, the correct tone combination can be selected.
The Q-multiplier 2 is identical with the Q-multiplier 1.

c. The amplifier 1.

Comprises of IC2 with associated components.

IC2 is a linear amplifier which amplifies the tone signal after the Q-multiplier 1. The amplifier is DC coupled to the non-inverting input so that the input resistance has a high value.
The gain can be adjusted by means of R20 and thereby the trigger-level for the succeeding schmitt-trigger.
The amplifier 2 is identical with the amplifier 1.
With regard to the IC's function, see appendix page 21 and 22.

d. The detector 1.

Comprises of Q5, E1 and E2 with associated components.

Q5 is an emitter follower which feeds the detector. The detector is a conventional voltage doubling circuit.
The detector 2 is identical with the detector 1.

e. The schmitt-trigger 1.

Comprises of IC3 with associated components.

The S.T. is an operational amplifier used as a threshold detector and governs the clock and the clear settings.
The threshold voltage is set by means of R29, E3 and R30

In stand by V_{in} at the non-inverting input is "0", thereby V_{out} is "0". If the S.T.'s threshold is surpassed by the DC voltage from the detector, the S.T. will change state and thereby the output goes "1".
The S.T. 2 is identical with the s.t.1.

f. The clock circuit, individual.

Comprises of Q6, Q7 and Q8 with associated components.

The clock circuit triggers the counter FF1 after a delay of about 25 mS. the delay serves to ensure against false calls, noise-impulses etc. The clock delay is adjusted by means of R35 to approx. 25 mS in which the S.T. has to be activated before the counter changes. In stand by the S.T.'s output is "0", Q6, Q7 and thereby Q8 are ON output "0". When the S.T. is activated Q6 is non conducting. C14 charges with the time constant R34//R35xC16. When the base voltage of Q7 reach $V_b > V_e$ Q7 goes OFF and so does Q8 output "1". When the tone disappears Q6 conducts and C16 discharges quickly through R36, and Q8 gets output "0". The counter FF1 changes. The clock-delay can be adjusted by means of R35.

g. The clock circuit group.

Comprises of Q25, Q26, Q27 and Q28 with associated components.

The clock group triggers the counter FF5. The delay and the function is the same as mentioned under sect. f.
Q28 governs the output of the clock indv. When Q27 is "1", Q28 goes ON and grounds the base of Q8, which gets output "1".

h. The clear circuit.

Comprises of Q9, Q10, Q11, Q12, E5, E6 and E12 and associated components.
The clear function serves the purpose of setting the counters to stand by after a correct of "false" call.

Q9 is an emitter-follower governed by ST1 or ST2. In stand by E5 and E12 are non-conducting, thereby Q10 and Q12 are both ON, output "0".
When ST1 or ST2 gets output "1" E5 or E12 is conducting C18 discharges quickly through Q9, whereby Q10 and Q12 go OFF, output "1", the counters are now able to start counting.
After the end of a tone, E5 of E12 is non-conducting, C18 charges With a time constant C18 x R43 , and when the base voltage of Q10 reaches $V_b < V_e$, Q10 conducts and thereby Q12 goes "0". The counters reset to stand by. The emitter-voltage is aranged by means of the voltage divider R45 and R46.
The delay is approximately 40 mS, measured between ST1's or ST2's output "0" to Q!s output "0". When the battery voltage is switched on a positive pulse in feet through E6 to the base of Q11 saturating Q12, whereby the counter is cleared.

i. The indv. counter FF1 to FF3.

Comprises of IC4a, IC5a, IC5b.

The counter is composed of three J-K master-slave flip-flops. By means of R87 they are coupled as ordinary bistable stages (i.e. the first flip-flop triggers the next flip-flop etc.).
FF1 has both clear and preset functions. By means of these functions the tone receiver can be strapped to 5 or 4 tone sequence.
With regard to the functions, see appendix page 23, 24 and 25.

The truth table is shown on page 16

j. The group counter, the group gate and the blocking gate.

Comprises of IC10, Q29 and Q24 with associated components.

The counter is composed of two J-K master flip-flops. They are almost coupled in the same manner as the indv. counter. The difference being that FF6's K input is governed by the group-gate Q29.
The gate is an inverter and is fed from the clear circuit. The gate serves purpose to "block" the output of FF6 if a group call is repeated under the following circumstances:
If the radio receiver's squelch system is opened these will affect FF6 in such a way that it is no longer cleared, meaning no negative pulse

Truth table for the counter

5-tone

Cleared (pending for call)	1	$\overline{1}$	2	$\overline{2}$	3	$\overline{3}$
Cleared (pending for call)	0	1	0	1	0	1
After first tone burst	1	0	0	1	0	1
After second tone burst	0	1	1	0	0	1
After third tone burst	1	0	1	0	0	1
After fourth tone burst	0	1	0	1	1	0
After fifth tone burst	1	0	0	1	1	0
40 mS after last tont burst (cleared, pending for call)	0	1	0	1	0	1

4-tone

	1	$\overline{1}$	2	$\overline{2}$	3	$\overline{3}$
Preset (pending for call)	1	0	0	1	0	1
After first tone burst	0	1	1	0	0	1
After second tone burst	1	0	1	0	0	1
After third tone burst	0	1	0	1	1	0
After fourth tone burst	1	0	0	1	1	0
40 mS after last tone burst (cleared, pending for call)	1	0	0	1	0	1

The truth table is similar for group calls

("0") arises from the cancelling switch.
The AF-muting has been detected manually, i.e. output 4 "0".

When the radio carrier disappears the FF6's clear receives a negative pulse "0", the output $\bar{6}$ goes "1" and 6 "0". The call is deleted.

The truth table is shown below:

Truth table for counter.

2 group figures.

	5	$\bar{5}$	6	$\bar{6}$
Cleared (pending for call)	0	1	0	1
After first tone burst	1	0	0	1
After second tone burst	0	1	1	0
40 mS after the last tone burst (cleared pending for call)	0	1	1	0
Call deleted by means of the squelch	0	1	0	1

1 group figure

	5	$\bar{5}$	6	$\bar{6}$
cleared (pending for call)	0	1	0	1
After first tone burst	1	0	1	0
40 mS after last tone burst (cleared, pending for call)	0	1	1	0
Call deleted by means of the squelch	0	1	0	1

With regard to the functions see appendix page

The pulse sequence is shown on page 23 and 24.

Q24
The blocking gate serves the purpose, that when the loudspeaker has been activated, manually or by a indv. call, a group call will not delete the loudspeaker.
If the output 4 is "1" the blocking gate will switch the output of S.T.2 to ground, the clock indv. and the clock group will not be activated.

k. The decoder

Comprises of IC6 and IC7.

The decoder is formed by means of T.T.L. gates, triple 3 input NAND gates.
The output of a NAND-gate is low ("0") only when all of the inputs are high ("1").
In stand by the output of IC6a or IC6b is always "0", 5 or 4 tones, respectively.
After the conclusion of a call IC7c feed signal to the read-out gate and the alarm.
With regard to the functions see appendix page 22.

l. The AF-gates indv. a, b, c, d, e.

Comprises of Q15 to Q19 with associated components.

The AF-gates are fed from the decoder's NAND-gates IC6a-IC7b. When the base of a transistor gets "0" from a NAND-gate, the transistor conducts and the relevant tag of the coil is engated.

m. The AF-gates group f and g.

Comprises of Q20 and Q21 with associated components.

The mode of operation is as mentioned under section l.
Q21 is fed from the output of IC7b or the output of FF5 (5), group call 1 or 2 figures, respectively.

n. The alarm circuit and the alarm muting.

Comprises of Q39, Q40, Q41, Q42 and E18 with associated components.

In stand by the Q39 is ON and E18 is non-conducting. Q40 and Q41 are both ON, thereby Q42 OFF.
By a call Q39 goes OFF and C46 charges through E18 causing that Q40 and Q41 turn OFF, govern Q42 to turn ON and connects TERMINAL 37 to chassis. After approximately 40mS (clear delay) IC7c goes "1" and turns Q39 ON. E18 is non-conducting and C46 discharges with a time constant C46 x R114, after this delay Q40 and Q41 turn ON, and disconnects the ground path for the alarm circuit. The alarm is ON for approximately 1 sec.

The alarm muting blocks the alarm circuit at a group call. After receiving the last group tone the FF6's output 6 goes "1". E19 conducts and thereby Q41 remains ON.

o. The AF-muting and the Key Lock Switch.

Comprises of Q30 Q31 and E14 with associated components.

The AF-muting and the Key-lock are governed by the output of the read-out gate (FF4, 4)
In stand by the output of Q30 is high (∿ + 10 V), E14 conducts and the loudspeaker is cut off. When the read-out gate is activated 4 goes "1", Q30 conducts and the AF-muting is suspended, TERMINAL 34.
The key-lock switch governs the voltage regulator of the radio transmitter, which only can be activated when Q31 is conducting, ground at TERMINAL 51, i.e. when the AF-muting is suspended.

p. The Call - and the Occupied Switch.

Comprises of Q32, Q33 and Q34 with associated components.

The call switch connects chassis to a lamp when the read-out gate is activated. As 4 goes "0", Q32 is non-conducting and feeds base current to Q33 grounding TERMINAL 47.
For the sake of avoiding retransmission a relay may be connected to TERMINAL 49 so the vehicle's entertainment radio may be suspended as long as the key-lock is operational.
The occupied switch connects the "occupied lamp" TERMINAL 45 to ground , when a radio carrier is present. The input is governed by a DC voltage from the radio receiver's squelch system SQ IN, TERMINAL 41.

q. The cancelling switch.

Comprises of Q38 with associated components.

When the radio telephone is turned on the output functions must not be activated. To ensure this, Q38 feeds a negative pulse ("0") to the preset of the read-out gate. When the battery voltage has been

switched on Q41 discharges through Q38 which goes ON for a short moment neutralizing the read-out gate. Further the same pulse is fed to the clear of FF6.
The cancelling switch also deletes the call after the reception of a group call by neutralization of the read-out gate.

R. S.Q. Delay

Comprises of Q35, Q36 and Q37 with associated components.
To overcome fading problems at group call, the time constant secures a time delay of approx. 3oo m.sec.
After a group call FF6 output $\bar{6}$ "0" and Q35 goes OFF. Q34 is ON indicating a radio carrier, E16 conducts and keeps Q36 OFF. When the radio carrier disappears Q34 goes OFF, E16 is OFF, C39 charges with a time constant Q39 x R98 after a while Q36 goes ON turning Q37 ON. A positive pulse ("1") is thereby fed to Q38 causing a negative pulse ("0") to the preset of the read out gate and hereby deletes the group call.
The same pulse cleares FF6 and the S.R. is ready for a new call.

S. The voltage regulator

Comprises of Q13 Q14 E7 and E8 with assoiated components.

The DC output from the voltage regulator is nom. 8,9 V and 4,9V for batteri variations between 1o,5 V and 16 V.

Appendix: Integrated Circuits

Four types of IC's (Integrated Circuits) are used in SR7841.

1. Operational Amplifier (TAA865)

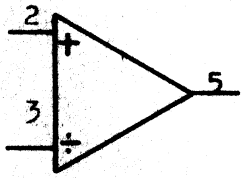
2. Triple 3-input NAND-gate
   (T.T.L. - low-power - series 64)

3. Dual J-K master-slave flip-flop
   (T.T.L. - low-power - series 64)

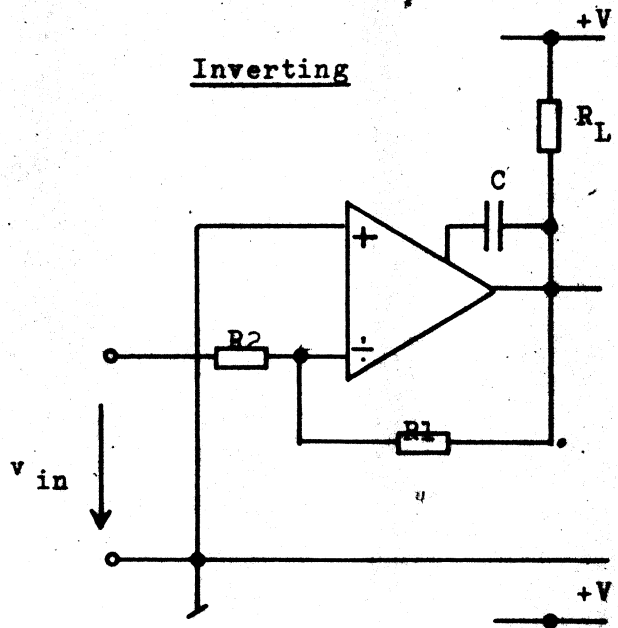
4. Dual J-K- master-slave flip-flop
   (T.T.L. - series 64)

1. Operational Amplifier IC1, IC2, IC3, IC8, IC9.

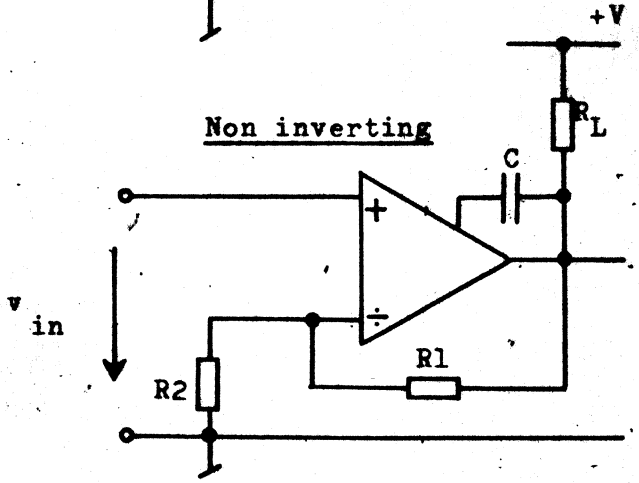
Symbol



Inverting



Non inverting



The amplifier has two inputs- and one output terminal. The plus sign (non-inverting) indicates that the input- and the output signal are in phase. The minus sign (inverting) indicates that the input- and output signal are out of phase (180°).
The gain is determined by R_1 and R_2.

Inverting configuration: $$Av = \frac{V_{out}}{V_{in}} \approx -\frac{R_1}{R_2}$$

Non-inverting configuration: $$Av = \frac{V_{out}}{V_{in}} \approx 1 + \frac{R_1}{R_2}$$

The condenser C is used for phase compensation to assure that the circuit remains stable.

RL is the collector resistor for the built-in output transistor.

2. Triple 3-input NAND gate IC6 and IC7.

Logic symbol

$$y = f(x_1 x_2 x_3)$$

$$y = x_1 \cdot x_2 \cdot x_3$$

Truth table.

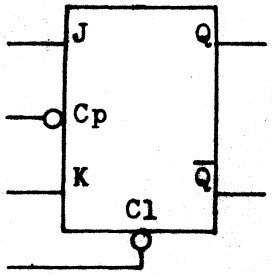
x_1	x_2	x_3	y
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

From the truth table is derived:

If one of the inputs is low ("0") ⇒ y = "1"
If all three inputs are high("1") ⇒ y = "0"

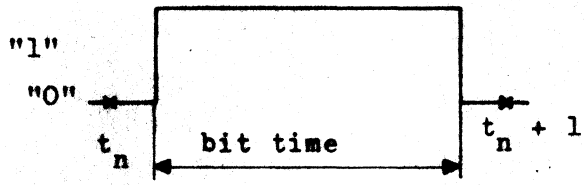
3. Dual J-K master-slave flip-flop IC5 and IC10.

Logic symbol.



Truth table		
t_n		t_{n+1}
J	K	Q
0	0	Q_n
0	1	0
1	0	1
1	1	$\overline{Q}_n$

Clock pulse (Cp)



t_n: Bit time before Cp goes high ("1")

t_{n+1}: Bit time after Cp has gone low ("0").

Q_n is the Q's position to the time t_n, which is before a Cp. After a Cp the Q's position is Q_{n+1} to the time t_{n+1}.

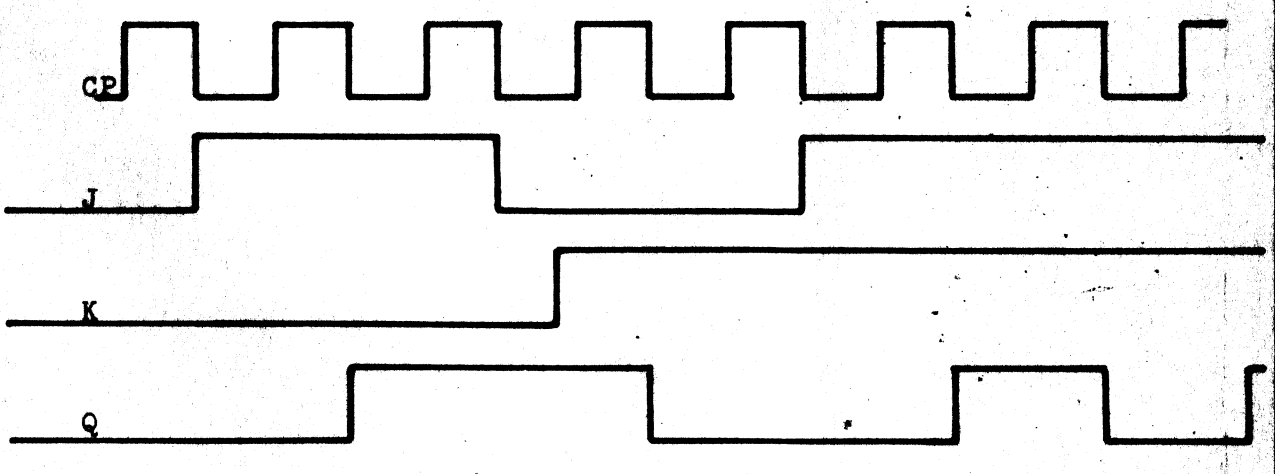
A J-K flip-flop is a bistable stage which changes by means of a Cp. Q's position is decided by the logical level on the J-K inputs before a Cp.
The change of the flip-flop occurs at the trailing edge of the Cp.

All of the J-K inputs of the Indv. counter are tied to V_{cc} (+5V) through a resistor R87 i.e. J-K "1". Following the truth table the logic level of the counter will change after each clock pulse.

The group counter is almost formed as the Indv. counter. The J-K inputs of FF5 are tied to V_{cc}(+5V) through the resistor R86 . The K-input of FF6 is governed from Q29 and the J-input is also tied to V_{cc}(+5V) through R86; i.e. K = 0 and J = "1", Q goes 1 at the trailing edge of the CP.

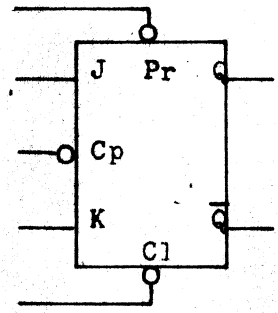
The output of FF6 will ramain in that position independent of the clock, as long as the J-K inputs are set as described above.

The pulse sequence for the truth-table is shown below.



3. J-K master-slave flip-flop with preset and clear IC4.

Logic symbol

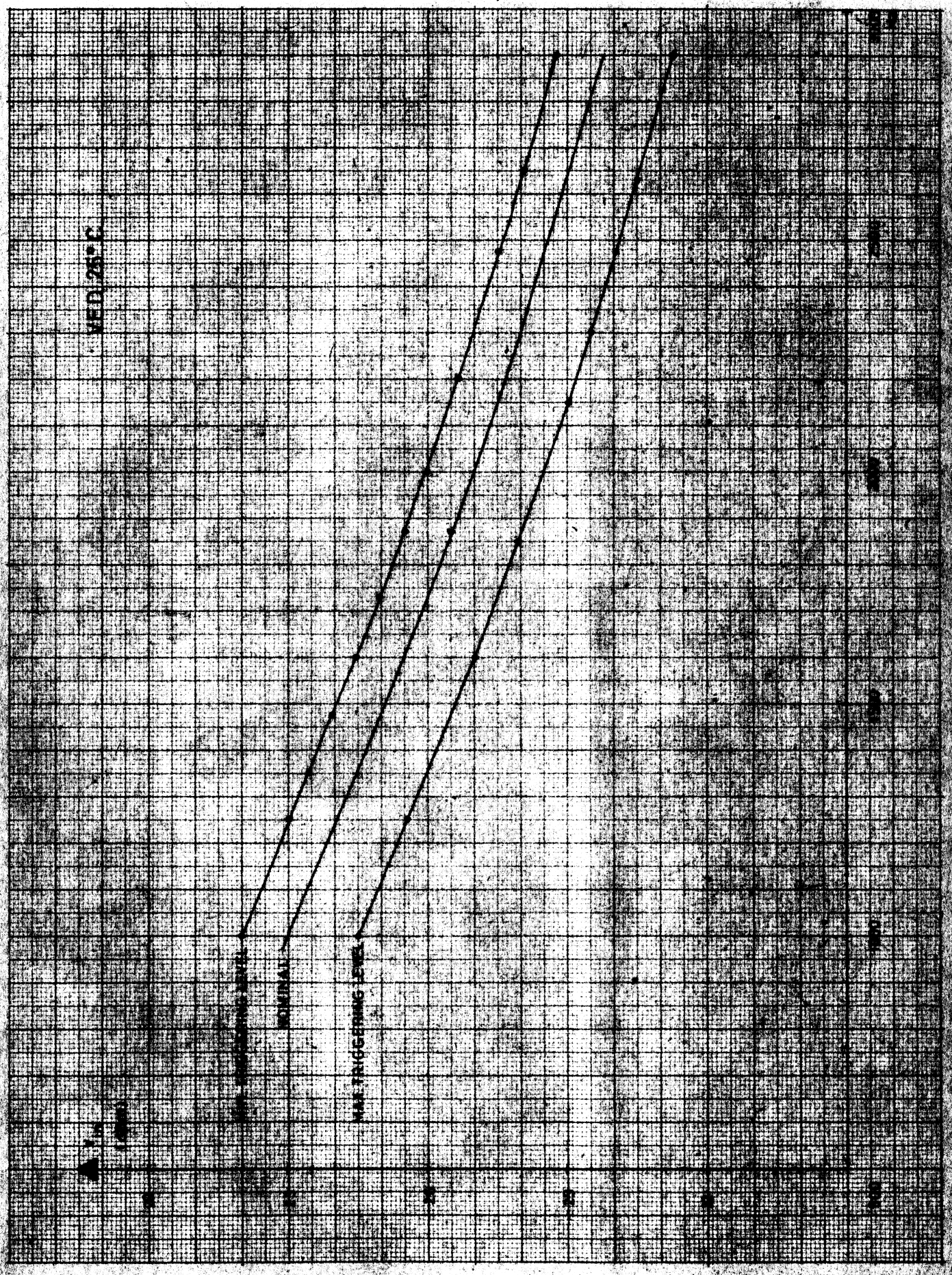


Cl = Clear
Pr = Preset
Cp = Clock-pulse

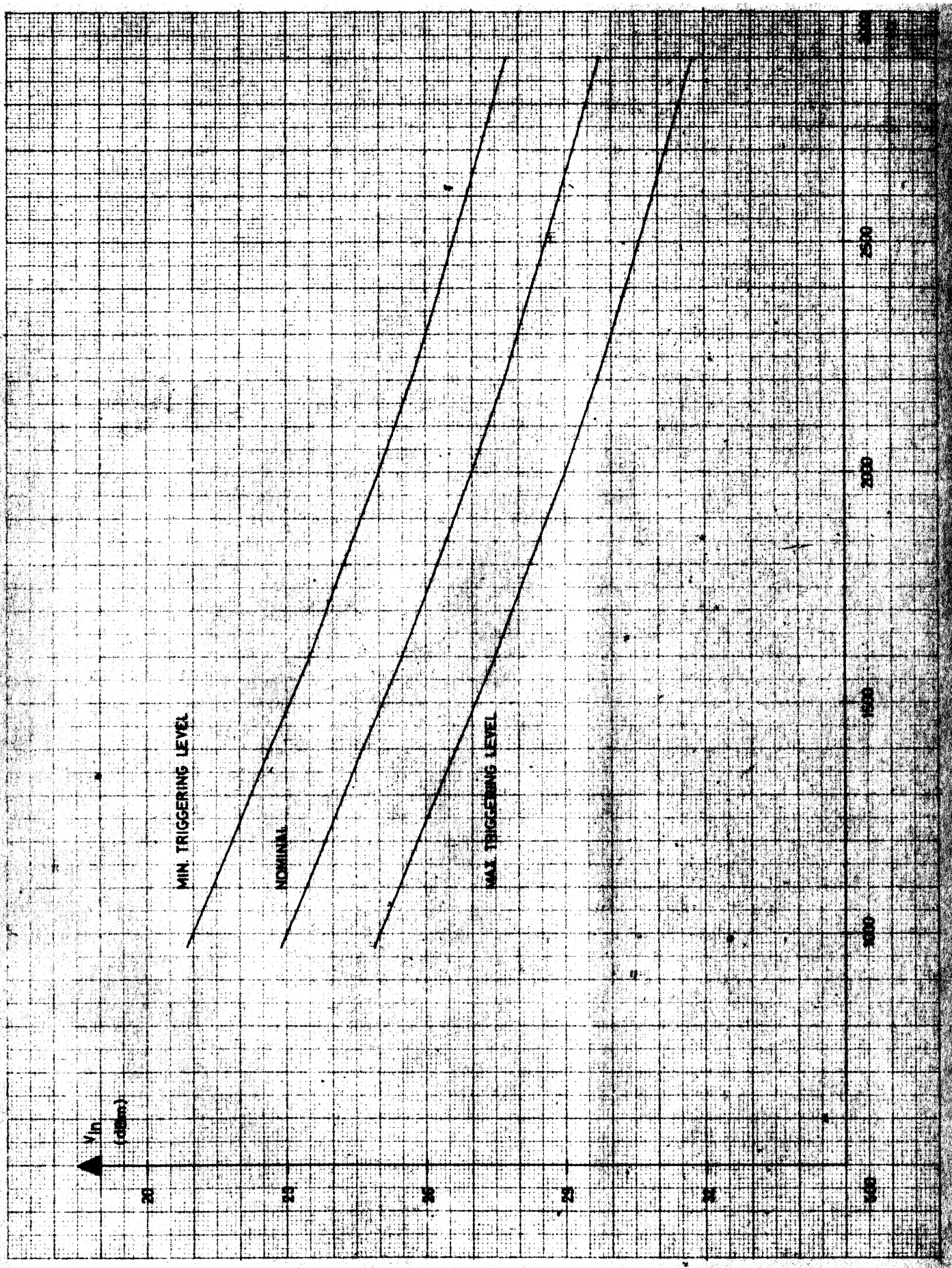
The logical functions are the same as mentioned under sect 2.

The clear and the preset are independent of the logical state of the clock and the J-K, (direct inputs) i.e.

Clear = "0" $\Rightarrow$ Q = "0"
Preset = "0" $\Rightarrow$ Q = "1".

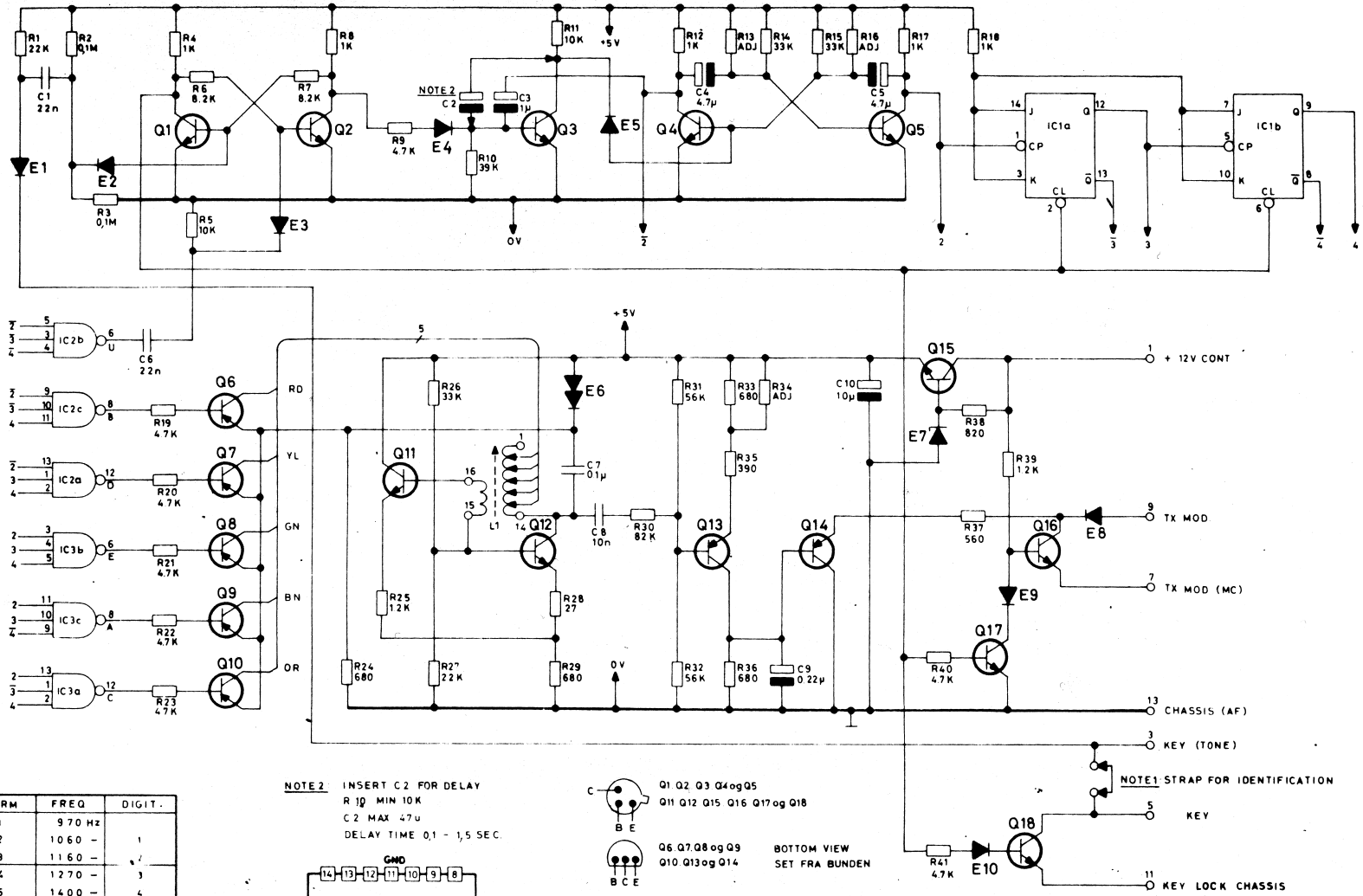


4.9.72 IGH-5230	Triggering level for the Schmitt - trigger in SR7841 at 25C.	ENHED 0.9 Page 5b



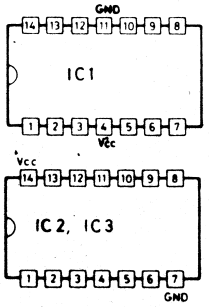
28.8.72

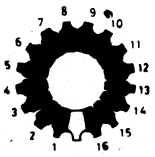
TN-5220 Revised 28-8-72 IGH-5230	Triggering leved for the Schmitt - trigger in in SR7841	ENHED 0.9 Page 5a



TERM	FREQ	DIGIT.
1	970 Hz	
2	1060 –	1
3	1160 –	2
4	1270 –	3
5	1400 –	4
6	1530 –	5
7	1670 –	6
8	1830 –	7
9	2000 –	8
10	2200 –	9
11	2400 –	0
12	2600 –	REPEAT
13	2800 –	ALARM
14		
15		
16		

NOTE 2 INSERT C2 FOR DELAY
R 10 MIN 10K
C 2 MAX 47u
DELAY TIME 0,1 - 1,5 SEC.





TOP VIEW
SET FRA OVEN

Q1 Q2 Q3 Q4 og Q5
Q11 Q12 Q15 Q16 Q17 og Q18

Q6 Q7 Q8 og Q9
Q10 Q13 og Q14

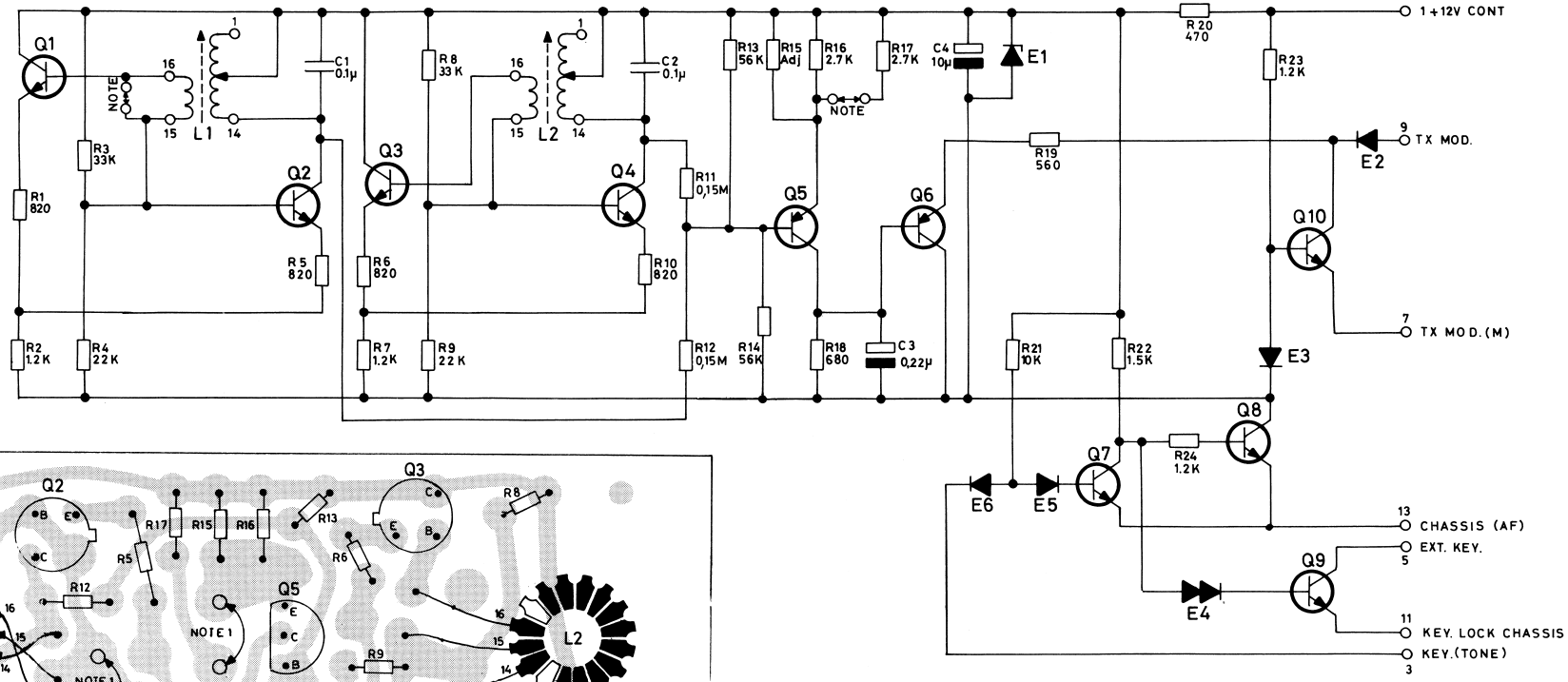
BOTTOM VIEW
SET FRA BUNDEN

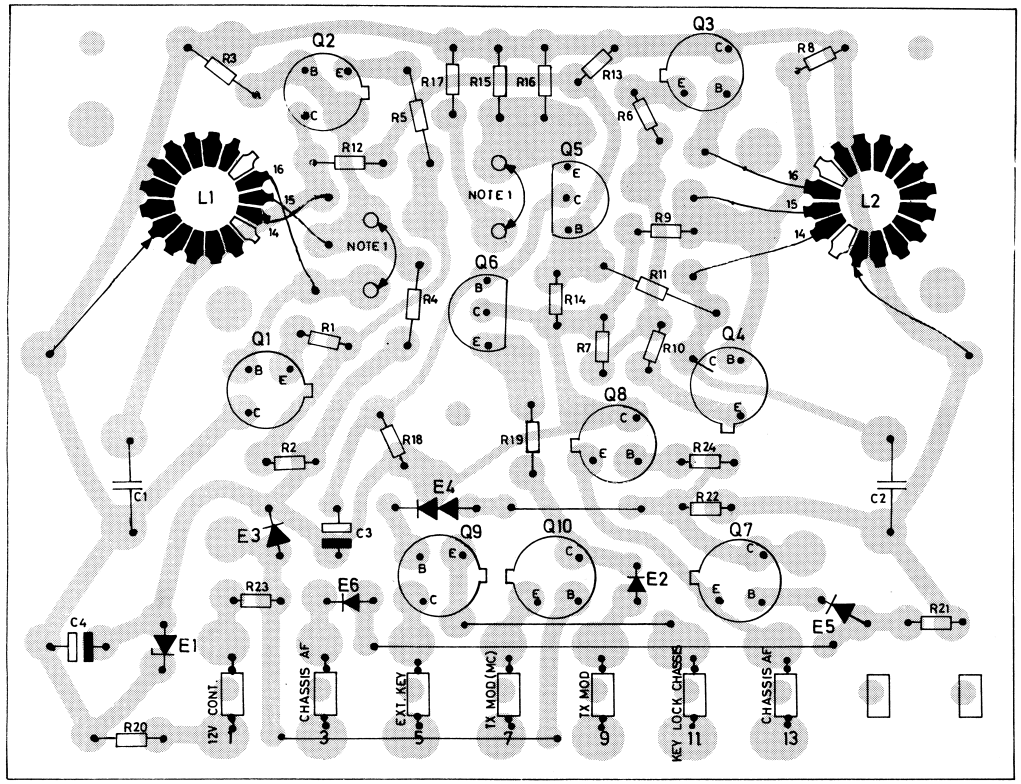
SEQUENTIAL TONE TRANSMITTER
SEKVENSTONESENDER

ST7845

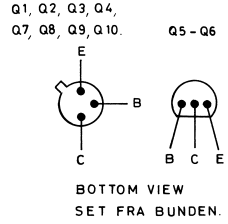
D401.583/2

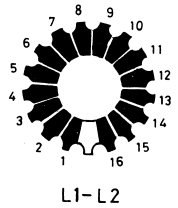
Storno





PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE
TRYKT KREDSLØB SET FRA KOMPONENTSIDEN





TERM.	FREQ.
1	1060 Hz
2	1160 –
3	1270 –
4	1400 –
5	1530 –
6	1670 –
7	1830 –
8	2000 –
9	2200 –
10	2400 –
11	2600 –
12	2900 –

TONE TRANSMITTER
TONESENDER

TT7812

D 401. 556/2

Ikke fra denne manual!

TYPE	NO.	CODE	DATA
TT7812		10.2453	Tone Transmitter
	C1	76.5068	0.1µF 1% polystyr TB 63V
	C2	76.5068	0.1µF 1% polystyr TB 63V
	C3	73.5118	0.22µF 20% tantal 35V
	C4	73.5109	10µF 20% tantal 16V
	R1	80.5248	820Ω 5% carbon film 1/8W
	R2	80.5250	1.2KΩ 5% carbon film 1/8W
	R3	80.5267	33KΩ 5% carbon film 1/8W
	R4	80.5265	22KΩ 5% carbon film 1/8W
	R5	80.5248	820Ω 5% carbon film 1/8W
	R6	80.5248	820Ω 5% carbon film 1/8W
	R7	80.5250	1.2KΩ 5% carbon film 1/8W
	R8	80.5267	33KΩ 5% carbon film 1/8W
	R9	80.5265	22KΩ 5% carbon film 1/8W
	R10	80.5248	820Ω 5% carbon film 1/8W
	R11	80.5275	0.15MΩ 5% carbon film 1/8W
	R12	80.5275	0.15MΩ 5% carbon film 1/8W
	R13	80.5270	56KΩ 5% carbon film 1/8W
	R14	80.5270	56KΩ 5% carbon film 1/8W
	R15	80.52XX	Adjusted carbon film
	R16	80.5254	2.7KΩ 5% carbon film 1/8W
	R17	80.5254	2.7KΩ 5% carbon film 1/8W
	R18	80.5247	680Ω 5% carbon film 1/8W
	R19	80.5246	560Ω 5% carbon film 1/8W
	R20	80.5445	470Ω 5% carbon film 1/4W
	R21	80.5261	10KΩ 5% carbon film 1/8W
	R22	80.5251	1.5KΩ 5% carbon film 1/8W
	R23	80.5250	1.2KΩ 5% carbon film 1/8W
	R24	80.5250	1.2KΩ 5% carbon film 1/8W
	L1	61.1157	Tone Coil
	L2	61.1157	Tone Coil
	E1	99.5114	Zenerdiode 5.6V 5% 1/4W
	E2	99.5219	AAZ15 Diode
	E3	99.5219	AAZ15 Diode
	E4	99.5209	Stab.diode ZE1.5
	E5	99.5028	1N914 Diode
	E6	99.5028	1N914 Diode
	Q1	99.5143	BC108 Transistor
	Q2	99.5143	BC108 Transistor
	Q3	99.5143	BC108 Transistor
	Q4	99.5143	BC108 Transistor
	Q5	99.5144	BC214L Transistor
	Q6	99.5144	BC214L Transistor

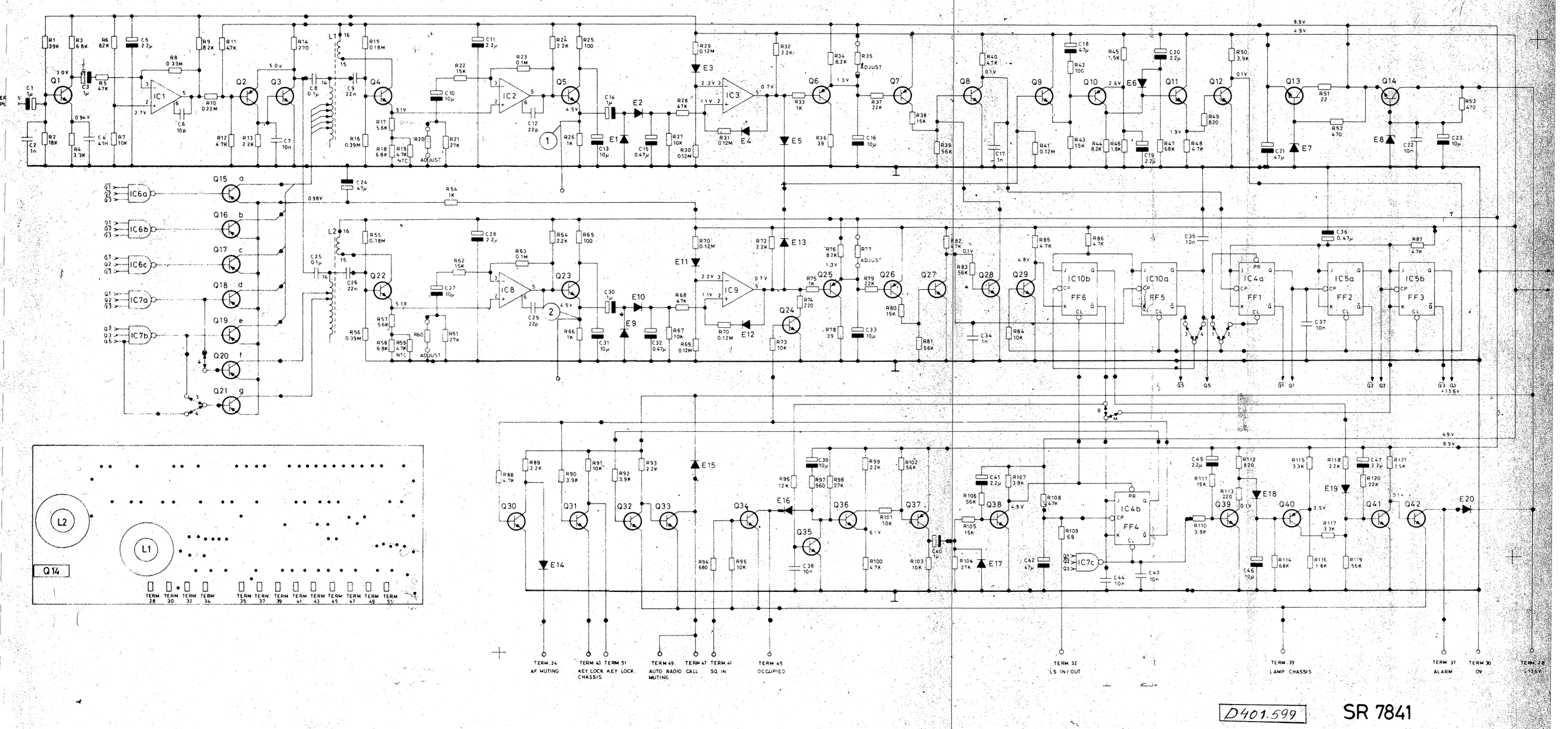
Storno

TYPE	NO.	CODE	DATA
	Q7	99.5143	BC108 Transistor
	Q8	99.5143	BC108 Transistor
	Q9	99.5143	BC108 Transistor
	Q10	99.5143	BC108 Transistor

TONE TRANSMITTER
TONESENDER

TT7812

X401.688



D401.599

SR 7841

PREEMPHASIS
FORBETONING

DRIVER

AMPL.
FORST.

DETECTOR
DETEKTOR

GATE

INVERT.

GATE

LIMITER
BEGRÆNSER

Q-MULTIPL.

EMITTER FOLLOWER
EMITTERFØLGER

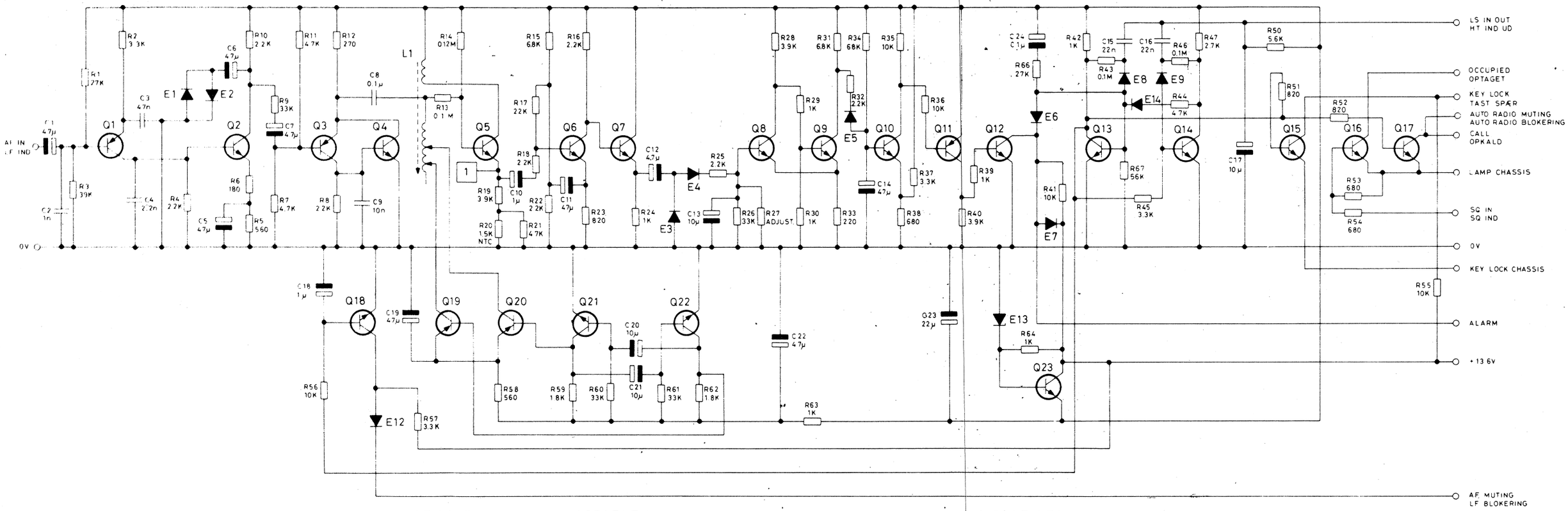
SCHMITT TRIG.

DELAY
FORSINK.

SWITCH

BISTAB. MV

3 x SWITCH



AF GATES

ASTABLE MV
ASTABIL MV

VOLTAGE REG.
SPÆNDINGSREG.

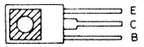
TERM	FREQ Hz
1	615
2	675
3	735
4	805
5	885
6	970
7	1060
8	1160
9	1270
10	1400
11	1530
12	1670
13	1830
14	2000
15	2200
16	2400
17	2600
18	2900

Q2. Q4. Q5. Q6. Q7. Q8. Q9. Q10. Q12. Q13
Q14. Q15. Q16. Q17. Q18. Q21. Q22

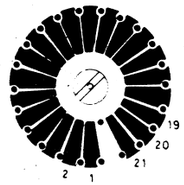
Q1. Q3. Q11. Q19. Q20

BOTTOM VIEW
SET FRA BUNDEN

Q23



L1



TONE RECEIVER
TONEMODTAGER

TR782

D401.161/5