

**STORNOPHONE 700**  
**TONE EQUIPMENT**

**Storno**



# **STORNOPHONE 700**

## **TONE EQUIPMENT**

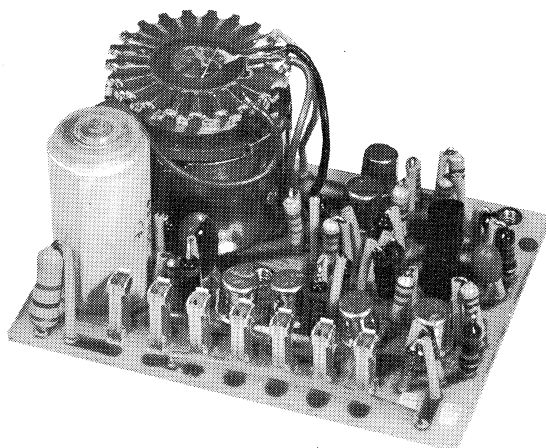
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TR782, TR783	
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TR786	Tone Receiver
SR781	Sequential Tone Receiver
SR781	Sequential Tone Receiver
SR785	Sequential Tone Receiver
SR785a	Sequential Tone Receiver
SR7841	Sequential Tone Receiver
SR7841a	Sequential Tone Receiver

Service Coordination  
4-78  
2nd Edition



# **TONE TRANSMITTER** **TT781      TT783**



## **Description**

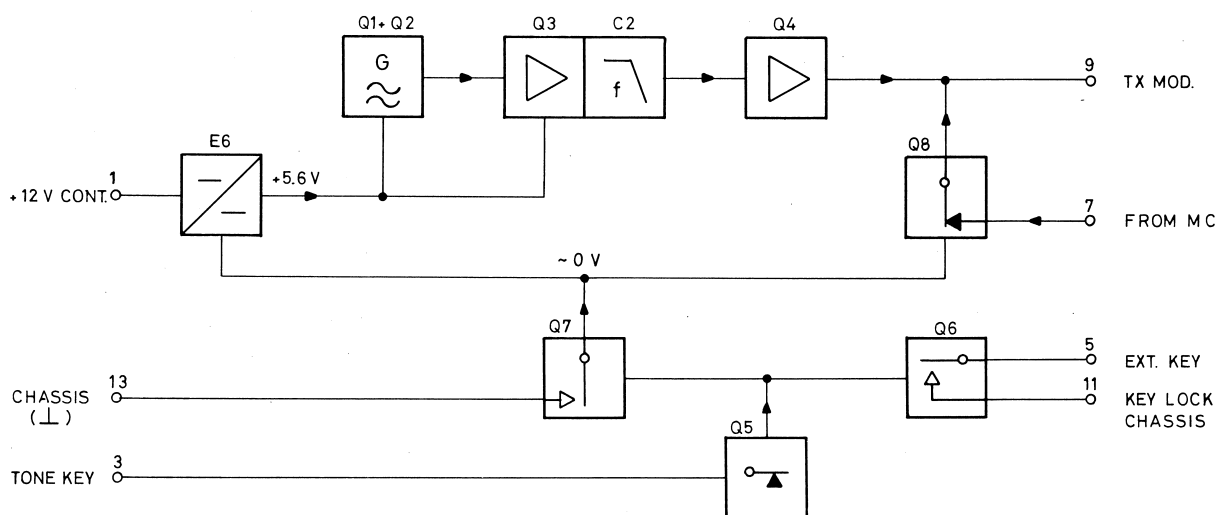
TT781 and TT783 are single tone transmitters for CQM700 series radiotelephones. They are identical except for their tone coils.

The TT781 is for use in CQM700 equipment operating on the public telephone service. It genera-

tes a tone to seize, and upon termination of the call, to release the telephone circuit. Only the 2400 Hz and the 2900 Hz tones are used.

The TT783 can generate any of the 12 tones in the 825 to 2450 Hz series.

BLOCK DIAGRAM of TT781 / TT783 :  
(refer to the schematic diagram,  
D401.577, for TT783 )



TT783 (SHOWN IN STAND BY)



In principle, Q1 and Q2 operate as a differential amplifier in a Hartley type oscillator configuration.

The supply voltage is stabilized with zener diode E6 to keep the oscillator output level constant.

Q3 serves to adjust (attenuate) the signal level and, with C2, to introduce de-emphasis before applying the signal to the output stage, Q4.

Emitter follower Q4 provides a low output impedance to match the input impedance of the modulator.

In stand by, R14 and E2 hold Q5 ON. Q5 holds Q6 and Q7 OFF. With Q7 OFF, there is no ground connection to Q1, Q2, Q3, and Q4. Q8 is forward biased by the high positive potential through R17, thus allowing the microphone signal to pass between terminals 7 and 9.

Depressing the tone key grounds terminal 3 and the positive potential through R14 disappears through E1. Without forward bias, Q5 cuts off and the collector voltage rises, driving Q6 and Q7 ON.

When Q6 goes ON, it establishes a ground path from terminal 11 to terminal 5. This switches the regulator voltage from RX to TX, keying the transmitter.

When Q7 conducts, it completes the ground connection to the tone generator circuits, and the tone signal is applied to the modulator via terminal 9. Q7 also cuts off Q8, preventing any microphone signal from interfering with the tone signal.

When the tone key is released the circuit returns to stand by.

## Technical Specification

### Power Supply

10.5 V - 16 V

### Current Consumption

Stand by: 6 - 10 mA

Activated: 16 - 33 mA

### Temperature Range

Operating range: -25°C - +60°C

Functioning range: -30°C - +80°C

### Output Impedance

600 Ω ± 20%

### TONE TRANSMITTER TT781

#### Tone Frequencies

2400, 2900 Hz

#### Frequency Accuracy

≤ 0.3%

#### Frequency Stability

≤ 0.6%

#### Output Level

- 21 dBm +1/-0dB (69 mV) at 2400 Hz

### Frequency Response

6 dB pr. octave de-emphasis

f<sub>c</sub> = 1000 Hz

### Distortion (voice modulation)

≤ 5%

### AF Gate Attenuation

≥ 50 dB

### Distortion (tone modulation)

≤ 3%

### TONE TRANSMITTER TT783

#### Tone Frequencies

825, 1010, 1240, 1435, 1520, 1750,  
1860, 1980, 2000, 2135, 2280, 2450 Hz.

#### Frequency Accuracy

≤ 0.5%

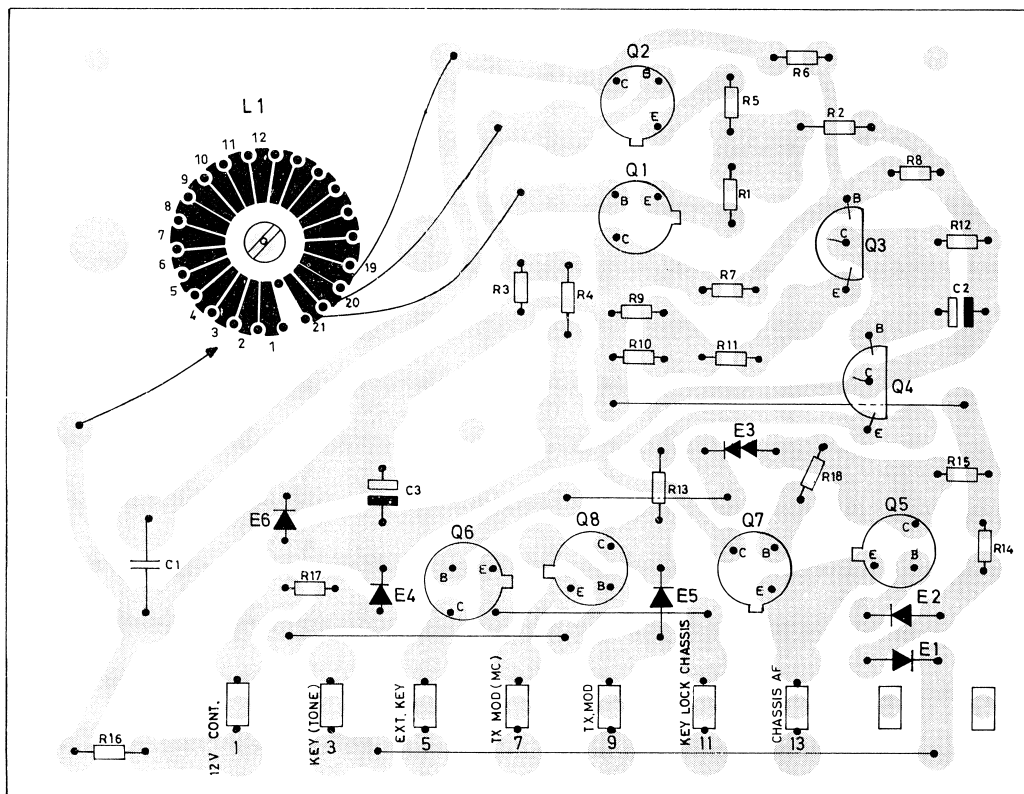
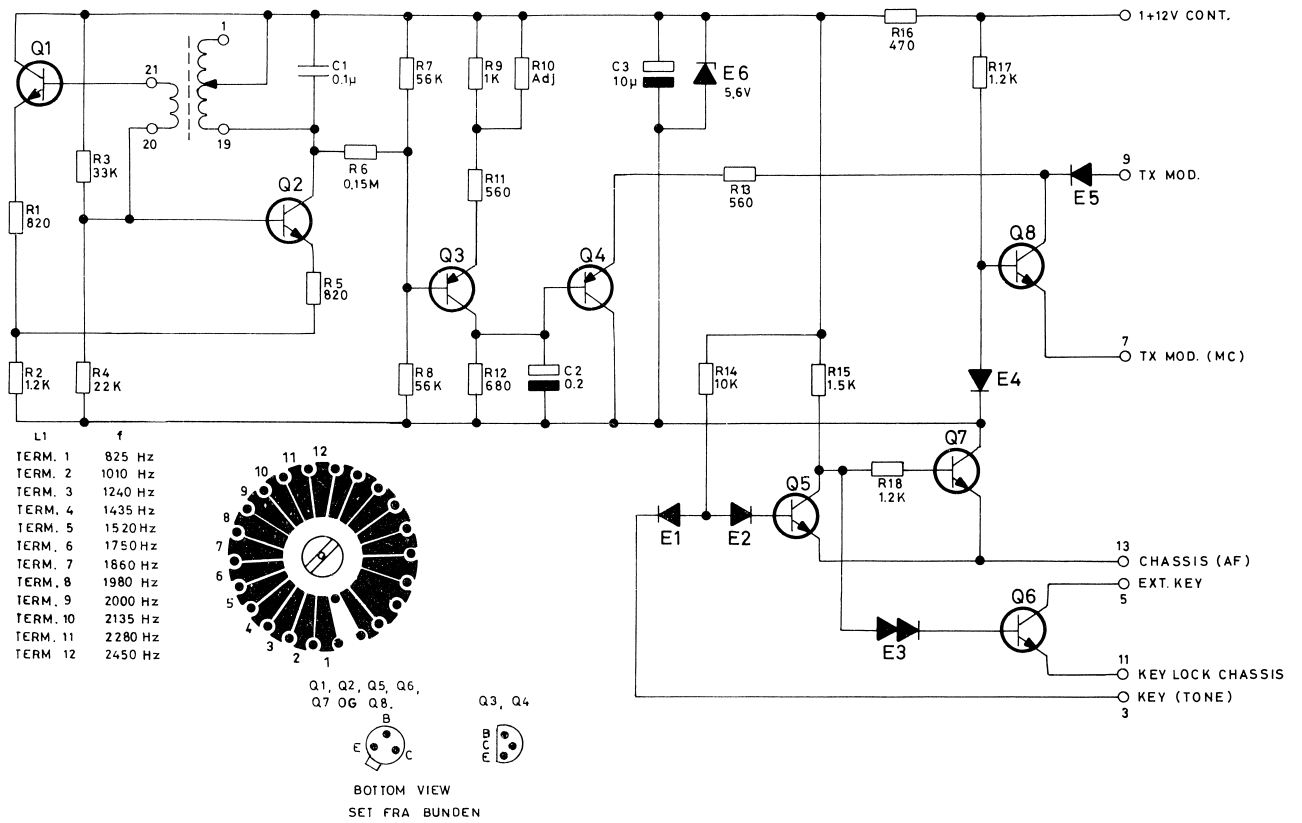
#### Frequency Stability

≤ 1%

#### Output Level

-17 dBm +1/0dB (110mV) at 1000 Hz





# TONE TRANSMITTER TONESENDER TT783



# Sorno

TYPE	NO.	CODE	DATA
TT783		10.2454	Tone Transmitter
	C1	76.5068	0, 1 $\mu$ F 1% polystyr. TB
	C2	73.5118	0, 22 $\mu$ F 20% tantal
	C3	73.5109	10 $\mu$ F 20% tantal
	R1	80.5248	820 $\Omega$ 5% carbonfilm
	R2	80.5250	1, 2K $\Omega$ 5% carbonfilm
	R3	80.5267	33K $\Omega$ 5% carbonfilm
	R4	80.5265	22K $\Omega$ 5% carbonfilm
	R5	80.5248	820 $\Omega$ 5% carbonfilm
	R6	80.5275	0, 15M $\Omega$ 5% carbonfilm
	R7	80.5270	56K $\Omega$ 5% carbonfilm
	R8	80.5270	56K $\Omega$ 5% carbonfilm
	R9	80.5249	1K $\Omega$ 5% carbonfilm
	R10	80.52XX	Adj. 5% carbonfilm
	R11	80.5246	560 $\Omega$ 5% carbonfilm
	R12	80.5247	680 $\Omega$ 5% carbonfilm
	R13	80.5246	560 $\Omega$ 5% carbonfilm
	R14	80.5261	10K $\Omega$ 5% carbonfilm
	R15	80.5251	1, 5K $\Omega$ 5% carbonfilm
	R16	80.5445	470 $\Omega$ 5% carbonfilm
	R17	80.5250	1, 2K $\Omega$ 5% carbonfilm
	R18	80.5250	1, 2K $\Omega$ 5% carbonfilm
	L1	61.1158	Tone coil
	E1	99.5028	1N914 Diode
	E2	99.5028	1N914 Diode
	E3	99.5209	1, 5V Stab. Diode
	E4	99.5219	AAZ15 Diode
	E5	99.5219	AAZ15 Diode
	E6	99.5114	5, 6V Zenerdiode 5%
	Q1	99.5143	BC108 Transistor
	Q2	99.5143	BC108 Transistor
	Q3	99.5144	BC214L Transistor
	Q4	99.5144	BC214L Transistor
	Q5	99.5143	BC108 Transistor
	Q6	99.5143	BC108 Transistor
	Q7	99.5143	BC108 Transistor
	Q8	99.5143	BC108 Transistor

# Sorno

TYPE	NO.	CODE	DATA

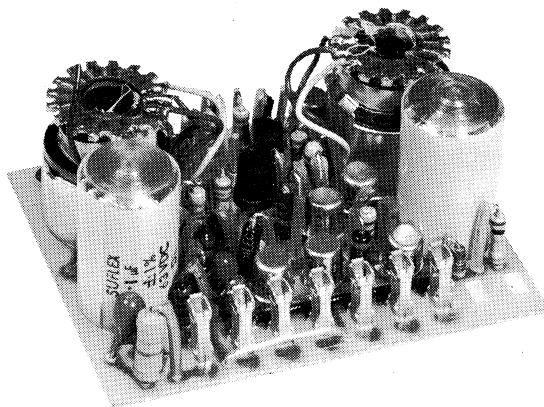
TONE TRANSMITTER  
 TONESENDER  
 TT783

X401, 687



# TONE TRANSMITTER

## TT7812 TT7813 TT7814



### Description

TT7812 is a tone transmitter for CQM700 series radiotelephones. It can be used for single or double tone operation.

In principle, Q1 and Q2 operate as a differential amplifier in a Hartley type oscillator configuration. Q3 and Q4 make up an identical oscillator. The supply voltage is stabilized with zener diode E1 to keep the oscillator output level constant.

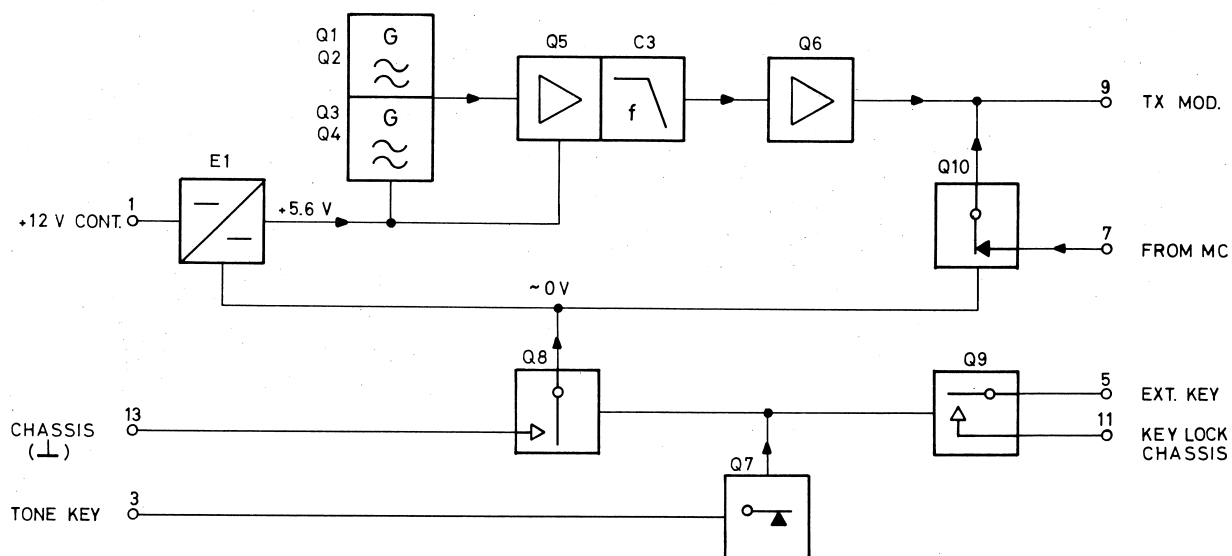
Each oscillator can be set to generate any one of the 12 tones in the standard Storno tone series of 1060 Hz to 2900 Hz. For single tone transmission the feedback winding of one of the

oscillator coils must be shorted out (refer to diagram D401.556).

Except for tone coil L2, TT7812, TT7813, and TT7814 are identical.

TT7813 : (refer to diagram D401.774) Coil L2 accommodates the tone series of 570 Hz to 1530 Hz.

TT7814 : (refer to diagram D401.775) Coil L2 accommodates the tone series of 615 Hz to 970 Hz.



TT7812, TT7813, TT7814 (IN STAND BY)



The remainder of this description applies to all three tone transmitters alike.

Q5 serves to adjust (attenuate) the signal level and, with C3, to introduce de-emphasis before applying the signal to the output stage, Q6.

Emitter follower Q6 provides a low output impedance to match the input impedance of the modulator.

In stand by, R21 and E5 hold Q7 ON. Q7 holds Q8 and Q9 OFF. With Q8 OFF, there is no ground connection to Q1, Q2, Q3, Q4, Q5, and Q6. Q10 is forward biased by the high positive potential through R23, Thus allowing the microphone signal to pass between terminals 7 and 9.

Depressing the tone key grounds terminal 3

and the positive potential through R21 disappears through E6. Without forward bias, Q7 cuts off and the collector voltage rises, driving Q8 and Q9 ON.

When Q9 goes ON, it establishes a ground path from terminal 11 to terminal 5. This switches the regulator voltage from RX to TX, keying the transmitter.

When Q8 conducts, it completes the ground connection to the tone generator circuits, and the tone signal is applied to the modulator via terminal 9. Q8 also cuts off Q10, preventing any microphone signal from interfering with the tone signal.

When the tone key is released the circuit returns to stand by.

## Technical Specification

### Power Supply

10.5 - 16 V

### Current Consumption

Stand by: 6 - 10 mA

Activated: 16 - 33 mA

### Ambient Temperature

Operating range:  $-25^{\circ}\text{C}$  -  $+60^{\circ}\text{C}$

Functioning range:  $-30^{\circ}\text{C}$  -  $+80^{\circ}\text{C}$

### Frequency Accuracy

$\leq 0.5\%$

### Frequency Stability

$\leq 1\%$

### Frequency Response

6 dB pr. octave de-emphasis  
 $f_c = 1000 \text{ Hz}$ .

### Output Impedance

$600 \Omega \pm 20\%$

### 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)

### Distortion (tone modulation)

$\leq 5\%$

### Distortion (voice modulation)

$\leq 5\%$

### AF Gate Attenuation

$\geq 50 \text{ dB}$

### TONE TRANSMITTER TT7812

#### Tone Frequencies

1060, 1160, 1270, 1400, 1530, 1670, 1830,  
2000, 2200, 2400, 2600, 2900 Hz.

### TONE TRANSMITTER TT7813

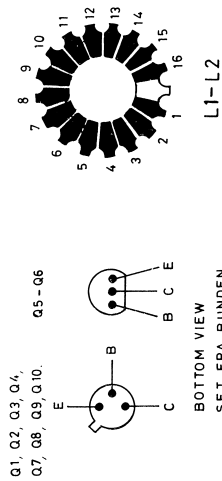
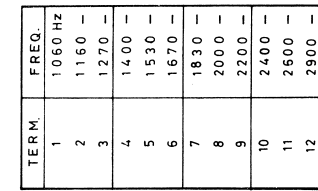
#### Tone Frequencies

- a. 1060, 1160, 1270, 1400, 1530,  
1670, 1830, 2000, 2200, 2400,  
2600, 2900 Hz.
- b. 570, 650, 740, 850, 1060, 1160,  
1270, 1400, 1530 Hz.

### TONE TRANSMITTER TT7814

#### Tone Frequencies

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



NOTE: INSERT SHORTING LINKS FOR SINGLE TONE MODULATION.  
STRAPBØJLER ISÆTTES VED ENKELT-TONEMODULATION.

TT7812

TRYKT KREDSLØB SET FRA KOMPONENTSIDEN

**D401.556/2**



Storno

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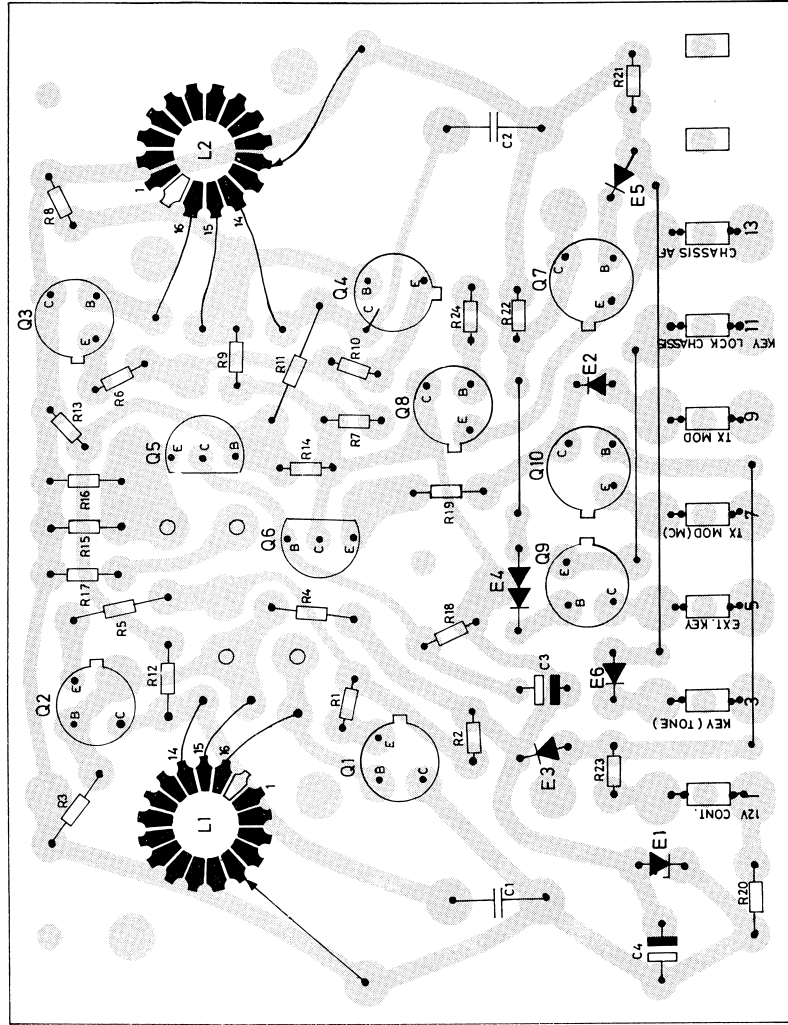
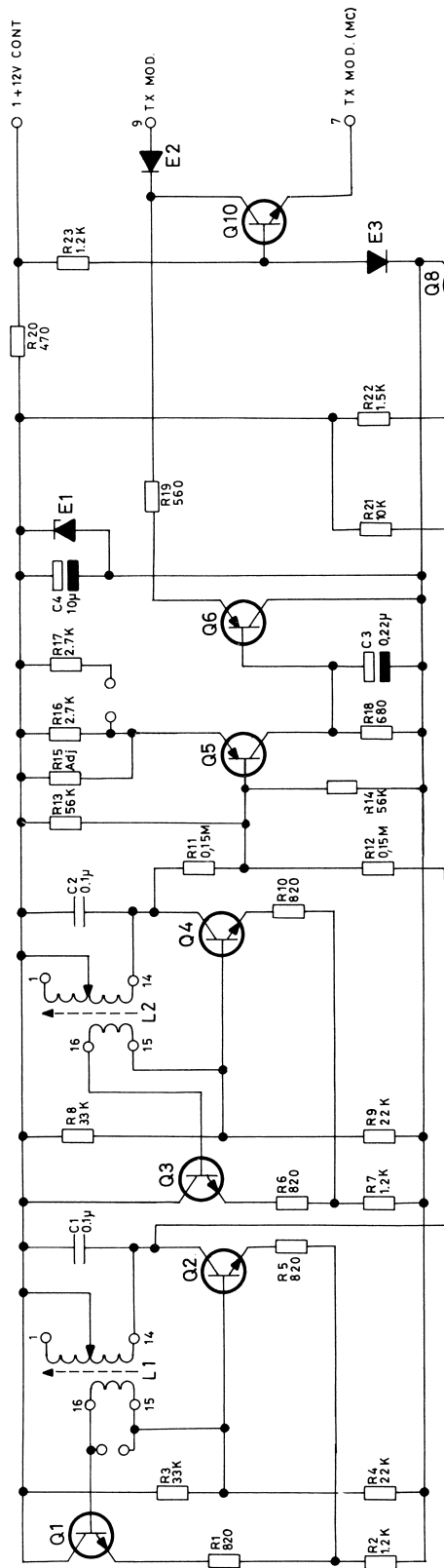
TYPE	NO.	CODE	DATA
TT7812		10.2453	Tone Transmitter
TT7813		10.2896	Tone Transmitter
TT7814		10.2907	Tone Transmitter
	C1	76.5068	0.1 $\mu$ F 1% polystyr TB
	C2	76.5068	0.1 $\mu$ F 1% polystyr TB
	C3	73.5118	0.22 $\mu$ F 20% tantal
	C4	73.5109	10 $\mu$ F 20% tantal
			63 V
			63 V
			35 V
			16 V
	R1	80.5248	820 $\Omega$ 5% carbon Film
	R2	80.5250	1.2 K $\Omega$ 5% carbon film
	R3	80.5267	33 K $\Omega$ 5% carbon film
	R4	80.5265	22 K $\Omega$ 5% carbon film
	R5	80.5248	820 $\Omega$ 5% carbon film
	R6	80.5248	820 $\Omega$ 5% carbon film
	R7	80.5250	1.2 K $\Omega$ 5% carbon film
	R8	80.5267	33 K $\Omega$ 5% carbon film
	R9	80.5265	22 K $\Omega$ 5% carbon film
	R10	80.5248	820 $\Omega$ 5% carbon film
	R11	80.5275	0.15 M $\Omega$ 5% carbon film
	R12	80.5275	0.15 M $\Omega$ 5% carbon film
	R13	80.5270	56 K $\Omega$ 5% carbon film
	R14	80.5270	56 K $\Omega$ 5% carbon film
	R15	80.52XX	Adjusted carbon film
	R16	80.5254	2.7 K $\Omega$ 5% carbon film
	R17	80.5254	2.7 K $\Omega$ 5% carbon film
	R18	80.5247	680 $\Omega$ 5% carbon film
	R19	80.5246	560 $\Omega$ 5% carbon film
	R20	80.5445	470 $\Omega$ 5% carbon film
	R21	80.5261	10 K $\Omega$ 5% carbon film
	R22	80.5251	1.5 K $\Omega$ 5% carbon film
	R23	80.5250	1.2 K $\Omega$ 5% carbon film
	R24	80.5250	1.2 K $\Omega$ 5% carbon film
			1/8 W
	L1	61.1157	Tone Coil
TT7812	L2	61.1157	Tone Coil
			1/8 W
	L2	61.1196	Tone Coil
TT7813	L2	61.1189	Tone Coil
TT7814			
	E1	99.5114	Zenerdiode 5.6 V 5%
	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
			1/4 W

TYPE	NO.	CODE	DATA
	Q1	99.5143	BC108 Transistor
	C2	99.5143	BC108 Transistor
	Q3	99.5143	BC108 Transistor
	Q4	99.5143	BC108 Transistor
	Q5	99.5144	BC214L Transistor
	Q6	99.5144	BC214L Transistor
	Q7	99.5143	BC108 Transistor
	Q8	99.5143	BC108 Transistor
	Q9	99.5143	BC108 Transistor
	Q10	99.5143	BC108 Transistor

TT7812, TT7813,  
TT7814

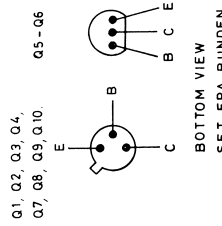
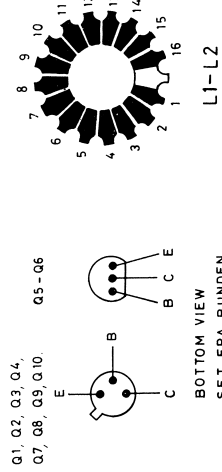
TT7812, TT7813,  
TT7814

X401.688/2



PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE  
TRYKT KREDSLØB SET FRA KOMPONENTSIDEN

TERM.	L1	FREQ.	L2	FREQ.
1	1060 Hz	570 Hz		
2	1160	650		
3	1270	740		
4	1400	850		
5	1530	1060		
6	1670	1160		
7	1830	1270		
8	2000	1400		
9	2200	1530		
10	2400			
11	2600			
12	2900			



# TONE TRANSMITTER T7813 TONESENDER

D401.774



**Storno**

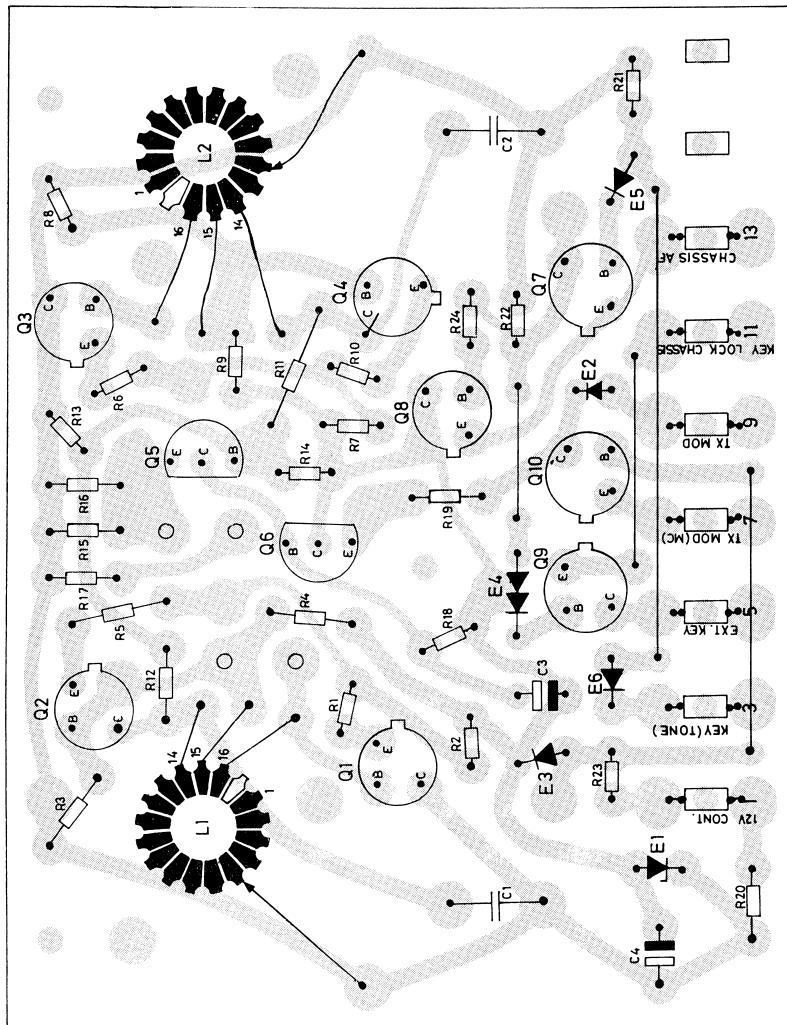
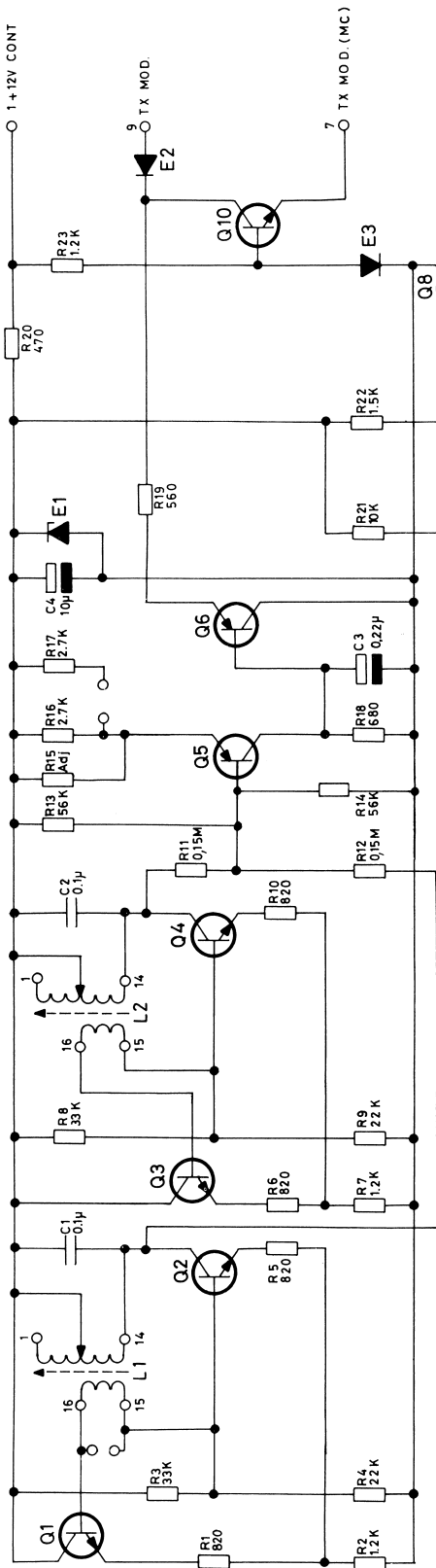
TYPE	NO.	CODE	DATA
TT7812		10.2453	Tone Transmitter
TT7813		10.2896	Tone Transmitter
TT7814		10.2907	Tone Transmitter
	C1	76.5068	0.1 $\mu$ F 1% polystyr TB
	C2	76.5068	0.1 $\mu$ F 1% polystyr TB
	C3	73.5118	0.22 $\mu$ F 20% tantal
	C4	73.5109	10 $\mu$ F 20% tantal
			63 V
			63 V
			35 V
			16 V
	R1	80.5248	820 $\Omega$ 5% carbon Film
	R2	80.5250	1.2 K $\Omega$ 5% carbon film
	R3	80.5267	33 K $\Omega$ 5% carbon film
	R4	80.5265	22 K $\Omega$ 5% carbon film
	R5	80.5248	820 $\Omega$ 5% carbon film
	R6	80.5248	820 $\Omega$ 5% carbon film
	R7	80.5250	1.2 K $\Omega$ 5% carbon film
	R8	80.5267	33 K $\Omega$ 5% carbon film
	R9	80.5265	22 K $\Omega$ 5% carbon film
	R10	80.5248	820 $\Omega$ 5% carbon film
	R11	80.5275	0.15 M $\Omega$ 5% carbon film
	R12	80.5275	0.15 M $\Omega$ 5% carbon film
	R13	80.5270	56 K $\Omega$ 5% carbon film
	R14	80.5270	56 K $\Omega$ 5% carbon film
	R15	80.52XX	Adjusted carbon film
	R16	80.5254	2.7 K $\Omega$ 5% carbon film
	R17	80.5254	2.7 K $\Omega$ 5% carbon film
	R18	80.5247	680 $\Omega$ 5% carbon film
	R19	80.5246	560 $\Omega$ 5% carbon film
	R20	80.5445	470 $\Omega$ 5% carbon film
	R21	80.5261	10 K $\Omega$ 5% carbon film
	R22	80.5251	1.5 K $\Omega$ 5% carbon film
	R23	80.5250	1.2 K $\Omega$ 5% carbon film
	R24	80.5250	1.2 K $\Omega$ 5% carbon film
			1/8 W
	L1	61.1157	Tone Coil
TT7812	L2	61.1157	Tone Coil
			1/8 W
TT7813	L2	61.1196	Tone Coil
TT7814	L2	61.1189	Tone Coil
			1/8 W
	E1	99.5114	Zenerdiode 5.6 V 5%
	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
			1/4 W

**Storno**

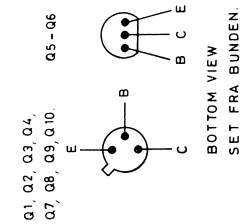
TYPE	NO.	CODE	DATA
	Q1	99.5143	BC108 Transistor
	Q2	99.5143	BC108 Transistor
	Q3	99.5143	BC108 Transistor
	Q4	99.5143	BC108 Transistor
	Q5	99.5144	BC214L Transistor
	Q6	99.5144	BC214L Transistor
	Q7	99.5143	BC108 Transistor
	Q8	99.5143	BC108 Transistor
	Q9	99.5143	BC108 Transistor
	Q10	99.5143	BC108 Transistor

TT7812, TT7813,  
TONE TRANSMITTER  
TT7814  
TONESENDER

X401.688/2



PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE  
TRYKT KREDSLØB SET FRA KOMPONENTSIDEN



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

# TONE TRANSMITTER TONESENDER

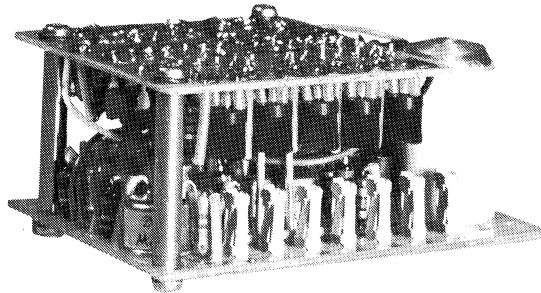
TT7814

D401.775





# SEQUENTIAL TONE TRANSMITTER ST7845

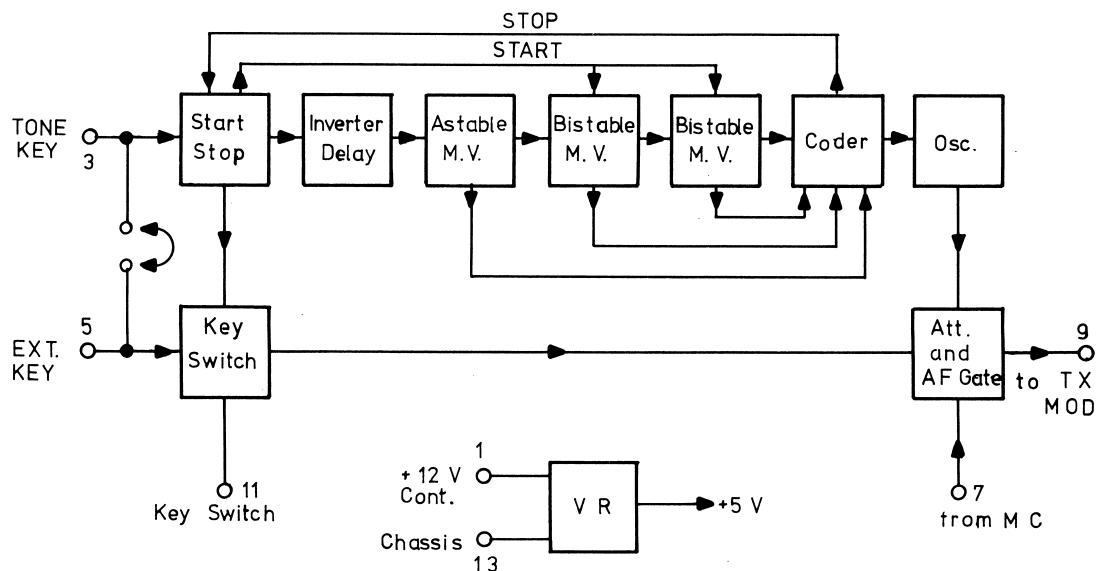


## Description

### General

ST7845 is a sequential tone transmitter developed for the Stornophone 700 series radiotelephones. ST7845 generates a five (or four) tone sequence code. When the Tone Key button is depressed ST7845 generates 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 by the tone oscillator.

An AF Gate blocks the voice modulation during the tone sequence and the transmitter is keyed through the Key Switch. After generating all seven pulses of the sequence, approximately 490 msec., the transmission stops, even if the tone key button remains depressed. This is because the start signal is a short-duration, capacitively coupled pulse that is relatively independent of how long the tone key button is held down, and gives only one start pulse for each time the tone key is activated.



### Start - Stop Circuit (Q1, Q2) and Key Switch (Q18)

The Start - Stop Circuit is an RS flip-flop consisting of Q1 and Q2. In stand by Q1 is ON and Q2 is OFF. Operating the Tone Key grounds terminal 3, causing a negative pulse through E1, C1, and E2 to turn Q1 OFF. The RS flip-flop then switches state.

Several things now happen. First, when the collector of Q1 goes HI, the positive potential (logic state 1') enables the two flip-flops, IC1a and IC1b.

The HI potential also turns Q17 and Q18 ON. Q18, the Key Switch, establishes a connection between terminals 5 and 11, causing the RX - TX Switch in the CQM700 to switch to the TX, or transmit condition. Q17 drives the AF Gate, Q16. When Q17 is turned ON the HI potential through R39, which forward biases Q16, disappears through E9 and Q17 so Q16 becomes cut off. Thus, during the transmission of the tone sequence, no signal from the microphone amplifier can reach the modulator to interfere.

At the end of a tone sequence, 2, 3, and 4 all go logical 1' and the output of IC2<sub>b</sub> will go 0'. The negative going pulse, applied to the base of Q2 via C6 and E3, turns the transistor OFF. The Start - Stop flip-flop then returns to its stand by position until another start pulse arrives from terminal 3.

### Inverter (Delay) Circuit (Q3)

In stand by Q3 is held ON by the HI potential at the collector of Q2, via R9 and E4. The standard version of ST7845 does not incorporate a delay here, but upon request C2 can be added. C2 and R10 can be arranged to introduce a time delay of from 0.1 sec. to 1.5 sec. before the first tone is transmitted.

In this case, R10 must not be less than 10 kΩ nor C2 greater than 47μF.

### Astable Multivibrator (Q4, Q5)

This Multivibrator generates square wave pulses having a repetition rate of approximately 140 msec. to produce the 70 msec. output pulses mentioned in the General section at the beginning of this description.

In standby the LO potential at the collector of Q3 holds Q4 OFF, via E5. Q5 will be ON.

When the tone sequence starts, Q3 switches OFF and E5 becomes reverse biased. C5 then begins to charge toward +V<sub>cc</sub>, switching Q4 ON. C4 discharges through Q4, driving Q5 OFF. Cutoff time for Q5 is determined by the time constant of R13 // R14 and C4. Likewise, cutoff time for Q4 is determined by R15 // R16 and C5. The regenerative action of the multivibrator generates square wave pulses which are taken off from the collector of Q5 and applied to the first bistable multivibrator, IC1<sub>a</sub>.

The resistances of R13 and R16 are chosen to adjust the two pulse lengths to 70 msec. each. Resistor values can be from 33kΩ to 100kΩ.

### Bistable Multivibrators (IC1<sub>a</sub>, IC1<sub>b</sub>)

These two Multivibrators are identical, J-K master-slave flip-flops packaged in the same DIP. With the J-K inputs tied to logical 1' via R18, their outputs will switch state for every clock pulse.

The square wave output from the collector of Q5 toggles the first flip-flop, IC1<sub>a</sub>, and the normal (Q) output of IC1<sub>a</sub> toggles IC1<sub>b</sub>. The square wave repetition rate (frequency) is divided by two in each flip-flop stage.

### Coder (Q6 - Q10 and IC2, IC3)

IC2 and IC3 are two DIP's, each containing three triple-input NAND gates. Five of these NAND gates drive the 5 transistor gates, Q6 to Q10. When all three inputs of a NAND gate are HI, the output goes LO, driving its associated transistor ON, enabling the tone oscillator to operate.

The transistor gates switch in the selected oscillator coil taps in the following sequence :

tone A	tone B	tone C	tone D	tone E
Q9 ON	Q6 ON	Q10 ON	Q7 ON	Q8 ON

For 4-tone signalling, the green lead from the collector of Q8 to the tone coil will not be soldered to the coil terminal at all.

If any one of the inputs to a NAND gate is LO, the output will be HI and its transistor gate will be held at cutoff.

#### Oscillator (Q11, Q12)

Q11 and Q12 operate as a differential amplifier in a Hartley oscillator configuration. Using a differential amplifier ensures ample feedback at all frequencies.

#### Attenuator (Q13, Q14)

Q13 adjusts (attenuates) the oscillator signal to the required level, while emitter follower Q14 matches the low input impedance of the modulator circuit in the CQM700.

R36 and C9 in the collector of Q13 provide the desired frequency response (6 dB de-emphasis pr. octave,  $f_c = 1000$  Hz). R34 in the emitter adjusts the output level.

#### AF Gate (Q16, Q17)

In stand by Q16 is forward biased by the HI potential through R39, and the microphone amplifier from terminal 7 is thus connected through to the modulator at terminal 9.

When the start pulse drives Q1 OFF, the HI potential from Q1's collector drives Q17 ON and the HI potential through R39 disappears through E9 and Q17 to ground. This switches Q16 OFF and any microphone signal will be isolated from the modulator as long as the tone code is being transmitted.

The tone sequence is applied to the modulator circuit via terminal 9.

#### Voltage Regulator (E7, Q15)

The Voltage Regulator is designed to keep the  $V_{cc}$  at +5 V  $\pm 5\%$  for all battery voltages from +10.5 V to +16 V.



# SEQUENTIAL TONE TRANSMITTER ST7845

## Technical Specification

### Tone Frequencies

970, 1060, 1160, 1270, 1400, 1530, 1670,  
1830, 2000, 2200, 2400, 2600, 2800 Hz.

### Pulse Sequences

4-tone sequence    3 pulses (unmodulated),  
                              70 m sec.  $\pm$  15 m sec. each.  
                              4 pulses (modulated),  
                              70 m sec.  $\pm$  15 m sec.

5-tone sequence    2 pulses (unmodulated),  
                              70 m sec.  $\pm$  15 m sec. each.  
                              5 pulses (modulated),  
                              70 m sec.  $\pm$  15 m sec.

### Frequency Stability

$\leq 1\%$

### Frequency Accuracy

$\leq 0.5\%$

### Frequency Response

6 dB pr. octave de-emphasis  
 $f_c = 1000$  Hz

### Output Impedance

$600\Omega \pm 20\%$

### Output Level (at 1000 Hz)

-17 dBm  $\pm 1$  / -0 dB

### Distortion (tone modulation)

$\leq 3\%$

### AF Gate Attenuation

$\geq 50$  dB

### Distortion (voice modulation)

$\leq 5\%$

### Power Supply

minimum:    10.5 V

maximum:    16 V

nominal:     13.6 V

### Current Consumption

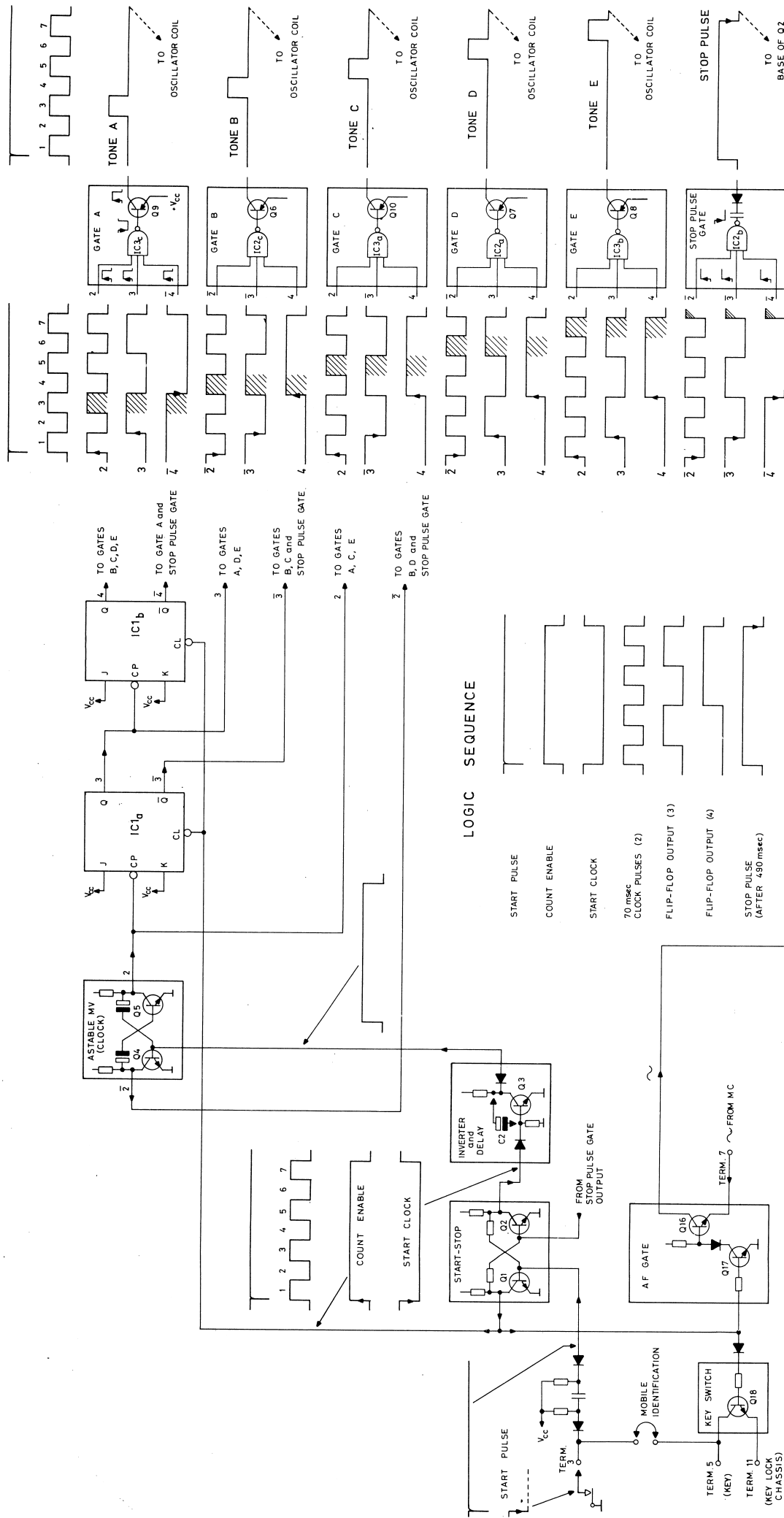
Stand by:     32 - 44 mA

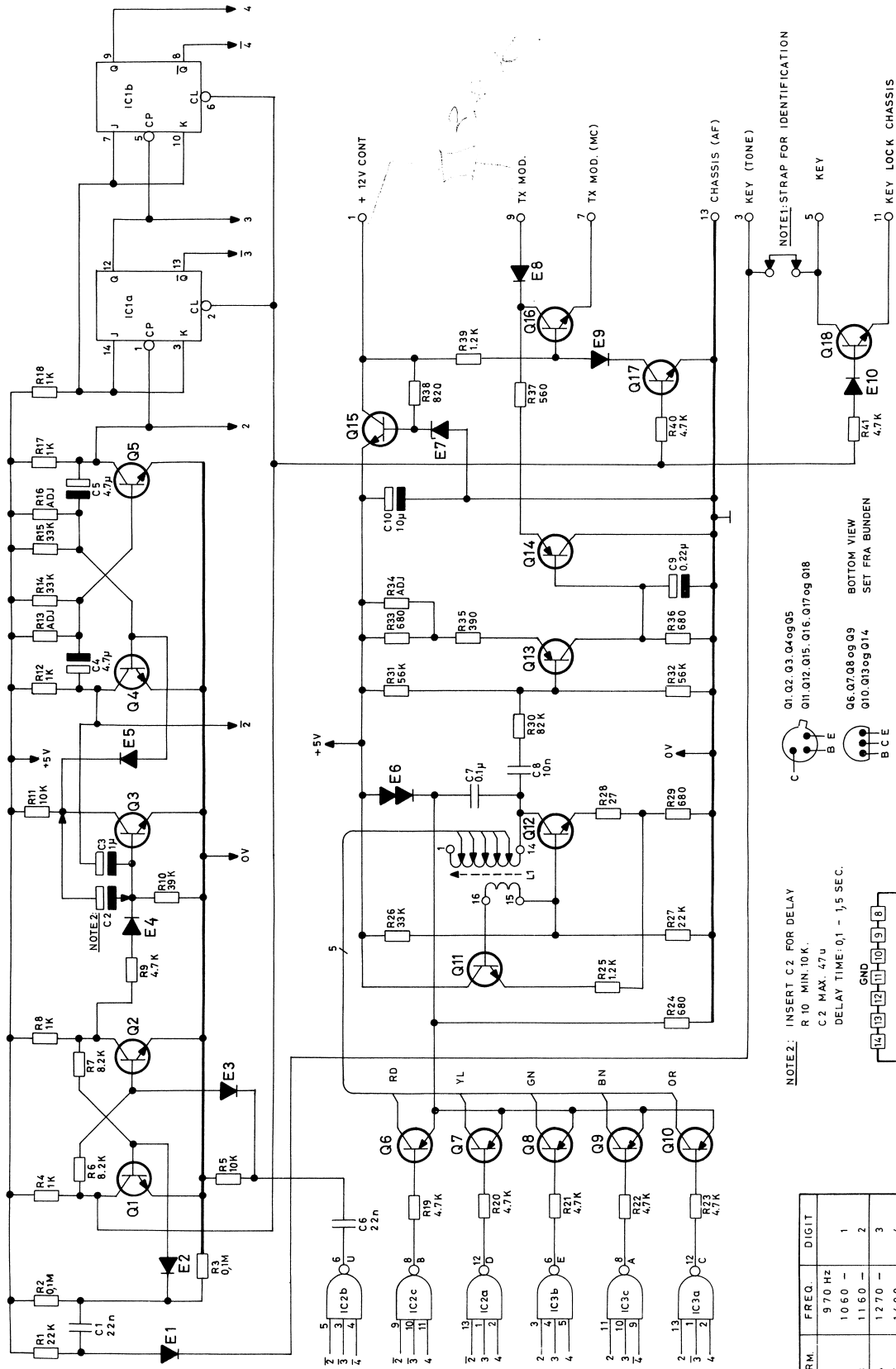
Activated:    42 - 54 mA

### Temperature Range

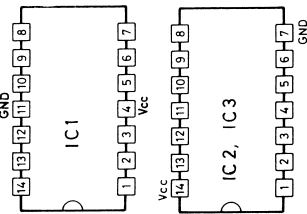
Operating range:  $-25^{\circ} - +60^{\circ}\text{C}$

Functioning range:  $-30^{\circ} - +80^{\circ}\text{C}$

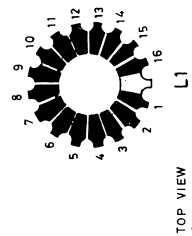




NOTE2: INSERT C2 FOR DELAY  
R 10 MIN 10 K.  
C2 MAX. 47 $\mu$   
DELAY TIME: 0.1 - 1.5 SEC.



NOTE1: STRAP FOR IDENTIFICATION  
Q1, Q2, Q3, Q4, Q5  
Q11, Q12, Q15, Q16, Q17, Q18  
Q6, Q7, Q8, Q9, Q10, Q13, Q14  
Q10, Q13, Q14  
B C E  
B C E  
B C E



TOP VIEW  
SET FRA OVEN

# SEQUENTIAL TONE TRANSMITTER SEKVENSTONESENDER

ST7845

D401.583/2

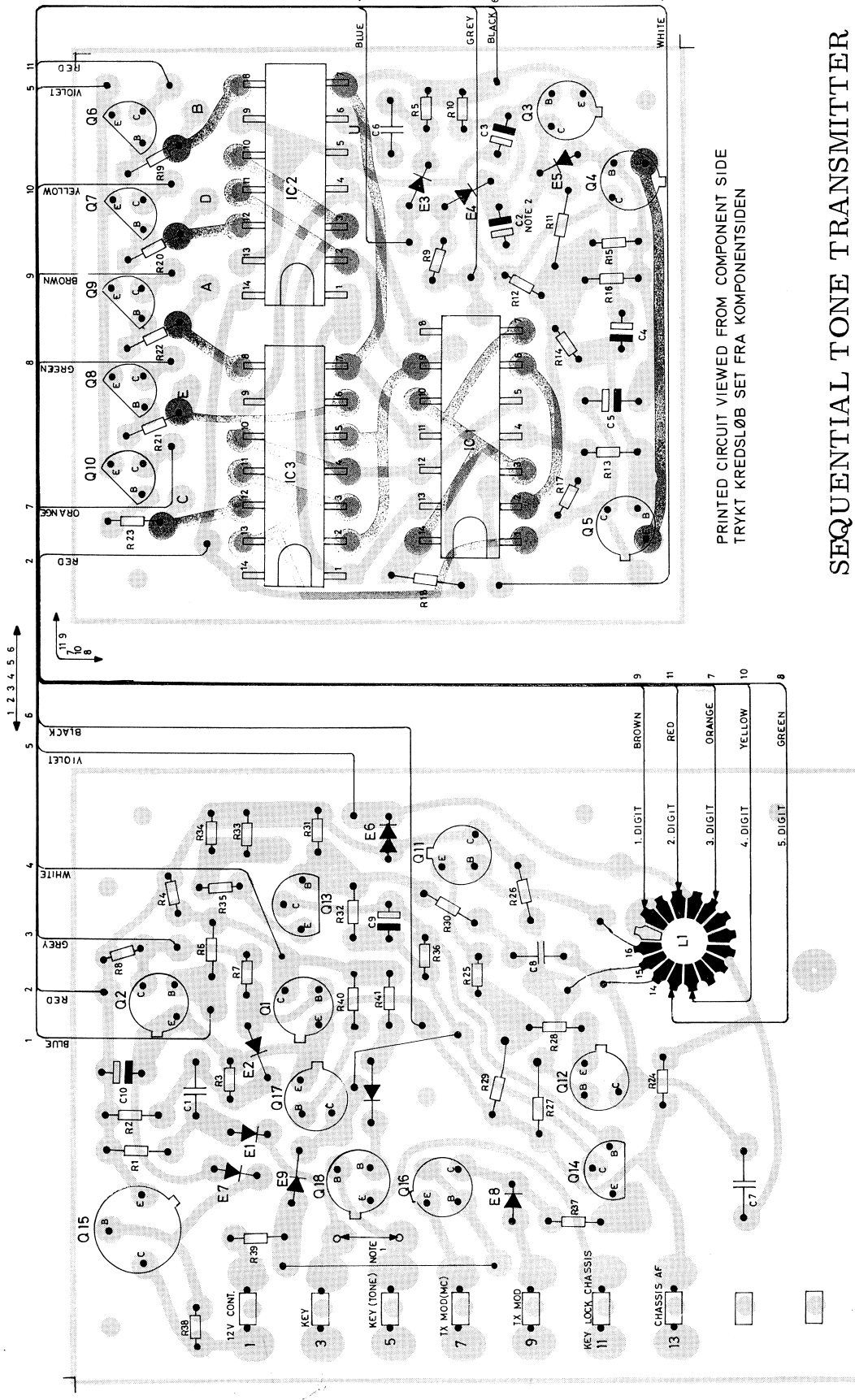
TYPE	NO.	CODE	DATA
ST7845	C1	10. 2455	Tone Sequence Transmitter
	C2	76. 5071	22nF 10% polyester FL 50V
	C3	73. 5114	1μF 20% tantal 35V
	C4	73. 5126	4. 7μF 20% tantal 35V
	C5	73. 5126	4. 7μF 20% tantal 35V
	C6	76. 5071	22nF 10% polyester. FL 50V
	C7	76. 5068	0. 1μF 1% polystyr TB 63V
	C8	76. 5070	10nF 10% polyester. FL 50V
	C9	73. 5118	0. 22μF 20% tantal 35V
	C10	73. 5109	10μF 20% tantal 16V
	R1	80. 5253	2. 2KΩ 5% carbon film 1/8W
	R2	80. 5273	0. 1MΩ 5% carbon film 1/8W
	R3	80. 5273	0. 1MΩ 5% carbon film 1/8W
	R4	80. 5249	1KΩ 5% carbon film 1/8W
	R5	80. 5261	10KΩ 5% carbon film 1/8W
	R6	80. 5260	8. 2KΩ 5% carbon film 1/8W
	R7	80. 5260	8. 2KΩ 5% carbon film 1/8W
	R8	80. 5249	1KΩ 5% carbon film 1/8W
	R9	80. 5257	4. 7KΩ 5% carbon film 1/8W
	R10	80. 5268	39KΩ 5% carbon film 1/8W
	R11	80. 5261	10KΩ 5% carbon film 1/8W
	R12	80. 5249	1KΩ 5% carbon film 1/8W
	R13	80. 52XX	Adjusted
	R14	80. 5267	33KΩ 5% carbon film 1/8W
	R15	80. 5267	33KΩ 5% carbon film 1/8W
	R16	80. 52XX	Adjusted
	R17	80. 5249	1KΩ 5% carbon film 1/8W
	R18	80. 5249	1KΩ 5% carbon film 1/8W
	R19	80. 5257	4. 7KΩ 5% carbon film 1/8W
	R20	80. 5257	4. 7KΩ 5% carbon film 1/8W
	R21	80. 5257	4. 7KΩ 5% carbon film 1/8W
	R22	80. 5257	4. 7KΩ 5% carbon film 1/8W
	R23	80. 5257	4. 7KΩ 5% carbon film 1/8W
	R24	80. 5247	680Ω 5% carbon film 1/8W
	R25	80. 5250	1. 2KΩ 5% carbon film 1/8W
	R26	80. 5267	33KΩ 5% carbon film 1/8W
	R27	80. 5265	22KΩ 5% carbon film 1/8W
	R28	80. 5230	27Ω 5% carbon film 1/8W
	R29	80. 5247	680Ω 5% carbon film 1/8W
	R30	80. 5272	82KΩ 5% carbon film 1/8W
	R31	80. 5270	56KΩ 5% carbon film 1/8W
	R32	80. 5270	56KΩ 5% carbon film 1/8W
	R33	80. 5247	680Ω 5% carbon film 1/8W
	R34	80. 52XX	Adjusted
	R35	80. 5244	390Ω 5% carbon film 1/8W

TYPE	NO.	CODE	DATA
	R36	80. 5247	680Ω 5% carbon film 1/8W
	R37	80. 5246	560Ω 5% carbon film 1/8W
	R38	80. 5248	820Ω 5% carbon film 1/8W
	R39	80. 5250	1. 2KΩ 5% carbon film 1/8W
	R40	80. 5257	4. 7KΩ 5% carbon film 1/8W
	R41	80. 5257	4. 7KΩ 5% carbon film 1/8W
	L1	61. 1140	Tone coil
	E1	99. 5028	1N914 Diode
	E2	99. 5028	1N914 Diode
	E3	99. 5028	1N914 Diode
	E4	99. 5028	1N914 Diode
	E5	99. 5219	AAZ15
	E6	99. 5209	Stab. diode ZE 1. 5
	E7	99. 5114	Zenerdiode 5. 6V 5%
	E8	99. 5219	AAZ15
	E9	99. 5219	AAZ15
	E10	99. 5028	1N914 Diode
	Q1	99. 5143	BC108 Transistor
	Q2	99. 5143	BC108 Transistor
	Q3	99. 5121	BC107 Transistor
	Q4	99. 5121	BC107 Transistor
	Q5	99. 5121	BC107 Transistor
	Q6	99. 5144	BC214L Transistor
	Q7	99. 5144	BC214L Transistor
	Q8	99. 5144	BC214L Transistor
	Q9	99. 5144	BC214L Transistor
	Q10	99. 5144	BC214L Transistor
	Q11	99. 5143	BC108 Transistor
	Q12	99. 5143	BC108 Transistor
	Q13	99. 5144	BC214L Transistor
	Q14	99. 5144	BC214L Transistor
	Q15	99. 5128	2N3053 Transistor
	Q16	99. 5143	BC108 Transistor
	Q17	99. 5143	BC108 Transistor
	Q18	99. 5143	BC108 Transistor
	IC1	14. 5008	Dual J-K Master-Slave Flip-Flop
	IC2	14. 5007	Triple 3-input NAND Gate
	IC3	14. 5007	Triple 3-input NAND Gate

SEQUENTIAL TONE TRANSMITTER ST7845  
SEKVENSTONESENDER

X401. 689

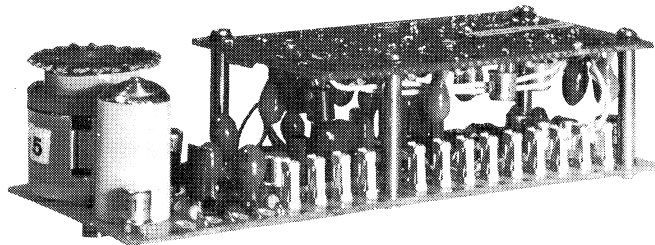




**SEQUENTIAL TONE TRANSMITTER  
ST7845  
SEKVENSTONESENDER**

## TONE RECEIVER

### TR782 TR783 TR785



### Introduction

TR782, TR783, and TR785 are selective tone receivers developed for use with Stornophone 700 radiotelephones. They are designed as double tone receivers but can also be employed in single tone mode. With the exception of a few frequency determining components, TR782, TR783, and TR785 are identical, and as far as this description is concerned, will be treated as though they were the same unit.

Tone frequencies for each unit are:  
(frequencies in Hz)

TR782	TR783	TR785
615	825	370
675	1010	450
735	1240	550
805	1435	675
885	1520	825
970	1750	1040
1060	1860	1240
1160	1980	1520
1270	2000	1860
1400	2135	2280
1530	2280	
1670	2450	
1830		
2000		
2200		
2400		
2600		
2900		

### General Description

Upon receipt of the appropriate tone signal with a duration of  $> 700$  ms the Call Lamp will light, the AF muting will be cancelled and the Key Locking function will "unlock".

The vehicle's traffic horn can be connected to the tone receiver via an auxiliary relay. Then, after the initial 700 ms required to establish a path through the tone receiver, the horn will sound for long as the tone signal continues to be received.

The audio circuit and the Key Lock are both turned on and off manually by means of the LS IN/OUT push button.

Since the Key Lock is "unlocked" with the same switch that turns on the loudspeaker, the operator is forced to check for the presence of another signal on the channel before being able to key his transmitter.

In addition, the tone receiver is equipped with an Occupied Lamp controlled by the squelch circuit in the radiotelephone. Thus, if an RF signal having that channel's frequency is present at the antenna input it will cause the Occupied Lamp to light as an indication that the channel is not free.

### Circuit Description

#### Pre-emphasis Stage

The pre-emphasis network includes transistor Q1 and follows an RC characteristic, 6 dB/octave, with cut-off frequency at 1000 Hz.

### Amplifier and Amplitude Limiter

Transistor Q2 amplifies the incoming signal linearly until diodes E1 and E2 begin conducting.

When the incoming double tone signal reaches a level of approx. 8 dB above minimum triggering level (approx. 3 dB when connected as a single tone receiver) full amplitude limiting of the signal occurs:

Trigger level,  $V_{IN} = -29$  dBm ( $-23$  dBm) at 1000 Hz.

Due to this limiting action along with the narrow pass band of the subsequent Q multiplier, adjacent tones having frequencies that differ from the resonant frequency by at least 4.5 % will be unable to trigger the tone receiver.

### Driver

Transistors Q3 and Q4 are arranged so that they present an extremely low output impedance (on the order of  $1\Omega$ ) which is suitable as a ground return for the resonant circuit in the following stage.

### Q Multiplier

The Q multiplier stage involves a parallel resonant circuit; this is coupled very loosely to the transistor, Q5, in order to maintain a constant Q over the entire tone range. C8 in the resonant circuit is grounded through the output impedance of the driver transistors while the relevant terminal(s) of coil L1 are alternately grounded through the AF gates, Q19 and Q20. This will be explained in the next section.

Part of the tone signal is reapplied to L1 in phase by means of a feedback winding in the collector circuit of Q5, approximately doubling the Q of L1.

To offset the effect of temperature upon the Q of L1 an NTC resistor, R20, is inserted in the emitter circuit of Q5. R20, aided by R19 and R21, maintains a nearly flat temperature response from  $-30^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$ .

### Astable Multivibrator and AF Gates

Transistors Q21 and Q22 form an astable multivibrator, driving the two AF gates, Q19 and

Q20. When Q21 (Q22) conducts it drives Q20 (Q19) ON. The ground connection, which also determines the resonant frequency of the tuned circuit, is through Q20 (Q19) and capacitor C19.

The multivibrator action turns the two AF gates alternately ON and OFF, switching tone frequencies at the pulse repetition rate of approx. 500 ms.

### Amplifier, Emitter, Follower, and Detector

Q6 amplifies the signal from the Q multiplier; its input resistance is bootstrapped to a value that will not load the Q multiplier.

The signal proceeds from Q6 to emitter follower Q7, then to the detector circuit, a conventional voltage doubler where R25 insures linearity for stronger signals.

The time constant of R25, C13, and R26/27 is long enough to form a low-pass filter for the tone signal components while short enough to react to the 250 ms half-periods of the multivibrator. For instance, should one of the tones of a double tone signal fail (tone does not match the receiver), the rectified DC voltage will drop to nearly 0 before the next tone arrives.

R27 sets the DC output level.

### Schmitt Trigger, Delay Circuit, and Inverter

Q8 and Q9 make up the Schmitt trigger. When a correct tone is received, the rectified DC voltage at the trigger input, base of Q8, turns the circuit ON and the high potential at the collector of Q9 cuts E5 OFF. A charge begins to build up on C14 through R34; when the charge reaches approx. 0.6 V above the emitter voltage of Q10, that transistor will go ON. This last circuit introduces a 700 ms delay between input and output. Refer to the General Description.

With no signal at the trigger input, the circuit is OFF and E5 conducts. C14 discharges through E5 and Q9, turning Q10 OFF.

Build-up time between gate shifts in the Q multiplier is approx. 20 to 30 ms, which is con-

siderable compared with the detector time constant and the fast action of the Schmitt trigger.

A resistor, R32 is inserted in the discharge path of C14 to introduce a time lag of approx. 40 ms in order to compensate for the Q multiplier build-up time, ensuring that Q10 does not turn off intermittently between tones.

When Q10 turns ON, it turns the inverter, Q11 ON as well.

#### Switch and Alarm Gate

When Q11 goes ON, it turns Q12 ON. Q12 switches the external alarm circuit ON by pulling the Alarm terminal, 37, virtually down to chassis potential. Q12, and therefore the alarm device, remains ON as long as the correct tone combination continues to be received.

#### Bistable Multivibrator and Outlet Switches

The bistable multivibrator comprises Q13 and Q14. There are two possibilities for triggering the multivibrator:

- (1) automatically, by reception of a correct tone call
- (2) manually, by pushbutton

Consider the manual mode first: pressing a pushbutton on the control panel grounds terminal 32, causing a trigger pulse via C15 and C16 to change the state of the bistable circuit.

Regardless of the state of the bistable multivibrator a correct tone signal will, as previously mentioned, turn Q12 ON whereby the base of Q13 becomes grounded via E6 and Q12. If Q13 happens to be ON at the time, it will be switched OFF; if it is already OFF, it will be held there. Thus, a tone call has higher priority than the manual switch.

Whenever Q13 is OFF the following occurs:

- (1) Q18 goes ON, connecting terminal 34 (AF Muting) to chassis through diode E12 and allowing the loudspeaker amplifier to operate.
- (2) Q17 goes ON, lighting the Call Lamp via terminal 47.

- (3) Q15 goes ON, releasing the Key Lock via terminal 51. It is then possible to operate the transmitter.

When the tone signal disappears the operator can change the state of the bistable circuit manually, as explained earlier.

#### Squelch Gate

When another call is in progress on the channel the RF signal will be detected in the radiotelephone receiver. The receiver squelch system will then feed a DC voltage (approx. +5 V emf /  $R_G = 1 \text{ k}\Omega$ ) to terminal 41. Q16 will be driven ON and will light the Occupied Lamp through terminal 45.

#### Audio Radio Muting

If the vehicle also has a broadcast radio installed, an auxiliary relay connected to terminal 49 may be used to silence the radio during the time that the Key Lock is released.

## Technical Specifications

#### Tone Receiver TR782

##### Power Supply

Operating range: 10.5 V - 16.0 V

Nominal: 13.6 V

##### Current Consumption

Stand by: nom. 45 mA

##### Temperature Range

Operating range:  $-25^{\circ} - +60^{\circ}\text{C}$

Functioning range:  $-30^{\circ} - +80^{\circ}\text{C}$

##### Input Impedance

$> 6 \text{ k}\Omega$

##### Signal Input Level

Nominal at 1000 Hz:  $-23 \text{ dBm}$

##### Equalization

Preemphasis (by RC function)  $f_c = 1 \text{ kHz}$

##### Signal Code

2 preset tone frequencies, received simultaneously for min. 700 mS



Signal Frequencies

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

Frequency Accuracy

With coil adjusted for 1060 Hz:  $\leq 0.3 \%$

Frequency Stability

(Typically  $\leq 0.5 \%$ ):  $\leq 1.0 \%$

Selectivity

Frequencies differing from  $f_o$  by 4.5 % or more are unable to trigger the tone receiver.

Maximum Load Currents

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

AF Muting

In conjunction with AA7xx :  $\geq 60$  dB

Tone Receiver TR783Power Supply

Operating range: 10.5 V - 16.0 V

Nominal: 13.6 V

Current Consumption

Stand by: nom. 45 mA

Temperature Range

Operating range:  $-25^{\circ}\text{C}$  -  $+60^{\circ}\text{C}$

Functioning range:  $-30^{\circ}\text{C}$  -  $+80^{\circ}\text{C}$

Input Impedance

$> 6 \text{ k}\Omega$

Signal Input Level

Nominal at 1000 Hz:  $-23 \text{ dBm}$

Equalization

Preemphasis (by RC function)  $f_c = 1 \text{ kHz}$

Signal Code

2 preset tone frequencies, received simultaneously for min. 700 mS

Signal Frequencies

825, 1010, 1240, 1435, 1520, 1750, 1860, 1980, 2000  
2135, 2280, 2450.

Frequency Accuracy

With coil adjusted for 1010 Hz =  $\leq 0.3 \%$

Frequency Stability

(Typically  $\leq 0.5 \%$ ):  $\leq 1.0 \%$

Selectivity

Frequencies differing from  $f_o$  by 4.5 % or more are unable to trigger the tone receiver.

Maximum Load Currents

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

AF Muting

In conjunction with AA7xx:  $\geq 60$  dB

Tone Receiver TR785Power Supply

Operating range: 10.5 V - 16.0 V

Nominal: 13.6 V

Current Consumption

Stand by: nom. 45 mA

Temperature Range

Operating range:  $-25^{\circ}\text{C}$  -  $+60^{\circ}\text{C}$

Functioning range:  $-30^{\circ}\text{C}$  -  $+80^{\circ}\text{C}$

Input Impedance

$> 6 \text{ k}\Omega$

Signal Input Level

Nominal at 1000 Hz :  $-23 \text{ dBm}$

Equalization

Preemphasis (by RC function)  $f_c = 1 \text{ kHz}$

Signal Code

2 preset tone frequencies, received simultaneously for min. 700 mS.

Signal Frequencies

370, 450, 550, 675, 825, 1010, 1240, 1520, 1860, 2280

Frequency Accuracy

With coil adjusted for 1010 Hz:  $\leq 0.3 \%$

Frequency Stability

(Typically  $\leq 0.5 \%$ ):  $\leq 1.0 \%$

Selectivity

Frequencies differing from  $f_o$  by 4.5 % or more are unable to trigger the tone receiver.

Maximum Load Currents

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

AF Muting

In conjunction with AA7xx: 60 dB.

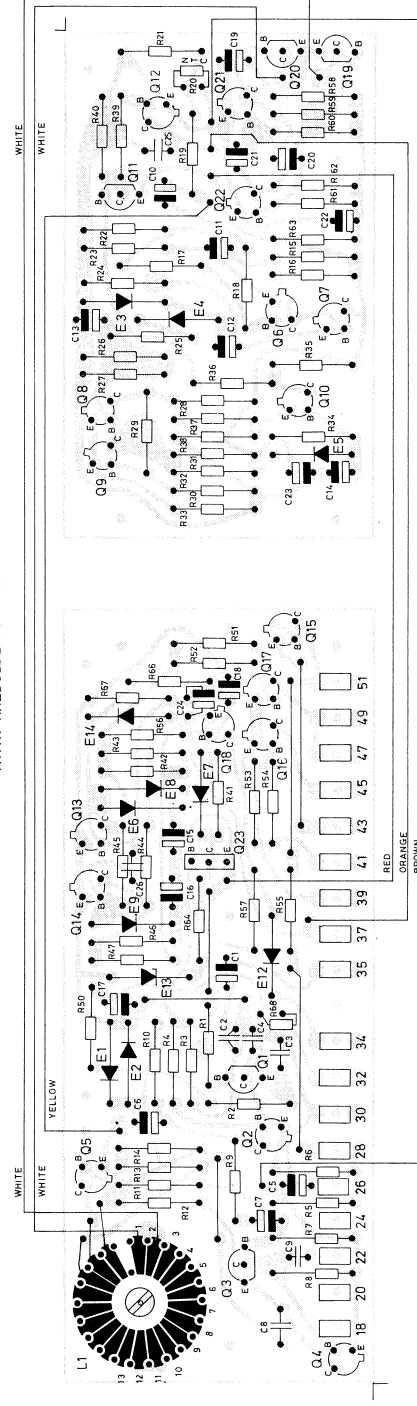


ASTABLE MV  
ASTABII MV

AF GATES

VOLTAGES WITH ( )  $V_{IN}$  1060 Hz = 55 mV  
VOLTAGES WITHOUT ( )  $V_{IN}$  0V

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



BOTTOM VIEW  
SET FRA BUNDEN

TR782  
TONE RECEIVER  
TONE MODTAGER

D401.161/6



# Storno

TYPE	NO.	CODE	DATA

X401.650/2



PREEMPHASIS  
FORBETONING

LIMITER  
BEGRÆNSER

DRIVER

Q-MULTIPL.

AMPL.  
FORST.

DETECTOR  
DETEKTOR

EMITTER FOLLOWER  
EMITTERFØLGER

SCHMITT TRIG.

DELAY  
FORSINK.

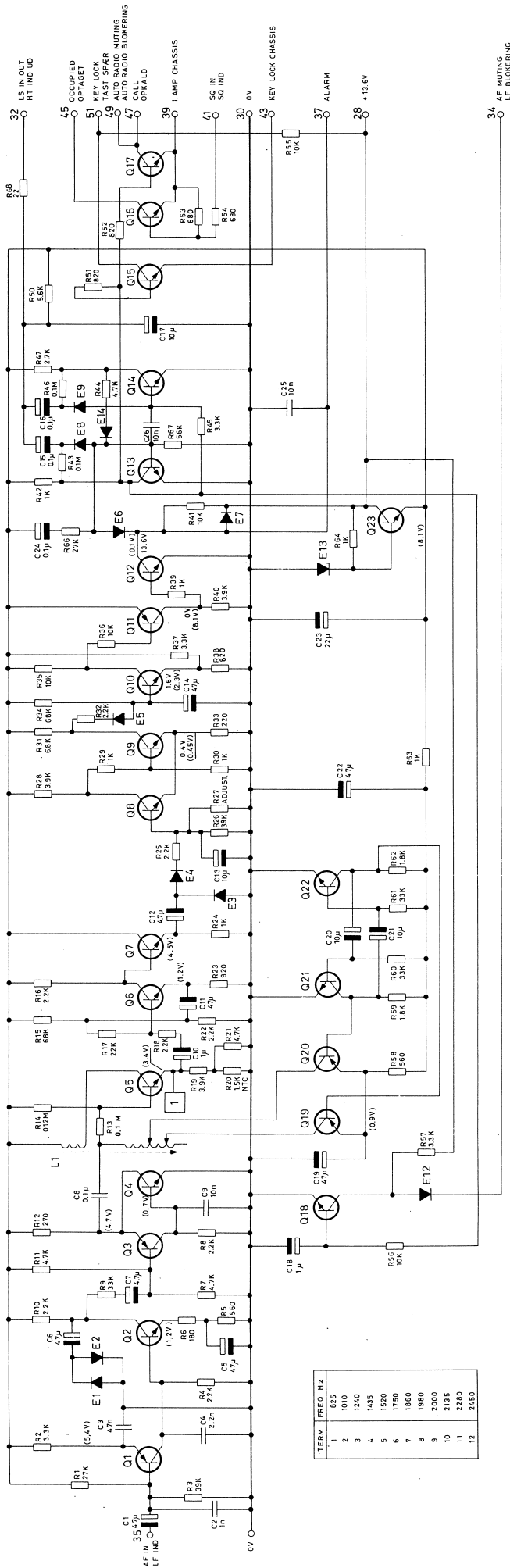
INVERT.

SWITCH

GATE

BISTAB. MV

3 x SWITCH



VOLTAGE REG.  
SPÆNDINGSREG.

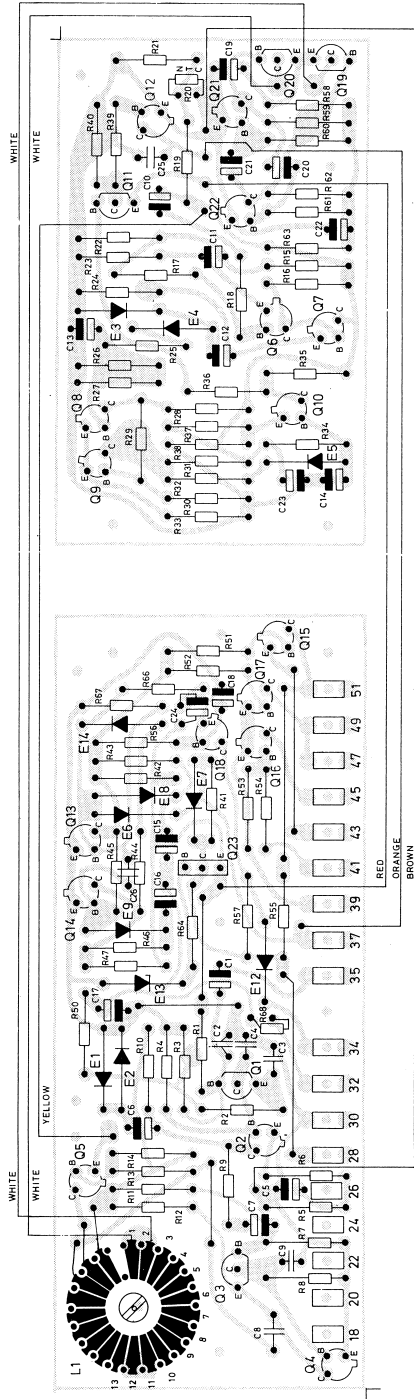
AF GATES

ASTABLE MV  
ASTABIL MV

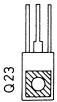
PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE  
TRYKT KREDSLØB SET FRA KOMPONENTSIDEN

VOLTAGES WITH ( )  $V_m$  1050Hz = 55mV  
VOLTAGES WITHOUT ( )  $V_m$  0V

Q1, Q3, Q11, Q19, Q20  
Q2, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q12, Q13  
Q14, Q15, Q16, Q17, Q18, Q21, Q22



BOTTOM VIEW  
SET FRA BUNDEN



TR783  
TONE RECEIVER  
TONEMODTAGER

**Storno®**

# Storno

TYPE	NO.	CODE	DATA
TR783		10. 2452	Tone Receiver
	C1	73. 5126	4. 7 $\mu$ F 20% tantal
	C2	76. 5069	1nF 10% polyester. FL
	C3	76. 5072	47nF 10% polyester. FL
	C4	76. 5059	2. 2nF 10% polyester FL
	C5	73. 5124	47 $\mu$ F 20% tantal
	C6	73. 5124	47 $\mu$ F 20% tantal
	C7	73. 5126	4. 7 $\mu$ F 20% tantal
	C8	76. 5068	0. 1 $\mu$ F 1% polystyr TB
	C9	76. 5070	10nF 10% polyester. FL
	C10	73. 5114	1 $\mu$ F 20% tantal
	C11	73. 5124	47 $\mu$ F 20% tantal
	C12	73. 5126	4. 7 $\mu$ F 20% tantal
	C13	73. 5109	10 $\mu$ F 20% tantal
	C14	73. 5124	47 $\mu$ F 20% tantal
	C15	73. 5089	0. 1 $\mu$ F 20% tantal
	C16	73. 5089	0. 1 $\mu$ F 20% tantal
	C17	73. 5109	10 $\mu$ F 20% tantal
	C18	73. 5114	1 $\mu$ F 20% tantal
	C19	73. 5124	47 $\mu$ F 20% tantal
	C20	73. 5109	10 $\mu$ F 20% tantal
	C21	73. 5109	10 $\mu$ F 20% tantal
	C22	73. 5124	47 $\mu$ F 20% tantal
	C23	73. 5127	22 $\mu$ F 20% tantal
	C24	73. 5089	0. 1 $\mu$ F 20% tantal
	C25	76. 5070	10nF 10% polyester. FL
	C26	76. 5070	10nF 10% polyester. FL
	R1	80. 5266	27K $\Omega$ 5% carbon film
	R2	80. 5255	3. 3K $\Omega$ 5% carbon film
	R3	80. 5268	39K $\Omega$ 5% carbon film
	R4	80. 5253	2. 2K $\Omega$ 5% carbon film
	R5	80. 5246	560 $\Omega$ 5% carbon film
	R6	80. 5240	180 $\Omega$ 5% carbon film
	R7	80. 5257	4. 7K $\Omega$ 5% carbon film
	R8	80. 5253	2. 2K $\Omega$ 5% carbon film
	R9	80. 5267	33K $\Omega$ 5% carbon film
	R10	80. 5253	2. 2K $\Omega$ 5% carbon film
	R11	80. 5257	4. 7K $\Omega$ 5% carbon film
	R12	80. 5242	270 $\Omega$ 5% carbon film
	R13	80. 5273	0. 1M $\Omega$ 5% carbon film
	R14	80. 5274	0. 12M $\Omega$ 5% carbon film
	R15	80. 5259	6. 8K $\Omega$ 5% carbon film
	R16	80. 5253	2. 2K $\Omega$ 5% carbon film
	R17	80. 5265	22K $\Omega$ 5% carbon film
	R18	80. 5253	2. 2K $\Omega$ 5% carbon film
	R19	80. 5256	3. 9K $\Omega$ 5% carbon film
	R20	89. 5008	1. 5K $\Omega$ 20% NTC

TYPE	NO.	CODE	DATA	
	R21	80.5257	4.7K $\Omega$ 5%	
	R22	80.5258	2.2K $\Omega$ 5%	
	R23	80.5248	820 $\Omega$ 5%	
	R24	80.5249	1 K $\Omega$ 5%	
	R25	80.5253	2.2K $\Omega$ 5%	
	R26	80.5268	39K $\Omega$ 5%	
	R27	80.52XX	Adjusted	
	R28	80.5256	3.9K $\Omega$ 5%	
	R29	80.5249	1 K $\Omega$ 5%	
	R30	80.5249	1 K $\Omega$ 5%	
	R31	80.5259	6.8K $\Omega$ 5%	
	R32	80.5253	2.2K $\Omega$ 5%	
	R33	80.5241	220 $\Omega$ 5%	
	R34	80.5271	68K $\Omega$ 5%	
	R35	80.5261	10K $\Omega$ 5%	
	R36	80.5261	10K $\Omega$ 5%	
	R37	80.5255	3.3K $\Omega$ 5%	
	R38	80.5247	680 $\Omega$ 5%	
	R39	80.5249	1 K $\Omega$ 5%	
	R40	80.5256	3.9K $\Omega$ 5%	
	R41	80.5261	10K $\Omega$ 5%	
	R42	80.5249	1 K $\Omega$ 5%	
	R43	80.5273	0.1 M $\Omega$ 5%	
	R44	80.5257	4.7K $\Omega$ 5%	
	R45	80.5255	3.3K $\Omega$ 5%	
	R46	80.5273	0.1 M $\Omega$ 5%	
	R47	80.5254	2.7K $\Omega$ 5%	
	R48			carbon film
	R49			carbon film
	R50	80.5258	5.6K $\Omega$ 5%	carbon film
	R51	80.5248	820 $\Omega$ 5%	carbon film
	R52	80.5248	820 $\Omega$ 5%	carbon film
	R53	80.5247	680 $\Omega$ 5%	carbon film
	R54	80.5247	680 $\Omega$ 5%	carbon film
	R55	80.5261	10K $\Omega$ 5%	carbon film
	R56	80.5261	10K $\Omega$ 5%	carbon film
R57	80.5255	3.3K $\Omega$ 5%	carbon film	
R58	80.5246	560 $\Omega$ 5%	carbon film	
R59	80.5252	1.8K $\Omega$ 5%	carbon film	
R60	80.5267	33K $\Omega$ 5%	carbon film	
R61	80.5267	33K $\Omega$ 5%	carbon film	
R62	80.5252	1.8K $\Omega$ 5%	carbon film	
R63	80.5249	1 K $\Omega$ 5%	carbon film	
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TONE RECEIVER  
 TONEMODTAGER

TR783

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X401.699/2

**Storno**

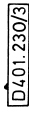
**Storno**

TYPE	NO.	CODE	DATA
R64	R65	80.5249	1 K $\Omega$ 5% carbon film 1/8W
R66	R67	80.5266	27K $\Omega$ 5% carbon film 1/8W
R68	R68	80.5270	56K $\Omega$ 5% carbon film 1/8W
		80.5229	22 $\Omega$ 5% carbon film 1/8W
L1		61.1135	Tone coil
E1	E2	99.5211	Stab. diode 0.8 V 5%
E3	E4	99.5211	Stab. diode 0.8 V 5%
E5	E6	99.5219	AAZ15 Diode
E7	E8	99.5219	AAZ15 Diode
E9	E10	99.5219	AAZ15 Diode
E11	E12	99.5020	1N4004 Diode
E13	E14	99.5028	1N914 Diode
		99.5028	1N914 Diode
		99.5219	AAZ15 Diode
		99.5042	Zenerdiode 9.1 V 5%
		99.5219	AAZ15 Diode
Q1	Q2	99.5144	BC214L Transistor
Q3	Q4	99.5143	BC108 Transistor
Q5	Q6	99.5144	BC214L Transistor
Q7	Q8	99.5143	BC108 Transistor
Q9	Q10	99.5143	BC108 Transistor
Q11	Q12	99.5143	BC108 Transistor
Q13	Q14	99.5143	BC108 Transistor
Q15	Q16	99.5143	BC108 Transistor
Q17	Q18	99.5143	BC108 Transistor
Q19	Q20	99.5143	BC108 Transistor
Q21	Q22	99.5144	BC214L Transistor
Q23		99.5143	BC108 Transistor
		99.5235	BD135 Transistor

TYPE	NO.	CODE	DATA

TONE RECEIVER  
TONEMODTAGER  
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**Storno**

TYPE	NO.	CODE	DATA
TR785		10.2451	Tone Receiver
	C1	73.5126	4.7 $\mu$ F 20% tantal
	C2	76.5069	1nF 10% polyester. FL
	C3	76.5072	47nF 10% polyester. FL
	C4	76.5059	2.2nF 10% polyester. FL
	C5	73.5124	47 $\mu$ F 20% tantal
	C6	73.5124	47 $\mu$ F 20% tantal
	C7	73.5126	4.7 $\mu$ F 20% tantal
	C8	76.5068	0.1 $\mu$ F 1% polystyr TB
	C9	76.5070	10nF 10% polyester. FL
	C10	73.5114	1 $\mu$ F 20% tantal
	C11	73.5124	47 $\mu$ F 20% tantal
	C12	73.5126	4.7 $\mu$ F 20% tantal
	C13	73.5109	10 $\mu$ F 20% tantal
	C14	73.5124	47 $\mu$ F 20% tantal
	C15	73.5089	0.1 $\mu$ F 20% tantal
	C16	73.5089	0.1 $\mu$ F 20% tantal
	C17	73.5109	10 $\mu$ F 20% tantal
	C18	73.5114	1 $\mu$ F 20% tantal
	C19	73.5124	47 $\mu$ F 20% tantal
	C20	73.5109	10 $\mu$ F 20% tantal
	C21	73.5109	10 $\mu$ F 20% tantal
	C22	73.5124	47 $\mu$ F 20% tantal
	C23	73.5127	22 $\mu$ F 20% tantal
	C24	73.5089	0.1 $\mu$ F 20% tantal
	C25	76.5070	10nF 10% polyester. FL
	C26	76.5070	10nF 10% polyester. FL
	R1	80.5266	27K $\Omega$ 5% carbon film
	R2	80.5255	3.3K $\Omega$ 5% carbon film
	R3	80.5268	39K $\Omega$ 5% carbon film
	R4	80.5253	2.2K $\Omega$ 5% carbon film
	R5	80.5246	560 $\Omega$ 5% carbon film
	R6	80.5240	180 $\Omega$ 5% carbon film
	R7	80.5257	4.7K $\Omega$ 5% carbon film
	R8	80.5253	2.2K $\Omega$ 5% carbon film
	R9	80.5267	33K $\Omega$ 5% carbon film
	R10	80.5253	2.2K $\Omega$ 5% carbon film
	R11	80.5257	4.7K $\Omega$ 5% carbon film
	R12	80.5242	270 $\Omega$ 5% carbon film
	R13	80.5274	0.12 M $\Omega$ 5% carbon film
	R14	80.5274	0.12 M $\Omega$ 5% carbon film
	R15	80.5259	6.8K $\Omega$ 5% carbon film
	R16	80.5253	2.2K $\Omega$ 5% carbon film
	R17	80.5265	22K $\Omega$ 5% carbon film
	R18	80.5253	2.2K $\Omega$ 5% carbon film
	R19	80.5256	3.9K $\Omega$ 5% carbon film
	R20	89.5008	1.5K $\Omega$ 20% NTC
	R21	80.5257	4.7K $\Omega$ 5% carbon film

**Storno**

TYPE	NO.	CODE	DATA
	R22	80.5253	2.2K $\Omega$ 5% carbon film
	R23	80.5248	820 $\Omega$ 5% carbon film
	R24	80.5249	1 K $\Omega$ 5% carbon film
	R25	80.5253	2.2K $\Omega$ 5% carbon film
	R26	80.5268	39K $\Omega$ 5% carbon film
	R27	80.52XX	Adjusted
	R28	80.5256	3.9K $\Omega$ 5% carbon film
	R29	80.5249	1 K $\Omega$ 5% carbon film
	R30	80.5249	1 K $\Omega$ 5% carbon film
	R31	80.5259	6.8K $\Omega$ 5% carbon film
	R32	80.5253	2.2K $\Omega$ 5% carbon film
	R33	80.5241	220 $\Omega$ 5% carbon film
	R34	80.5271	68K $\Omega$ 5% carbon film
	R35	80.5261	10K $\Omega$ 5% carbon film
	R36	80.5261	10K $\Omega$ 5% carbon film
	R37	80.5255	3.3K $\Omega$ 5% carbon film
	R38	80.5247	680 $\Omega$ 5% carbon film
	R39	80.5249	1 K $\Omega$ 5% carbon film
	R40	80.5256	3.9K $\Omega$ 5% carbon film
	R41	80.5261	10K $\Omega$ 5% carbon film
	R42	80.5249	1 K $\Omega$ 5% carbon film
	R43	80.5273	0.1 M $\Omega$ 5% carbon film
	R44	80.5257	4.7K $\Omega$ 5% carbon film
	R45	80.5255	3.3K $\Omega$ 5% carbon film
	R46	80.5273	0.1 M $\Omega$ 5% carbon film
	R47	80.5254	2.7K $\Omega$ 5% carbon film
	R48		
	R49		
	R50	80.5258	5.6K $\Omega$ 5% carbon film
	R51	80.5248	820 $\Omega$ 5% carbon film
	R52	80.5248	820 $\Omega$ 5% carbon film
	R53	80.5247	680 $\Omega$ 5% carbon film
	R54	80.5247	680 $\Omega$ 5% carbon film
	R55	80.5261	10K $\Omega$ 5% carbon film
	R56	80.5261	10K $\Omega$ 5% carbon film
	R57	80.5255	3.3K $\Omega$ 5% carbon film
	R58	80.5246	560 $\Omega$ 5% carbon film
	R59	80.5252	1.8K $\Omega$ 5% carbon film
	R60	80.5267	33K $\Omega$ 5% carbon film
	R61	80.5267	33K $\Omega$ 5% carbon film
	R62	80.5252	1.8K $\Omega$ 5% carbon film
	R63	80.5249	1 K $\Omega$ 5% carbon film

**TR785**  
**TONER RECEIVER**  
**TONEMODTAGER**

X401.700/2

**Storno**

**Storno**

TYPE	NO.	CODE	DATA
	R64	80. 5249	1 K $\Omega$ 5% carbon film 1/8W
	R65	80. 5215	1.5 $\Omega$ 5% carbon film 1/8W
	R66	80. 5266	27K $\Omega$ 5% carbon film 1/8W
	R67	80. 5270	56K $\Omega$ 5% carbon film 1/8W
	R68	80. 5229	22 $\Omega$ 5% carbon film 1/8W
	L1	61. 1134	Tone coil
	E1	99. 5211	Stab. diode 0.8 V 5% 1/4W
	E2	99. 5211	Stab. diode 0.8 V 5% 1/4W
	E3	99. 5219	AAZ15 Diode
	E4	99. 5219	AAZ15 Diode
	E5	99. 5219	AAZ15 Diode
	E6	99. 5219	AAZ15 Diode
	E7	99. 5020	1N4004 Diode
	E8	99. 5028	1N914 Diode
	E9	99. 5028	1N914 Diode
	E10		
	E11		
	E12	99. 5219	AAZ15 Diode
	E13	99. 5042	Zenerdiode 9.1 V 5%
	E14	99. 5219	AAZ15 Diode
	Q1	99. 5144	BC214L Transistor
	Q2	99. 5143	BC108 Transistor
	Q3	99. 5144	BC214L Transistor
	Q4	99. 5143	BC108 Transistor
	Q5	99. 5143	BC108 Transistor
	Q6	99. 5143	BC108 Transistor
	Q7	99. 5143	BC108 Transistor
	Q8	99. 5143	BC108 Transistor
	Q9	99. 5143	BC108 Transistor
	Q10	99. 5143	BC108 Transistor
	Q11	99. 5144	BC214L Transistor
	Q12	99. 5143	BC108 Transistor
	Q13	99. 5143	BC108 Transistor
	Q14	99. 5143	BC108 Transistor
	Q15	99. 5143	BC108 Transistor
	Q16	99. 5143	BC108 Transistor
	Q17	99. 5143	BC108 Transistor
	Q18	99. 5143	BC108 Transistor
	Q19	99. 5144	BC214L Transistor
	Q20	99. 5144	BC214L Transistor
	Q21	99. 5143	BC108 Transistor
	Q22	99. 5143	BC108 Transistor
	Q23	99. 5235	BD135 Transistor

TYPE	NO.	CODE	DATA

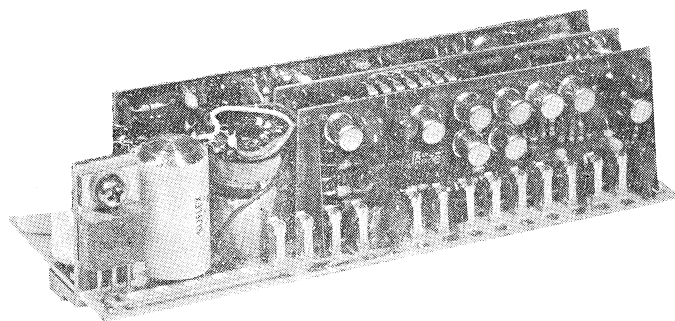
TONE RECEIVER TR785  
TONE MODTAGER

X401.700/2



## SEQUENTIAL TONE RECEIVER

### SR785



### Introduction

SR785 is a sequential tone receiver for selective calling. It was developed for use in Stornophone 700 radiotelephone equipment. The frequencies employed are the standard Storno series; 970 Hz to 2800 Hz.

SR785 is designed to operate on a 5-tone sequence, but can also be set to accommodate a 4-tone sequence.

### General Description

Upon reception of a signal having the correct tones in the proper sequence the following events take place (in the receiver):

The Call Lamp lights, the AF Muting is cancelled and the Key Lock function "unlocks". When the vehicle's traffic horn is connected to the tone receiver via an auxiliary relay, the horn will also sound for about one second.

The audio circuit and the Key Lock are both turned on and off manually by means of the LS IN/OUT push button. Since the switch that "unlocks" the Key Lock also turns on the loudspeaker, the operator is forced to check for the presence of another signal on the channel before being able to key his transmitter.

In addition, the tone receiver is equipped with an Occupied Lamp controlled by the squelch circuit in the radiotelephone receiver. Thus, if an RF signal having that channel's frequency is present at the antenna input it will cause the Occupied Lamp to light as an indication that the channel is not free.

After reception of a correct call the speaker will remain open until the LS IN/OUT button is depressed.



Logic Terms

Positive logic is employed in SR785; logical references are:

1. low voltage level ( $\sim 0V$ ) = logic state "0" (LO)
2. high voltage level ( $\sim 5V$ ) = logic state "1" (HI)

5-tone Signalling

The Input Stage includes Q1, IC1, Q2 and Q3. The first tone of a sequential tone signal, arriving from input terminal 35, passes through the input stage, where it becomes suitable for applying to the Q Multiplier.

In stand by the Q Multiplier is tuned, via AF Gate a, for the first tone of its code. If the first tone received corresponds to the circuit resonant frequency, it becomes selected, is then amplified in IC2 and rectified at the Detector, Q5, E1, and E2.

The rectified signal turns the Schmitt Trigger, IC3, ON. The output of IC3 becomes logic "1" and suspends the Clear function (Q9 - Q12). Binary Counters FF1 to FF3 are then ready to count.

A 25 ms delay is introduced between the time that the Schmitt Trigger output becomes logic "1" and the clock pulse from the Clock stage goes "1".

When the 1st tone ends, the Schmitt Trigger output goes "0" again, bringing the Clock output to logic "0". Counter FF1 then switches state, also causing the Decoder (IC6 and IC7) to step to the next AF gate, which is b.

The output of the Clear stage remains at logic "1" for about 40ms after the Schmitt Trigger has returned to "0". The next (2nd) 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 to receive the 1st tone again.

The 2nd, 3rd, 4th, and 5th tones of a sequence occur like the 1st, each time stepping the Decoder one position forward until the final tone is received. At the end of the 5th tone the IC7<sub>c</sub> output goes "0" which causes the Alarm circuit to ground terminal 37. A relay connected here will sound the traffic horn for approximately 1 second.

IC7<sub>c</sub> also clears the Read-out Gate, FF4. This lights the Call Lamp via FF4 output 4 and terminal 47 while turning the speaker ON via output  $\bar{4}$  and terminal 34.

The Call Lamp and the speaker will remain ON until switched OFF manually with the LS IN/OUT push button (via terminal 32).

When the channel is occupied (a carrier wave being received) the receiver squelch circuit feeds a voltage to terminal 41 (SQUELCH IN). The Occupied Lamp lights via terminal 45.

The Key Lock disables the transmitter via terminal 51. The voltage regulator will only supply power to the transmitter section when terminal 51 (KEY LOCK) from SR785 is at chassis ground potential.

Conditions for transmitting are:

- AF Muting cancelled (term. 34 LO)
- Call Lamp ON (term. 47 to ground)
- Key Lock cancelled (term. 51 to ground)

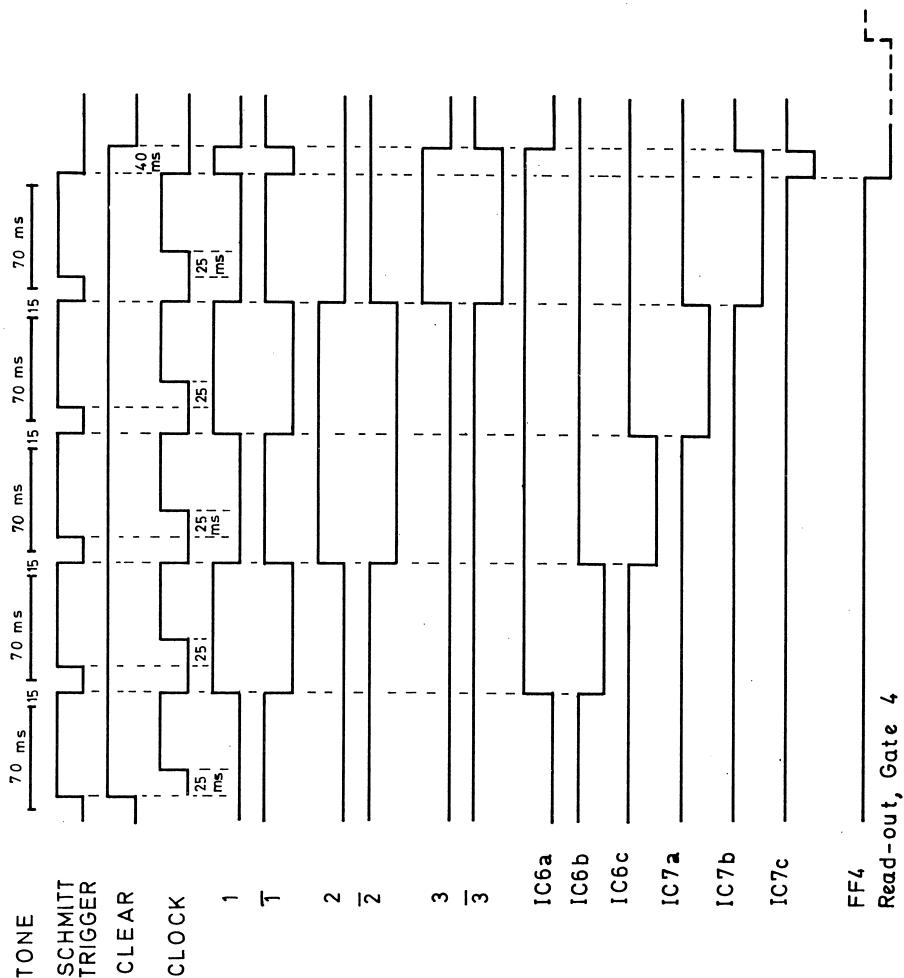
Approximately 40ms after the last tone in the sequence, the Clear output goes "0", clearing Counter FF1 - FF3. AF Gate a is then set to wait for the 1st tone of a new call.

4-tone Signals

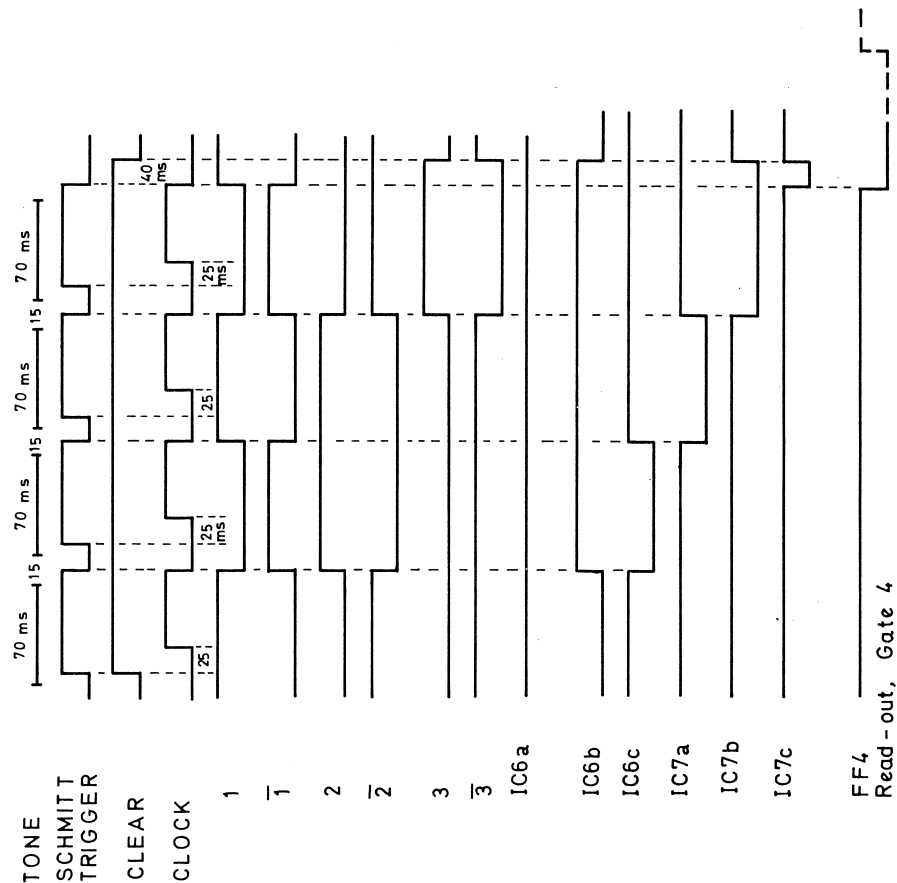
SR785 can also be strapped for 4-tone code signalling. The Clear output will then preset FF1 to switch in AF Gate b when in stand by, thus by-passing Gate a.

Pulse sequences for 4 and 5-tone signals follow:

5-TONE PULSE SEQUENCE



4-TONE PULSE SEQUENCE



### Input Stage (Q1, IC 1, Q2, Q3)

The pre-emphasis network includes Q1, R4 and C4.

IC 1 is a linear amplifier. Signal clipping begins when the signal amplitude approaches the supply voltage level (5V). Full amplitude limiting occurs when the input signal is 6 dB above the nominal 110 mV value.

R5 and R8 determine the amplifier gain. Voltage divider R6 and R7 sets the DC output level.

The limiting action and the narrow pass-band of the subsequent Q Multiplier ensure selectivity. Tones differing by at least 4.5 % from the resonant frequency will not be able to trigger the tone receiver.

Transistors Q2 and Q3 are arranged so that they present an extremely low output impedance (on the order of  $1\Omega$ ) which is suitable as a common return connection for the resonant circuit in the following stage.

### Q Multiplier (Q4)

The Q Multiplier involves a parallel resonant circuit, L1 and C8. This is very loosely coupled to the transistor, Q4, in order to maintain a constant Q over the entire tone range. C8 in the resonant circuit is grounded through the output impedances of the driver transistors while the relevant terminals of coil L1 are alternately grounded through the AF Gates, a - e (Q15 - Q19).

A portion of the tone signal is reapplied to L1 in phase by means of a feedback winding in the collector circuit of Q4, approximately doubling the Q of L1.

To offset the effect of temperature upon the Q of L1 an NTC resistor, R19, is inserted in the emitter circuit of Q4. R19, aided by R17 and R18, maintains a nearly flat temperature response from  $-30^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$ .

### Amplifier (IC2)

The signal from the Q Multiplier is DC coupled to the non-inverting input of IC2. Amplifier gain, and thus trigger level for the Schmitt Trigger, is adjustable by changing the value of R20.

### Detector (Q5, E1, E2)

Emitter follower Q5 drives the voltage doubling rectifier circuit.

### Schmitt Trigger (IC3)

The Schmitt Trigger is an operational amplifier working as a threshold detector to control the Clock and the Clear settings. The threshold voltage is set by network R29, E3, and R30.

In stand by the state of the non-inverting input is logic "0", thus the trigger output is also "0". When the rectified DC voltage from the Detector surpasses the threshold the Schmitt Trigger switches state and the output goes "1".

### Clock (Q6, Q7, Q8)

The Clock toggles Counter FF1 after first introducing a 25 ms delay in order to prevent erratic operation. The Clock output pulse is delayed until the Schmitt Trigger has displayed a logic "1" output state for approx. 25 ms. Delay time is adjustable by means of R35.

In stand by the output state of IC3 is "0", holding Q6, Q7, and Q8 ON. Clock output is also "0". When IC3 triggers, its output goes logic "1". This cuts off Q6, and C16 begins charging through R34 in parallel with R35. After the set delay time, Q7 becomes reverse biased and cuts off, turning Q8 OFF. Clock output at the collector of Q8 goes "1".

When the tone ends, the Schmitt Trigger returns to its quiescent state and Q6 goes ON and C16 discharges rapidly through Q6 and R36, turning Q7, then Q8 ON. Clock output switches to logic state "0", and FF1 toggles.

### Clear Circuit (Q9 - Q12, E5, E6)

The Clear circuit sets the Counter to stand by approx. 40 ms after the last correct tone arrives. Where the tone code is correct for the receiver setting the last tone will, of course, be the 5th tone (4th tone with 4-tone signalling). In the event of an incorrect tone code, the tone receiver will respond normally until one of the tones in the false sequence fails to match the resonant frequency set up by the AF Gates. Since each

tone lasts for about 70 ms, the Clear circuit will have reset the Counter to stand by before the incorrect tone expires and prior to the arrival of the next tone.

Emitter follower Q9 is driven by the Schmitt Trigger output through diode E5. In stand by, E5 cannot conduct, and Q9 is OFF. Q10, Q11, and Q12 are all ON, and output is at logic "0".

When the Schmitt Trigger output goes "1", E5 conducts, turning Q9 ON. C18 discharges through Q9, whereby Q10, Q11, and Q12 go OFF (output state "1"). The Counter is now able to start counting.

At the end of a tone E5 stops conducting (trigger output at "0" again) and C18 charges through R42 and R43. The charge building up on C18 eventually overcomes the emitter bias and turns Q10 ON. Emitter voltage for Q10, and thus the time elapsing before the Clear circuit returns to its quiescent state, is determined by voltage divider R45 and R46. When Q10 conducts, it turns Q11 and Q12 ON, as well, resetting the Counter to stand by.

The 40 ms delay is measured as the time elapsed between the Schmitt Trigger output "0" and when the Clear output goes "0".

Tones in a sequence arrive with maximum 15 ms interval between them, which is fast enough to keep the Clear output at "1".

When battery voltage is initially applied to the circuit a positive pulse is fed through E6 to the base of Q11, driving Q12 into saturation and ensuring that the Counter is cleared and ready to accommodate an incoming call.

#### Counter FF1 - FF3 (IC4<sub>a</sub>, IC5<sub>a</sub>, IC5<sub>b</sub>)

The Counter is composed of three J-K master-slave flip-flops with their J-K inputs all tied to logic state "1" through resistor R87. Each FF will thus toggle whenever it receives a clock pulse at the same time that its Clear input is held at "1". The Clock stage toggles FF1, FF1 toggles FF2, and FF2 toggles FF3.

FF1 has a Preset as well as a Clear function, allowing the tone receiver to be strapped to either 4-tone or 5-tone sequences.

Truth tables for these two modes follow:

#### Truth Table for the Counter

##### 5-tone

	1	$\overline{1}$	2	$\overline{2}$	3	$\overline{3}$
Cleared (pending call)	0	1	0	1	0	1
After the first tone	1	0	0	1	0	1
After the second tone	0	1	1	0	0	1
After the third tone	1	0	1	0	0	1
After the fourth tone	0	1	0	1	1	0
After the fifth tone	1	0	0	1	1	0
40 ms after the last tone (cleared pending call)	0	1	0	1	0	1

##### 4-tone

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

#### Decoder (IC6, IC7)

Each Decoder IC contains 3 separate, 3-input TTL NAND gates.

The output of a NAND gate is LO (logic "0") only when all of its inputs are HI (logic "1").

In stand by, 5-tone mode, the output of IC6<sub>a</sub> is always "0". In the 4-tone mode, the output of IC6<sub>b</sub> will be "0", instead.

At the end of a correct tone call IC7<sub>c</sub> presents a logic "0" to the Read-out Gate and to the Alarm circuit. The Alarm output, terminal 37, goes "0" through Q42.

#### AF Gates a, b, c, d, e (Q15 - Q19)

The AF Gates are controlled from the Decoder NAND gates, IC6<sub>a</sub> - IC7<sub>b</sub>. When a transistor

base is driven L0 (logic "0") by a NAND gate, that transistor will conduct and ground the coil terminal connected to its collector.

#### Alarm Circuit (Q39 - Q42, E18)

In stand by, Q39 is ON and E18 cannot conduct. Q40 and Q41 are both ON, and Q42 is OFF.

A correct call turns Q39 OFF and C46 charges through E18, causing Q40 and Q41 to turn OFF, driving Q42 ON, and connecting terminal 37 (ALARM) to chassis ground.

After approximately 40 ms (the clear delay) IC7<sub>c</sub> goes "1" and turns Q39 ON again. E18 can no longer conduct and C46 discharges through R114. After the delay caused by the time constant of C46 - R114, Q40 and Q41 turn ON and disconnect the Alarm circuit common return through Q42. The Alarm stays ON for approximately 1 second.

#### AF Muting and Key Lock Switch (Q30, Q31, E14)

The AF Muting and the Key Lock are controlled by the output of Read-out Gate IC4<sub>b</sub> (output  $\bar{4}$ ).

In stand by the outputs of Q30 and Q31 are HI ( $\sim +10V$ ), E14 conducts and the loudspeaker is muted through terminal 34.

As long as the potential at terminal 51 is HI, the transmitter keying function is also disabled.

When the Read-out Gate is activated, output  $\bar{4}$  goes "1", and Q30 and Q31 conduct, suspending the AF Muting and Key Lock functions.

#### Call and Occupied Lamp Switches (Q32, Q33, Q34)

The Call Lamp Switch, Q33, lights the Call Lamp by grounding it through terminal 47.

Terminal 49, in parallel with terminal 47, is provided for automatic muting of the vehicle's broadcast band radio, and requires an auxiliary relay.

At the end of a tone sequence, output 4 of FF4 goes "0", cutting Q32 OFF and turning Q33 ON, to complete the common return path for terminals 47 and 49.

Whenever the channel is occupied a DC voltage from the Squelch circuit, via terminal 41, turns Q34 ON, grounding the Occupied Lamp through terminal 45.

#### Cancelling Switch (Q38)

When the radiotelephone 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 is switched ON, C41 discharges through Q38 which goes ON briefly, presetting the Read-out Gate.

## Technical Specifications

#### Supply Power

Nominal: 13.6 V  
Minimum: 10.5 V  
Maximum: 16.0 V

#### Current Drain

Stand by: 100 mA  $\pm$  15 mA

#### Regulated Voltages

Nominal: 8.9 V and 4.9 V

#### Temperature Range

Operating range:  $-25^{\circ}C$  to  $+60^{\circ}C$   
Functioning range:  $-30^{\circ}C$  to  $+80^{\circ}C$

#### Input Impedance

$\geq 6 K\Omega$

#### Signal Input Level

Nominal at 1000 Hz: 110 mV

#### Equalization

Preemphasis (by RC function)  $f_c = 1000$  Hz

#### Signalling Code

Sequence of 4 or 5 tone bursts of 70 ms  $\pm$  15 ms duration with maximum 15 ms interval between tone bursts.



Tone Signal Frequencies

<u>Coil terminal</u>	<u>Tone frequency</u>
1	970 Hz
2	1060 Hz
3	1160 Hz
4	1270 Hz
5	1400 Hz
6	1530 Hz
7	1670 Hz
8	1830 Hz
9	2000 Hz
10	2200 Hz
11	2400 Hz
12	2600 Hz
13	2800 Hz

Frequency Accuracy

Coil tuned for 1060 Hz:  $\leq 0.4\%$  for all tones

Frequency Stability

(typically  $\leq 0.5\%$ ):  $\leq 1.0\%$

Selectivity

Frequencies differing from  $f_o$  by 4.5% or more are unable to trigger the tone receiver.

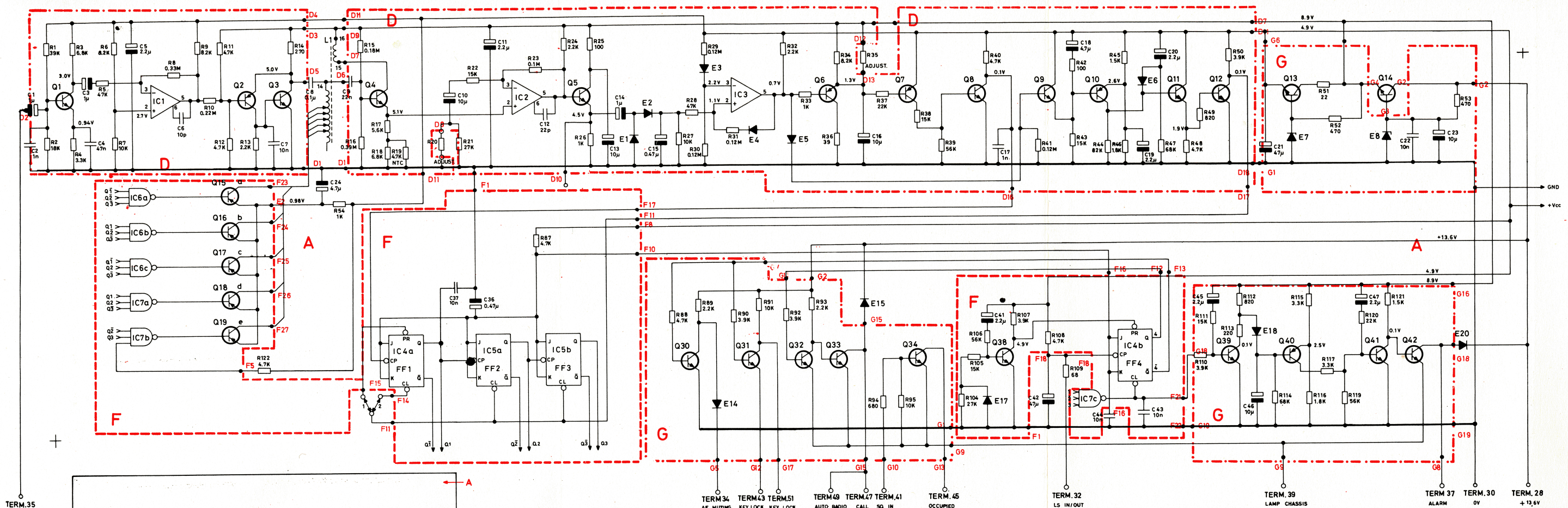
Maximum Load Currents

Terminal 37	ALARM	100 mA (for 1.2 sec)
Terminal 47	CALL	100 mA
Terminal 45	OCCUPIED	100 mA
Terminal 51		
and 43	KEY LOCK	10 mA
Terminal 34	AF MUTING	$I_{load}$ min. 0.75 mA for $V_{out} = 8 V$

AF Muting

In conjunction with terminal 18 of CF701:  
 $\geq 60$  dB.

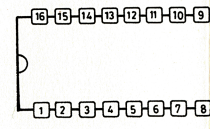
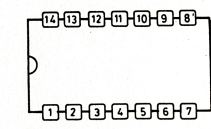
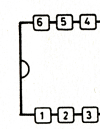
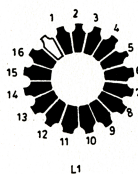




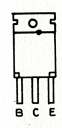
4-TONE SEQUENTIAL RECEIVER: INSERT STRAP 1  
5-TONE SEQUENTIAL RECEIVER: INSERT STRAP 2

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

	Vcc PIN	GND PIN
IC1	2	6
IC2	2	6
IC3	2	6
IC4	5	13
IC5	4	11
IC6	14	7
IC7	14	7



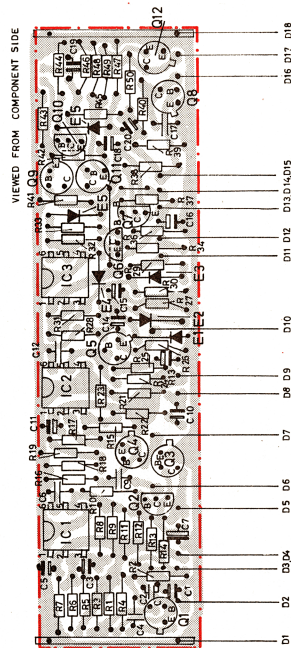
TOP VIEW



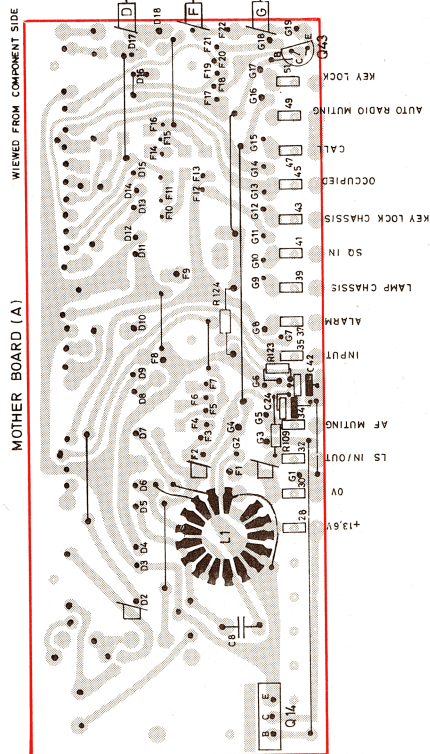
BOTTOM VIEW



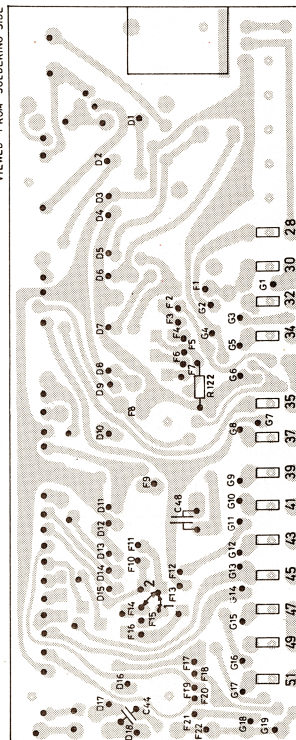
INDIVIDUAL CHAIN (D)



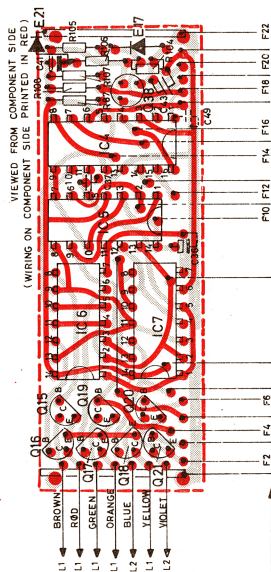
MOTHER BOARD (A)



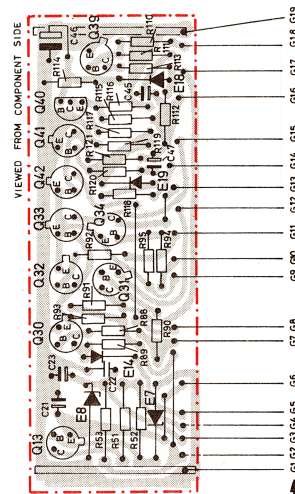
VIEWED FROM SOLDERING SIDE



COUNTER AND DECODER (F)



OUTLET SWITCHES (G)



TYPE	NO.	CODE	DATA
SR785		10.2541	Sequential Tone Receiver
	C1	73.5135	1μF -20 + 50% tantal
	C2	76.5069	1nF 10% polyester. FL
	C3	73.5135	1μF -20 + 50% tantal
	C4	76.5072	47nF 10% polyester. FL
	C5	73.5129	2.2μF -20 + 50% tantal
	C6	74.5135	10pF 5% ceram
	C7	76.5070	10nF 10% polyester. FL
	C8	76.5068	0.1μF 1% polystyr. TB
	C9	76.5071	22nF 10% polyester. FL
	C10	73.5109	10μF 20% tantal
	C11	73.5129	2.2μF -20 + 50% tantal
	C12	74.5106	22pF ± 0.5pF ceram
	C13	73.5109	10μF 20% tantal
	C14	73.5114	1μF 20% tantal
	C15	73.5125	0.47μF 20% tantal
	C16	73.5109	10μF 20% tantal
	C17	76.5069	1nF 10% polyester. FL
	C18	73.5126	4.7μF 20% tantal
	C19	73.5129	2.2μF -20 + 50% tantal
	C20	73.5129	2.2μF -20 + 50% tantal
	C21	73.5124	47μF 20% tantal
	C22	76.5070	10nF 10% polyester. FL
	C23	73.5109	10μF 20% tantal
	C24	73.5124	47μF 20% tantal
	C36	74.5134	0.47μF -20+50% tantal
	C37	74.5109	10 nF -20+80% ceram PL
	C41	73.5129	2.2μF -20+50% tantal
	C42	73.5129	2.2μF -20+50% tantal
	C43	74.5109	10nF -20+80% ceram PL
	C44	74.5109	10nF -20+80% ceram PL
	C45	73.5129	2.2μF -20+50% tantal
	C46	73.5109	10μF 20% tantal
	C47	73.5129	2.2μF -20+50% tantal
	C48	76.5070	10 nF 10% polyester. FL
	C49	74.5155	1 nF -20+80% ceram PL
	R1	80.5068	39 kΩ 5% carbon film
	R2	80.5064	18 kΩ 5% carbon film
	R3	80.5059	6.8kΩ 5% carbon film
	R4	80.5055	3.3kΩ 5% carbon film
	R5	80.5069	47kΩ 5% carbon film
	R6	80.5060	8.2kΩ 5% carbon film
	R7	80.5061	10kΩ 5% carbon film
	R8	80.5079	0.39 MΩ 5% carbon film
	R9	80.5060	8.2kΩ 5% carbon film
	R10	80.5077	0.22 MΩ 5% carbon film
	R11	80.5057	4.7kΩ 5% carbon film

TYPE	NO.	CODE	DATA
SR785	R12	80.5057	4.7kΩ 5% carbon film
	R13	80.5053	2.2kΩ 5% carbon film
	R14	80.5042	270Ω 5% carbon film
	R15	80.5076	0.18MΩ 5% carbon film
	R16	80.5080	0.39MΩ 5% carbon film
	R17	80.5058	5.6kΩ 5% carbon film
	R18	80.5059	6.8kΩ 5% carbon film
	R19	89.5009	4.7kΩ 20% NTC
	R20	80.50xx	Adjusted 5% carbon film
	R21	80.5066	27kΩ 5% carbon film
	R22	80.5063	15kΩ 5% carbon film
	R23	80.5073	0.1MΩ 5% carbon film
	R24	80.5053	2.2kΩ 5% carbon film
	R25	80.5037	100Ω 5% carbon film
	R26	80.5049	1kΩ 5% carbon film
	R27	80.5061	10kΩ 5% carbon film
	R28	80.5069	47kΩ 5% carbon film
	R29	80.5074	0.12MΩ 5% carbon film
	R30	80.5074	0.12MΩ 5% carbon film
	R31	80.5074	0.12MΩ 5% carbon film
	R32	80.5053	2.2kΩ 5% carbon film
	R33	80.5049	1kΩ 5% carbon film
	R34	80.5060	8.2kΩ 5% carbon film
	R35	80.50xx	Adjusted 5% carbon film
	R36	80.5032	39Ω 5% carbon film
	R37	80.5065	22kΩ 5% carbon film
	R38	80.5063	15kΩ 5% carbon film
	R39	80.5070	56kΩ 5% carbon film
	R40	80.5057	4.7kΩ 5% carbon film
	R41	80.5074	0.12MΩ 5% carbon film
	R42	80.5037	100Ω 5% carbon film
	R43	80.5063	15kΩ 5% carbon film
	R44	80.5072	82kΩ 5% carbon film
	R45	80.5051	1.5kΩ 5% carbon film
	R46	80.5052	1.8kΩ 5% carbon film
	R47	80.5071	68kΩ 5% carbon film
	R48	80.5057	4.7kΩ 5% carbon film
	R49	80.5048	820Ω 5% carbon film
	R50	80.5056	3.9kΩ 5% carbon film
	R51	80.5229	22Ω 5% carbon film
	R52	80.5245	470Ω 5% carbon film
	R53	80.5245	470Ω 5% carbon film

SEQUENTIAL TONE RECEIVER  
SEKVENSTONEMODTAGER

SR785

X401.701/2

Storno

TYPE	NO.	CODE	DATA
R54		80.5049	1k $\Omega$ 5% carbon film
R87		80.5057	4.7k $\Omega$ 5% carbon film
R88		80.5057	4.7k $\Omega$ 5% carbon film
R89		80.5053	2.2k $\Omega$ 5% carbon film
R90		80.5056	3.9k $\Omega$ 5% carbon film
R91		80.5061	10k $\Omega$ 5% carbon film
R92		80.5056	3.9k $\Omega$ 5% carbon film
R93		80.5053	2.2k $\Omega$ 5% carbon film
R94		80.5047	680 $\Omega$ 5% carbon film
R95		80.5061	10k $\Omega$ 5% carbon film
R104		80.5066	27k $\Omega$ 5% carbon film
R105		80.5063	15k $\Omega$ 5% carbon film
R106		80.5070	56k $\Omega$ 5% carbon film
R107		80.5056	3.9k $\Omega$ 5% carbon film
R108		80.5057	4.7k $\Omega$ 5% carbon film
R109		80.5027	15 $\Omega$ 5% carbon film
R110		80.5056	3.9k $\Omega$ 5% carbon film
R111		80.5063	15k $\Omega$ 5% carbon film
R112		80.5048	820 $\Omega$ 5% carbon film
R113		80.5041	220 $\Omega$ 5% carbon film
R114		80.5071	68k $\Omega$ 5% carbon film
R115		80.5055	3.3k $\Omega$ 5% carbon film
R116		80.5052	1.8k $\Omega$ 5% carbon film
R117		80.5055	3.3k $\Omega$ 5% carbon film
R119		80.5070	56k $\Omega$ 5% carbon film
R120		80.5065	22k $\Omega$ 5% carbon film
R121		80.5051	1.5k $\Omega$ 5% carbon film
R122		80.5057	4.7k $\Omega$ 5% carbon film
R123		80.5072	82 K $\Omega$ 5% carbon film
R124		80.5064	18 K $\Omega$ 5% carbon film
L1		61.1148	Tone coil
E1		99.5237	1N4148 Diode
E2		99.5237	1N4148 Diode
E3		99.5237	1N4148 Diode
E4		99.5237	1N4148 Diode
E5		99.5237	1N4148 Diode
E6		99.5237	1N4148 Diode
E7		99.5114	5.6V 5% Zenerdiode
E8		99.5042	9.1V 5% Zenerdiode
E14		99.5237	1N4148 Diode
E17		99.5237	1N4148 Diode
E18		99.5237	1N4148 Diode
Q1		99.5143	BC108 Transistor
Q2		99.5144	BC214L Transistor

Storno

TYPE	NO.	CODE	DATA
	Q3	99.5143	BC108 Transistor
	Q4	99.5143	BC108 Transistor
	Q5	99.5143	BC108 Transistor
	Q6	99.5144	BC214L Transistor
	Q7	99.5144	BC214L Transistor
	Q8	99.5143	BC108 Transistor
	Q9	99.5143	BC108 Transistor
	Q10	99.5144	BC214L Transistor
	Q11	99.5143	BC108 Transistor
	Q12	99.5143	BC108 Transistor
	Q13	99.5143	BC108 Transistor
	Q14	99.5246	TIP31 Transistor
	Q15	99.5144	BC214L Transistor
	Q16	99.5144	BC214L Transistor
	Q17	99.5144	BC214L Transistor
	Q18	99.5144	BC214L Transistor
	Q19	99.5144	BC214L Transistor
	Q30	99.5143	BC108 Transistor
	Q31	99.5143	BC108 Transistor
	Q32	99.5143	BC108 Transistor
	Q33	99.5143	BC108 Transistor
	Q34	99.5143	BC108 Transistor
	Q38	99.5143	BC108 Transistor
	Q39	99.5143	BC108 Transistor
	Q40	99.5143	BC108 Transistor
	Q41	99.5143	BC108 Transistor
	Q42	99.5143	BC108 Transistor
	Q43	99.5117	BC167 Transistor
	IC1	14.5017	TAA861 Operational Amplifier
	IC2	14.5017	TAA861 Operational Amplifier
	IC3	14.5017	TAA861 Operational Amplifier
	IC4	14.5009	Dual J-K Master-slave F. F. Clear/pres.
	IC5	14.5008	Dual J-K Master-slave F. F. Clear
	IC6	14.5007	Triple 3-input NAND Gate
	IC7	14.5007	Triple 3-input NAND Gate

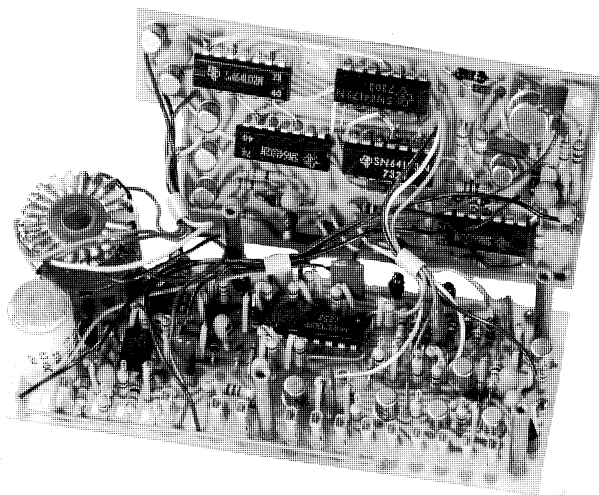
# SEQUENTIAL TONE RECEIVER SEKVENSTONEMODTAGER

SR785

X401.701/2

# SEQUENTIAL TONE RECEIVER

## SR785a



### Description

SR785a is a sequential tone receiver for selective calling. It was developed for use in Stornophone 700 radiotelephone equipment. The frequencies employed are the standard Storno series: 970 Hz to 2800 Hz.

SR785a is designed to operate on a 5-tone sequence, but can also be set to accommodate a 4-tone sequence.

#### GENERAL DESCRIPTION

Upon reception of a signal having the correct tones in the proper sequence the following events take place (in the receiver):

The Call Lamp lights, the AF Muting is cancelled and the Key Lock function "unlocks". An audio alarm signal of about 1.3 seconds in duration can be sent out over the radiotelephone's loudspeaker, and when the vehicle's traffic horn is connected to the tone receiver via an auxiliary relay, the horn will also sound for the same length of time.

There is also a provision for automatically turning off the car's broadcast band receiver when a call arrives.

The audio circuit and the Key Lock are both turned on and off manually by means of the LS IN/OUT push button. Since the switch that "unlocks" the Key Lock also turns on the loudspeaker, the operator is forced to check for the presence of another signal on the channel before being able to key his transmitter.

In addition, the tone receiver is equipped with an Occupied Lamp controlled by the squelch circuit in the radiotelephone receiver. Thus, if an RF signal having that channel's frequency is present at the antenna input it will cause the Occupied Lamp to light as an indication that the channel is not free.

After reception of a correct call the speaker will remain open until the LS IN/OUT button is depressed.

#### Logic Terms

Positive logic is employed in SR785a; logical references are:

1. low voltage level ( $\sim 0V$ ) = logic state "0" (LO)
2. high voltage level ( $\sim 5V$ ) = logic state "1" (HI)



### Tone Signalling

The first tone of a sequential signal, arriving from input terminal 35, passes through the Amplifier/Limiter, IC1, where it becomes suitable for applying to the tuned circuit of L1 and C8.

In stand by the resonant frequency of the tuned Circuit is set up by the first Tone Gate, Q4, for the first tone of its code. If the first tone received corresponds to the circuit resonant frequency, it becomes selected, is then amplified by IC2 and detected by E1.

The correct tone will thus fire the Schmitt Trigger, IC3a, whose output drives the Clock Delay (CP Delay) circuit, IC3b. This circuit produces a Clock Pulse whose leading (positive going) edge is delayed approximately 15 msec. from the Schmitt Trigger output signal.

The clock pulse is applied to the Counter circuit, IC6a, IC7a and IC6b. The Counter is arranged as a synchronous, divide-by-5 counter whose binary states are read out in BCD (binary coded decimal) mode in the Decoders, IC4a-d and IC5a-b.

The first five Decoders drive the Tone Gates, Q4-Q8. The output of the sixth Decoder, IC5b, is applied to the Readout circuit, IC7b.

The Readout flip-flop is also timed by the same clock pulses that toggle the Counter flip-flops.

At the end of a tone pulse, the Schmitt Trigger reverts to its quiescent state and the resultant trailing (negative going) pulse edge from the CP Delay output causes the Counter flip-flops to change state. (So far, with just the first pulse completed, only Counter IC6a is affected.)

The Decoders sense the new binary state and turn Tone Gate Q4 OFF and Tone Gate Q5 ON, thus setting the resonant circuit up for the second tone in the sequential code.

Suppose that the next tone received does not match the receiver's code. It will not be selected by the resonant circuit and no signal will be available to fire the Schmitt Trigger. When the Schmitt Trigger was fired the first time, it also turned Q1 ON and activated the Clear Delay circuit, IC3c. The output of IC3c then enabled the Counters by applying a HI logical state to their Clear inputs. The Clear Delay output remains HI for about 70 msec. after the Schmitt Trigger has returned to "0". If the second tone does not activate the Schmitt Trigger by then, Q1 goes OFF and the Clear Delay output goes LO, clearing the counter and setting the Decoders back to the stand by position, i.e. ready to receive the first tone again. This is what happens if the second, or any consequent tone fails (for instance, if the tone is not the correct one for the particular receiver under consideration).

The 2nd, 3rd, 4th and 5th tones of a sequence occur like the 1st, each time stepping the Decoder one position forward until the final tone has been received.

When all five tones have been received, at the end of the 5th tone, IC7b clears the Holding Circuit, IC8, and turns transistor Q2 ON.

Q2 drives the Alarm Delay circuit.

All the functions mentioned in the beginning of this description, i.e. Call Lamp, AF Muting, Key Lock, Alarm Tone Generator, etc. occur at this time.

The Call Lamp and the speaker will remain ON until switched OFF manually with the LS IN/OUT push button (via terminal 32).

If the operator later wants to make a call, he must first "unlock" the Key Lock function with the LS IN/OUT push button again, thus turning the loudspeaker ON. If there is any traffic on his channel, he will hear it and be warned before he can key his transmitter.



CIRCUIT DESCRIPTIONInput Stage (IC1)

Input terminal 35 can be wired in either of two positions (marked DK and SV on schematic diagram D401.894):

DK = input signal through C2 and R1, linear response

SV = input signal differentiated through C1 to match the modulation index used in Sweden and by Storno.

The amplifier circuit incorporates amplitude limiting for signal levels above the minimum required to activate the Schmitt Trigger.

Resistor R6 sets the amplifier sensitivity.

Amplifier Stage (IC2)

The signal is inductively coupled to the Amplifier via the parallel resonant circuit, L1 and C8.

Five of the taps on tone coil L1 are wired to Tone Gates Q4 to Q8, respectively (with a 4-tone code, Q8 is not used). When a Tone Gate is ON, i.e. conducting, it completes a path from its coil tap to chassis ground and the parallel resonant circuit for that particular tone frequency is formed.

NTC resistor R13 compensates for variations in circuit Q caused by changes in ambient temperature.

The selected signal passes to operational amplifier IC2, which is bootstrapped so as not to load the resonant circuit. Amplifier gain is determined by the ratio of R17 to R19.

Detector and Schmitt Trigger (E1, E2, IC3a)

The amplified tone signal is then rectified by the forward-biased diode, E1, and filtered by C13. The resultant DC voltage is present at the inverting input of IC3a.

When the rectified voltage exceeds the threshold level set by R21, R22, R25, R26 and diode E2, the output of the Schmitt Trigger

switches from LO ( $\sim 0V$ ) to HI ( $\sim 5V$ ) and remains in that state for the duration of the tone pulse.

Feedback to the non-inverting input via R27 produces a circuit hysteresis of circa 0.2 V.

When the tone ends the Schmitt Trigger switches back to its quiescent state, i.e.: output LO.

Clock Delay (E4, IC3b)

In stand by the Schmitt Trigger output state is LO, C15 is discharged through E4, and the potential at the non-inverting input is also LO (IC3b output is also LO).

Notice that the voltage divider network of R41 and R42 determines the threshold voltage at the inverting inputs of all 3 "delay" circuits, IC3b, IC3c and IC3d.

Now, when the Schmitt Trigger output goes HI, it reverse-biases diode E4 and capacitor C15 begins to charge through resistors R31 and R32. The moment the charge on C15, as seen at the non-inverting input of the comparator, reaches the threshold level, the output switches to the HI state.

It takes C15 approx. 15 msec. to charge up to the threshold level of IC3b. This is what determines the Clock Delay time; removing the short circuit across R30 lengthens the delay time.

At the end of the tone the Schmitt Trigger output returns to its LO state and C15 can once again discharge through E4 and R32. The time constant of this circuit provides a delay at the negative going trailing edge of the pulse, too. These delays prevent random noise pulses from operating the circuit erratically.

Clear Delay (Q1, IC3c)

In stand by, Q1 is OFF and C16 has no charge on it. When the Schmitt Trigger output goes HI it drives Q1 ON, and C16 builds up a charge via R37 and Q1, triggering comparator IC3c so its output goes HI. The Clear Delay circuit operates similarly to the Clock Delay circuit.

As long as the Schmitt Trigger keeps operating at the normal tone intervals, Q1 can maintain the charge on C16. At the end of the 5th tone, the Schmitt Trigger reverts to its quiescent state (output LO) and turns Q1 OFF, as the emitter of Q1 will be biased by the charge on C16. The discharge path for C16 is through R36 and R37. In about 70 msec, the voltage at the non-inverting input of IC3c will fall back to the threshold level and the comparator output switches state. The LO potential at the Clear Delay output clears the Counter and the Readout circuits. Since the interval between tones is normally much less than 70 msec., the Clear Delay will remain OFF (output HI) throughout the entire tone sequence.

#### Counter (IC6a, IC7a, IC6b)

The Counter elements are J-K master-slave flip-flops arranged as a synchronous, divide-by-five counter that is clocked by the Clock Delay output and is cleared by the Clear Delay output. All of the normal (Q) and complement ( $\bar{Q}$ ) Counter outputs are wired to appropriate Decoder inputs (IC4 and IC5).

The binary information present at each flip-flop input when a clock pulse arrives will be transferred to the output by the trailing edge of the clock pulse. A 5-tone code sequence, correct for the receiver in question, produces 5 clock pulses, one for each tone pulse.

70 msec. after the 5th tone ends, the logical "0" (LO) state at the Clear Delay output clears the Counter flip-flops. However, the Counter will not be able to start counting again until the flip-flops are enabled by the Clear Delay output being switched to logical "1" again by the Schmitt Trigger action.

#### Decoder (IC4a-d, IC5a)

#### and Tone Gates (Q4-Q8)

The wiring between the Counter outputs and the Decoder NOR gate inputs is arranged to drive the Tone Gates one at a time.

The output of a NOR gate is HI (logical state "1") only when all of its inputs are LO (logical state "0"). If either or both of its inputs are HI, the NOR gate output will be LO.

In stand by, both inputs to IC4a are LO and the output is therefore HI. The other 5 Decoder NOR gates have at least one of their inputs HI, so their outputs will all be LO. Tone Gate Q4 is thus held ON by IC4a, while Q5-Q8 are held OFF by IC4b - IC5a.

Transistor Q4, conducting hard, acts as a virtual short circuit from chassis ground to whichever tone coil tap is specified for the first tone of the code sequence. At the end of the first clock pulse, one of the inputs to IC4a goes HI, the NOR gate output goes LO, and Q4 cuts off. At the same time both inputs to IC4b are now LO, its output goes HI, and Q5 goes ON to tune the resonant circuit for the 2nd tone of the code sequence.

One special consideration here is that the actual maximum HI potential measurable at the NOR gate output is limited to approx. 0.7 V by the conducting Tone Gate transistor's emitter-base junction.

With each correct pulse the Counter steps the Decoder one position forward until the final tone has been received.

#### Readout Circuit (IC5b, IC7b)

At the end of the 4th tone of a 5-tone signal (or the 3rd tone of a 4-tone signal) both inputs to IC5b will be LO, and the NOR gate output will go HI, driving the J input of IC7b HI, as well.

Now, with its J input driven HI and its K input held at chassis ground potential, IC7b can switch output states when the trailing (negative going) edge of the 5th (or 4th) tone pulse arrives. The normal (Q) output activates the Alarm Delay circuit, and the complement ( $\bar{Q}$ ) output clears the Holding Circuit, IC8.

70 msec. later the Clear Delay, IC3c, clears the Counter and Readout circuits, and the Tone

Receiver is set up for the first tone again by the Decoder and Tone Gate circuits.

A strapping arrangement at the input of IC5b allows for either 4 or 5-tone codes.

#### Alarm Delay (IC3d, Q2, Q3)

Transistor Q2 is normally OFF and the output of IC3d is HI; Q3, a PNP transistor, is held OFF, and so is Q13.

When the Q output of IC7b in the Readout circuit goes HI at the end of the last tone pulse, it drives Q2 ON. Then capacitor C18 quickly charges through the conducting transistor Q2. When the charge reaches the threshold established by the resistive divider circuit of R41 and R42 the output of IC3d goes LO, turning Q3, then Q13 ON.

Q13 acts as a switch capable of carrying 100 mA of current between ground and terminal 37, the connection for an auxiliary alarm relay.

As long as the Clear Delay, IC3c, output remains HI, Q2 is held ON by IC7b and maintains the charge across C18. 70 msec. after the last pulse from the Clock Delay, IC3b, ends, IC3c switches state and clears the Counter and Readout IC's. The Q output of IC7b returns to logical "0", turning Q2 OFF. C18 now discharges slowly through R43 and R44.

The time constant of C18, R43 and R44 is calculated so that the Alarm Delay, IC3d, output switches back to logical "1" approx. 1,3 sec. after the end of the final clock pulse.

The Alarm Delay is a comparator circuit that operates in the same manner as the Clock Delay.

#### Holding Circuit (IC8, Q9, Q11)

##### Call Lamp + Key Lock Switches (Q10, Q11)

The Holding Circuit is an integrated flip-flop with its J and K inputs both tied to logical "1" through R64. With both the J and the K inputs HI, the flip-flop output will complement itself for each clock pulse arriving at the CP

(toggle) input. Notice that the CP input is also tied to +Vcc, through R62. This simulates the flat top portion of a clock pulse. Now whenever the LS IN/OUT push button on the radiotelephone control panel is pressed, terminal 32 is grounded. C30 at the CP input discharges quickly through the 27 $\Omega$  resistor, R63, and the flip-flop sees a negative going trailing edge of a "clock pulse" and switches state. When the push button is released again, C30 charges up to +Vcc through R62, forming the positive going leading edge of the next "clock pulse".

Only the normal (Q) output is used in this circuit; it switches Q11 ON and OFF.

As just seen, IC8 is designed so that it can only be toggled manually by means of the LS IN/OUT switch. However, the Clear input is operated electronically from the  $\bar{Q}$  output of Readout flip-flop IC7b.

C32 provides a drive pulse to the base of Q9, saturating the transistor as soon as the radiotelephone is turned on. This pulls the collector of Q9 down to ground, presetting IC8. In the preset state, the Q output is HI and Q11 is held OFF, and Q10 and Q12 are likewise OFF.

With the collector of Q9 LO, diode E3 keeps the Schmitt Trigger output at logical "0", as well, inhibiting both the Clock and the Clear Delay circuits.

As capacitor C32 accumulates a charge, the charging current decreases until it no longer can forward bias Q9. The transistor goes OFF, its collector voltage goes HI, and IC8 becomes enabled.

Diode E6 serves to discharge C32 when the equipment is turned off.

Each time the LS IN/OUT button is pressed, IC8 changes state, switching Q11 ON or OFF and, in turn, driving Q10 and Q12 into saturation or cut-off.

When Q10 conducts it provides a ground connection to light the Call Lamp and, when ap-

plicable, to operate a relay for muting the car's broadcast band radio.

Q12, conducting simultaneously, turns the loud-speaker ON and also unlocks the Key Lock function.

At the end of the last tone pulse in a sequence, the complement output ( $\bar{Q}$ ) of IC7b clears IC8, whose output goes LO and turns Q11 ON. Q10 and Q12 are then driven into saturation. 70 msec. after, the Clear Delay clears the Counter and Readout circuits and  $\bar{Q}$  of IC7b goes HI again. IC8 can be manually toggled via terminal 32 any time afterwards.

Note that whenever the speaker is in operation, whether turned on manually or by an incoming call, the Call Lamp will light.

#### Occupied Lamp Switch (Q14)

Whenever the channel is occupied a DC voltage from the Squelch circuit, via terminal 41, turns Q14 ON and establishes a ground connection to the Occupied Lamp, so it can light.

#### Alarm Tone Generator (IC5c, IC5d)

Two NOR gates, coupled to operate as a free-running (astable) multivibrator, generate an audio signal that is available at terminal 20. The Generator can be strapped to the output of IC3d or to +Vcc through R61.

In stand by, IC3d has a HI output, which would inhibit NOR gate IC5d. When a selective call comes through, the Alarm Delay output goes LO for approx. 1.3 sec. During that interval the multivibrator can oscillate at a frequency determined by the time constants of R57 / C27 and R58 / C26. When the Alarm Delay output goes HI again the oscillator stops.

On the other hand, if its input is tied to +Vcc, IC5d would be permanently inhibited and no audio signal could be generated, at all.

Output signal level can be regulated by resistor R60.

Regardless of the state of IC8 a correct tone signal will clear the flip-flop and turn Q11, then Q10 and Q12 ON. Thus, a tone call has higher priority than the manual switch.

T R U T H    T A B L E  
for Counter, Readout, and Decoder Circuits

Clock Pulse	Clear Delay	IC6a				IC7a				IC6b				IC4a	IC4b	IC4c	IC4d	IC5a	IC5b	IC7b $\bar{Q}$
		J	K	Q	$\bar{Q}$	J	K	Q	$\bar{Q}$	J	K	Q	$\bar{Q}$							
0	0	1	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	1
1	1	1	0	1	0	1	0	0	1	0	0	0	1	0	1	0	0	0	0	1
2	1	1	0	1	0	1	0	1	0	1	0	0	1	0	0	1	0	0	0	1
3	1	0	1	1	0	1	0	1	0	1	0	1	0	0	0	0	1	0	0	1
4	1	0	1	0	1	0	0	1	0	1	0	1	0	0	0	0	0	1	1	1
5	1	0	1	0	1	0	0	1	0	1	0	1	0	0	0	0	0	1	1	0
$\Delta$	0	1	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	1

NOTE:  $\Delta$  = 70 msec. after the end of the 5th tone

# SEQUENTIAL TONE RECEIVER

## SR785a

### Technical Specification

#### Supply Power

Nominal: 13.6 V  
 Minimum: 10.5 V  
 Maximum: 16.0 V

#### Current Drain

Stand by: 24 mA  $\pm$  4 mA

#### Regulated Voltage

Nominal 4.9 V

#### Temperature Range

Operating range:  $-25^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$   
 Functioning range:  $-30^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$

#### Maximum Load Currents

Terminal 37 ALARM 100 mA (for 1.3 sec.)  
 Terminal 47 Call 100 mA  
 Terminal 45 OCCUPIED 100 mA  
 Terminal 51  
 and 43 KEY LOCK 10 mA  
 Terminal 34 AF MUTING  $I_{\text{load}}$  min. 0.75 mA  
 for  $V_{\text{out}} = 8 \text{ V}$

#### Input Impedance

$\geq 6 \text{ K}\Omega$

#### Signal Input Level

Nominal at 1000 Hz: 110 mV

#### AF Muting

In conjunction with terminal 18 of CF701 or CF702:  
 $\geq 60 \text{ dB}$ .

#### Signalling Code

Sequence of 4 or 5 tone bursts of 70 ms  $\pm$  15 ms duration with maximum 15 ms interval between tone bursts.

#### Tone Signal Frequencies

<u>Coil terminal</u>	<u>Tone frequency</u>
1	970 Hz
2	1060 Hz
3	1160 Hz
4	1270 Hz
5	1400 Hz
6	1530 Hz
7	1670 Hz
8	1830 Hz
9	2000 Hz
10	2200 Hz
11	2400 Hz
12	2600 Hz
13	2800 Hz

#### Frequency Accuracy

Coil tuned for 1060 Hz:  $\leq 0.3\%$  for all tones

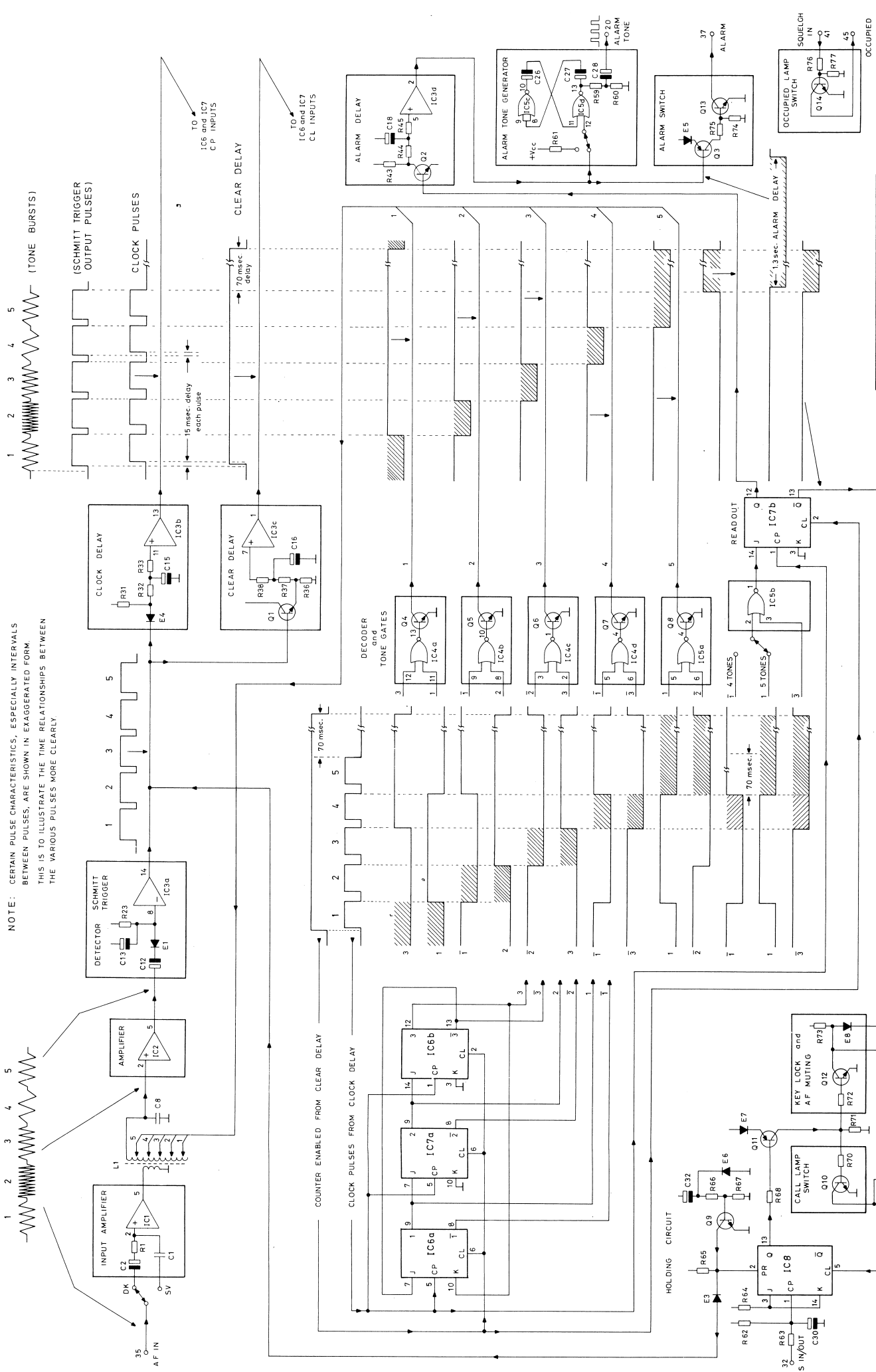
#### Frequency Stability

(typically  $\leq 0.5\%$ )  $\leq 1.0\%$

#### Selectivity

Frequencies differing from  $f_0$  by 4% or more are unable to trigger the tone receiver.

NOTE: CERTAIN PULSE CHARACTERISTICS, ESPECIALLY INTERVALS BETWEEN PULSES, ARE SHOWN IN EXAGGERATED FORM THIS IS TO ILLUSTRATE THE TIME RELATIONSHIPS BETWEEN THE VARIOUS PULSES MORE CLEARLY



SR785a FUNCTIONAL DIAGRAM  
**Stereo** D401977

Storno

Storno

TYPE	NO.	CODE	DATA
SR785a		10. 2541-01	Sequential Tone Receiver
	C1	74. 5061	4.7nF 10% polyest. FL
	C2	73. 5118	0.22μF 20% tantal
	C3	73. 5102	2.2μF 20% tantal
	C4	74. 5116	33pF 5% ceram TB
	C5		not used
	C6	73. 5109	10μF 20% tantal
	C7	73. 5089	0.1μF 20% tantal
	C8	76. 5068	0.1μF 1% polystyr TB
	C9	73. 5102	2.2μF 20% tantal
	C10	73. 5114	1μF 20% tantal
	C11	74. 5116	33pF 5% ceram TB
	C12	73. 5114	1μF 20% tantal
	C13	73. 5118	0.22μF 20% tantal
	C14		not used
	C15	73. 5102	2.2μF 20% tantal
	C16	73. 5102	2.2μF 20% tantal
	C17	76. 5071	22nF 10% polyest. FL
	C18	73. 5109	10μF 20% tantal
	C19	76. 5071	22nF 10% polyest. FL
	C20	76. 5070	10nF 10% polyest. FL
	C21	73. 5114	1μF 20% tantal
	C22	73. 5124	47nF 20% tantal
	C23	74. 5165	100pF 10% ceram
	C24	73. 5126	4.7μF 20% tantal
	C25	76. 5070	10nF 10% polyest. FL
	C26	73. 5118	0.22μF 20% tantal
	C27	73. 5118	0.22μF 20% tantal
	C28	73. 5089	0.1μF 20% tantal
	C29	73. 5109	10μF 20% tantal
	C30	73. 5126	4.7μF 20% tantal
	C31	74. 5155	1nF -20+80% ceram PL
	C32	73. 5126	4.7μF 20% tantal
	C33	76. 5070	10nF 10% polyest. FL
	C34	73. 5114	1μF 20% tantal
	R1	80. 5262	12kΩ 5% carbon film
	R2	80. 5268	39kΩ 5% carbon film
	R3	80. 5264	18kΩ 5% carbon film
	R4	80. 5261	10kΩ 5% carbon film
	R5	80. 5261	10kΩ 5% carbon film
	R6	80. 52xx	Adjusted
	R7	80. 5253	2.2kΩ 5% carbon film
	R8	80. 5279	0.33 MΩ 5% carbon film
	R9	80. 5259	6.8kΩ 5% carbon film
	R10	80. 5261	10kΩ 5% carbon film
	R11	80. 5265	22kΩ 5% carbon film

TYPE	NO.	CODE	DATA	
	R12	80. 5262	12kΩ 5% carbon film	1/8W
	R13	89. 5009	15kΩ 20% NTC	0. 6W
	R14	80. 5261	10kΩ 5% carbon film	1/8W
	R15	80. 5264	18kΩ 5% carbon film	1/8W
	R16	80. 5265	22kΩ 5% carbon film	1/8W
	R17	80. 5260	8.2kΩ 5% carbon film	1/8W
	R18	80. 5273	0.1 MΩ 5% carbon film	1/8W
	R19	80. 5273	0.12 MΩ 5% carbon film	1/8W
	R20	80. 5258	5.6kΩ 5% carbon film	1/8W
	R21	80. 5256	3.9kΩ 5% carbon film	1/8W
	R22	80. 5249	1kΩ 5% carbon film	1/8W
	R23	80. 5278	0.2 MΩ 5% carbon film	1/8W
	R24	80. 5270	56kΩ 5% carbon film	1/8W
	R25	80. 5258	5.6kΩ 5% carbon film	1/8W
	R26	80. 5276	0.18 MΩ 5% carbon film	1/8W
	R27	80. 5274	0.12 MΩ 5% carbon film	1/8W
	R28	80. 5261	10kΩ 5% carbon film	1/8W
	R29		Not used	
	R30	80. 5259	6.8kΩ 5% carbon film	1/8W
	R31	80. 5260	8.2kΩ 5% carbon film	1/8W
	R32	80. 5251	1.5kΩ 5% carbon film	1/8W
	R33	80. 5264	18kΩ 5% carbon film	1/8W
	R34	80. 5278	0.27 MΩ 5% carbon film	1/8W
	R35	80. 5261	10kΩ 5% carbon film	1/8W
	R36	80. 5269	47kΩ 5% carbon film	1/8W
	R37	80. 5253	2.2kΩ 5% carbon film	1/8W
	R38	80. 5264	18kΩ 5% carbon film	1/8W
	R39	80. 5276	0.18 MΩ 5% carbon film	1/8W
	R40	80. 5261	10kΩ 5% carbon film	1/8W
	R41	80. 5261	10kΩ 5% carbon film	1/8W
	R42	80. 5261	10kΩ 5% carbon film	1/8W
	R43	80. 5276	0.18 MΩ 5% carbon film	1/8W
	R44	80. 5250	1.2kΩ 5% carbon film	1/8W
	R45	80. 5264	18kΩ 5% carbon film	1/8W
	R46	80. 5276	0.18 MΩ 5% carbon film	1/8W
	R47	80. 5261	10kΩ 5% carbon film	1/8W
	R48	80. 5262	12kΩ 5% carbon film	1/8W
	R49	80. 5261	10kΩ 5% carbon film	1/8W
	R50	80. 5261	10kΩ 5% carbon film	1/8W
	R51	80. 5261	12kΩ 5% carbon film	1/8W
	R52	80. 5226	12Ω 5% carbon film	1/8W
	R53	80. 5251	1. 5Ω 5% carbon film	1/8W

SEQUENTIAL TONE RECEIVER  
SEKVENSTONEMODTAGER

SR785a

X401. 963

**Storno**

TYPE	NO.	CODE	DATA
R54	80.5253	2.2kΩ	5% carbon film
R55	80.5258	5.6kΩ	5% carbon film
R56		Not used	
R57	80.5251	1.5kΩ	5% carbon film
R58	80.5251	1.5kΩ	5% carbon film
R59	80.5269	47kΩ	5% carbon film
R60	80.5061	10kΩ	5% carbon film
R61	80.5268	39kΩ	5% carbon film
R62	80.5268	39kΩ	5% carbon film
R63	27kΩ	5% carbon film	
R64	80.5268	39kΩ	5% carbon film
R65	80.5263	15kΩ	5% carbon film
R66	80.5265	22kΩ	5% carbon film
R67	80.5268	39kΩ	5% carbon film
R68	80.5257	4.7kΩ	5% carbon film
R69	80.5257	4.7kΩ	5% carbon film
R70	80.5246	680Ω	5% carbon film
R71	80.5261	10kΩ	5% carbon film
R72	80.5255	3.3kΩ	5% carbon film
R73	80.5253	2.2kΩ	5% carbon film
R74	80.5261	10kΩ	5% carbon film
R75	80.5246	680Ω	5% carbon film
R76	80.5246	680Ω	5% carbon film
R77	80.5261	10kΩ	5% carbon film
L1	61.1259	Tone coil	
E1	99.5237	1N4148 Diode	
E2	99.5237	1N4148 Diode	
E3	99.5237	1N4148 Diode	
E4	99.5237	1N4148 Diode	
E5	99.5237	1N4148 Diode	
E6	99.5237	1N4148 Diode	
E7	99.5237	1N4148 Diode	
E8	99.5237	1N4148 Diode	
Q1	99.5143	BC108 Transistor	
Q2	99.5143	BC108 Transistor	
Q3	99.5144	S5144 Transistor	
Q4	99.5201	BC109 Transistor	
Q5	99.5201	BC109 Transistor	
Q6	99.5201	BC109 Transistor	
Q7	99.5201	BC109 Transistor	
Q8	99.5201	BC109 Transistor	
Q9	99.5143	BC108 Transistor	
Q10	99.5143	BC108 Transistor	
Q11	99.5144	S5144 Transistor	
Q12	99.5143	BC108 Transistor	

**Storno**

TYPE	NO.	CODE	DATA
	Q13	99.5143	BC108 Transistor
	Q14	99.5143	BC108 Transistor
	IC1	14.5017	Operational Amplifier
	IC2	14.5017	Operational Amplifier
	IC3	14.5019	Quadruple comparator
	IC4	14.5018	Quadruple 2-input pos. NOR Gate
	IC5	14.5018	Quadruple 2-input pos. NOR Gate
	IC6	14.5008	Dual J-K master-slave Flip-Flop
	IC7	14.5008	Dual J-K master-slave Flip-Flop
	IC8	14.5056	Dual J-K master-slave Flip-Flop
	IC9	14.5055	Voltage regulator

SEQUENTIAL TONE RECEIVER  
SEKVENSTONEMODTAGER

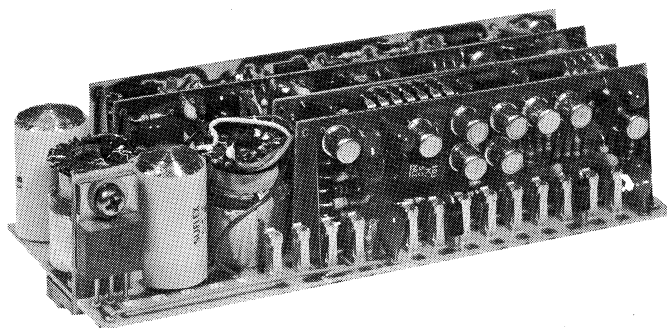
SR785a

X401.963



## SEQUENTIAL TONE RECEIVER

### SR7841



### Introduction

SR7841 is a sequential tone receiver for selective calling. It was developed for use in Storno-phone 700 radiotelephone equipment. The frequencies employed are the standard Storno series: 970 Hz to 2800 Hz.

The SR7841 tone receiver can be coded for any of the following operating modes:

- 4 or 5 tones, individual call, only
- 4 or 5 tones, including one group call digit
- 4 or 5 tones, including two group call digits

### General Description

#### Individual Call

Upon reception of a signal having the correct tones in the proper sequence the following events take place (in the receiver):

The Call Lamp lights, the AF Muting is cancelled and the Key Lock function "unlocks". When the vehicle's traffic horn is connected to the tone receiver via an auxiliary relay, the horn will also sound for about one second.

The audio circuit and the Key Lock are both turned on and off manually by means of the LS

IN / OUT push button. Since the switch that "unlocks" the Key Lock also turns on the loudspeaker, the operator is forced to check for the presence of another signal on the channel before being able to key his transmitter.

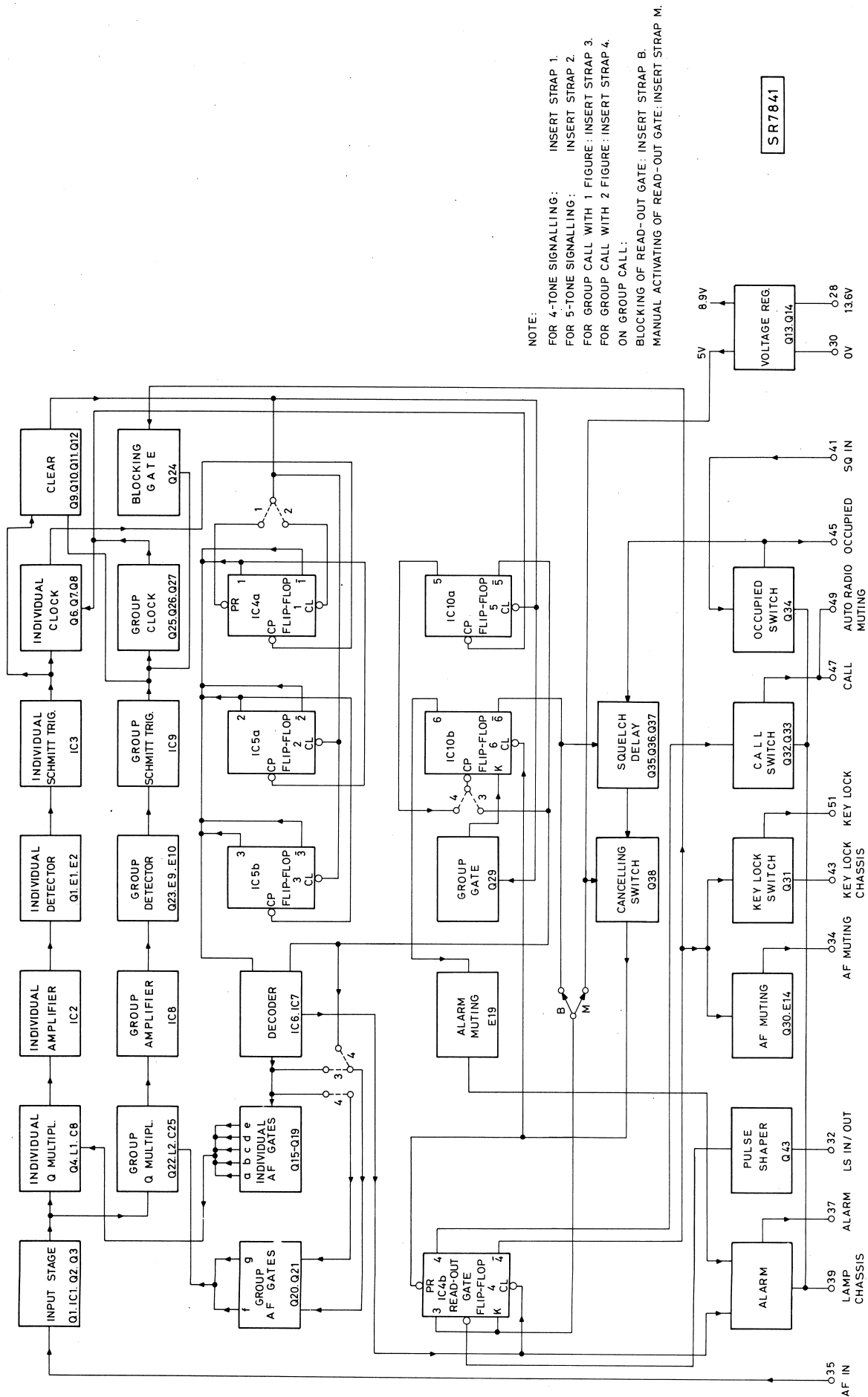
In addition, the tone receiver is equipped with an Occupied Lamp controlled by the squelch circuit in the radiotelephone receiver. Thus, if an RF signal having that channel's frequency is present at the antenna input it will cause the Occupied Lamp to light as an indication that the channel is not free.

At the end of a call the Call Lamp, governed by the receiver Squelch, goes out when the carrier disappears.

After reception of a correct call the speaker will remain open until the LS IN / OUT button is depressed.

#### Group Call

Group calls do not activate the Alarm circuit. Also, the loudspeaker becomes automatically muted again at the end of a group call.



### Logic Terms

Positive logic is employed in SR7841; logical references are:

1. low voltage level ( $\sim 0V$ ) = logic state "0" (LO)
2. high voltage level ( $\sim 5V$ ) = logic state "1" (HI)

## Mode of Operation

### 5-tone Individual Signalling

The Input Stage includes Q1, IC1, Q2 and Q3.

The first tone of a sequential tone signal, arriving from input terminal 35, passes through the input stage, where it becomes suitable for applying to the Q Multiplier.

In stand by the Q Multiplier is tuned, via Individual AF Gate a, for the first tone of its code. If the first tone received corresponds to the circuit resonant frequency, it becomes selected, is then amplified in IC2 and rectified at the Detector, Q5, E1, and E2.

The rectified signal turns the Individual Schmitt Trigger, IC3, ON. The output of IC3 becomes logic "1" and suspends the Clear function (Q9 - Q12). Individual Counters FF1 to FF3 and Group Counter FF5 are then ready to count.

A 25 ms delay is introduced between the time that the Schmitt Trigger output becomes logic "1" and the clock pulse from the Clock stage goes "1". When the 1st tone ends, the Schmitt Trigger output goes "0" again, bringing the Clock output to logic "0". Counter FF1 then switches state, also causing the Decoder (IC6 and IC7) to step to the next AF Gate, which is b.

The output of the Clear stage remains at logic "1" for about 40 ms after the Schmitt Trigger has returned to "0". The next (2nd) 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 to receive the 1st tone again.

The 2nd, 3rd, 4th, and 5th tones of a sequence occur like the 1st, each time stepping the Decoder one position forward until the final tone is received. At the end of the 5th tone the IC7<sub>c</sub> output goes "0" which causes the Alarm circuit to ground terminal 37. A relay connected here will sound the traffic horn for approximately 1 second.

IC7<sub>c</sub> also clears the Read-out Gate, FF4. This lights the Call Lamp via FF4 output 4 and terminal 47 while turning the speaker ON via output 4 and terminal 34.

The Call Lamp and the speaker will remain ON until switched OFF manually with the LS IN/OUT push button (via terminal 32).

When the channel is occupied (a carrier wave being received) the receiver squelch circuit feeds a DC voltage to terminal 41 (SQUELCH IN). The Occupied Lamp lights via terminal 45.

The Key Lock disables the transmitter via terminal 51. The voltage regulator will only supply power to the transmitter section when terminal 51 (KEY LOCK) from SR7841 is at chassis ground potential.

Conditions for transmitting are:

- AF Muting cancelled (term. 34 LO)
- Call Lamp ON (term. 47 to ground)
- Key Lock cancelled (term. 51 to ground)

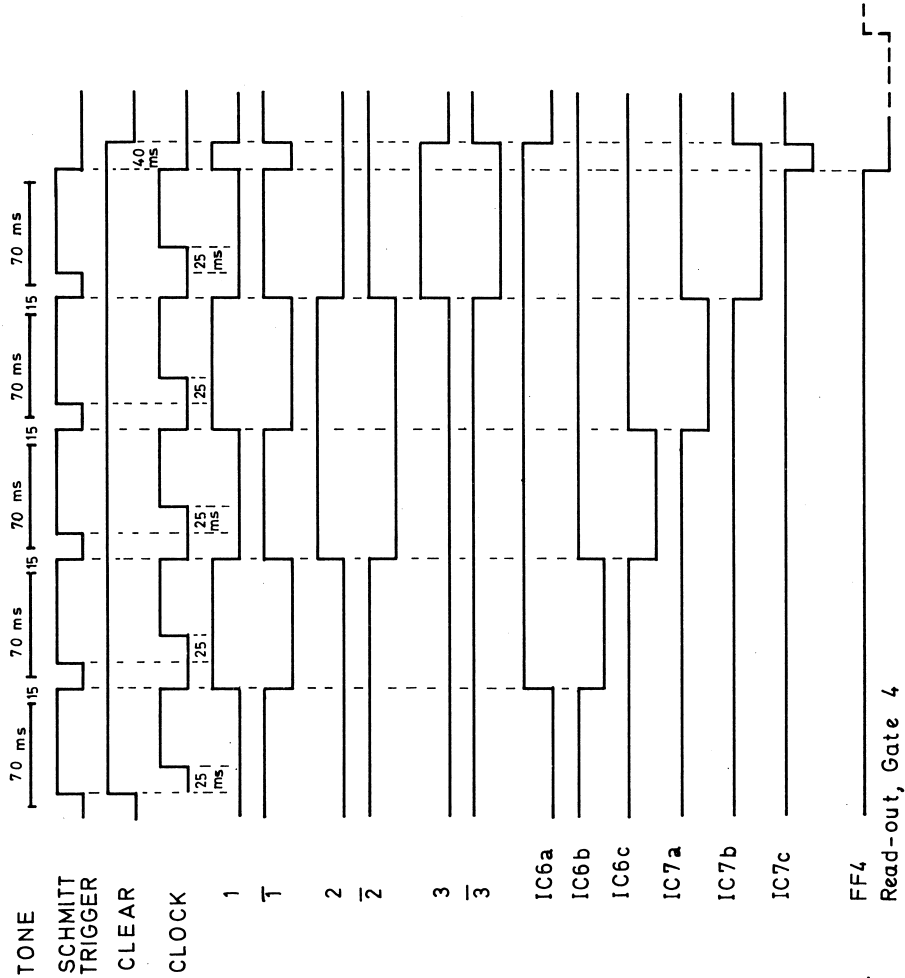
Approximately 40 ms after the last tone in the sequence, the Clear output goes "0", clearing Counter FF1 - FF3. AF Gate a is then set to wait for the 1st tone of a new call.

### 4-tone Signals

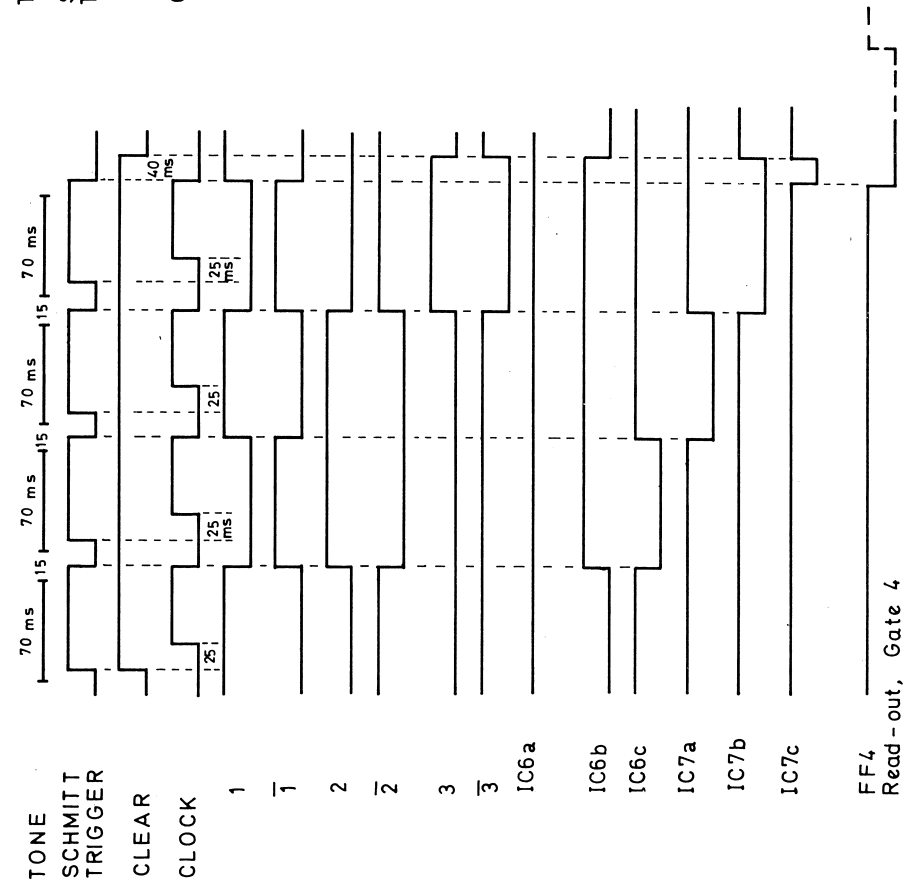
SR7841 can also be strapped for 4-tone code signalling. The Clear output will then preset FF1 to switch in AF Gate b when in stand by, thus bypassing Gate a.

Pulse sequences for 4 and 5-tone signals follow:

5-TONE PULSE SEQUENCE



4-TONE PULSE SEQUENCE



### Group Calls, One Group Digit

The first 4 tones of a 5-tone signal take place just as described for individual calling. Now the receiver is ready for the final tone (digit).

Preparing for the final digit, AF Gate e sets coil L1 for the frequency that would normally be the 5th tone of the sequence. At the same time, AF Gate g sets coil L2 for the group tone. The two Q Multiplier inputs are parallel connected.

If the incoming tone has the frequency for an individual call the Individual Q Multiplier will respond, resulting in a normal individual call. However, if the 5th tone matches the group digit frequency the Group Q Multiplier will respond.

The chain of circuits consisting of the Group Q Multiplier, Group Amplifier, Group Detector, Group Schmitt Trigger, and Group Clock are identical with the Individual chain.

The signal proceeds through the Group chain to the output of the Group Schmitt Trigger. The trigger output goes "1", so the Clear circuit function will still be suspended and Individual Counters FF1 - FF3 as well as Group Counter FF5 can count.

After the 25 ms delay the Group Clock output goes "1". The Group Clock drives the Individual Clock via transistor Q28, forcing the Individual Clock output to follow the Group Clock Output; i.e. when the Group Clock output goes logic "1", so does the Individual Clock output.

When the 5th tone ends, the output of the Group Schmitt Trigger goes "0". The Group Counter toggles and reads:

output  $\bar{5}$  = "0"  
output 6 = "1"  
output  $\bar{6}$  = "0"

The k input of FF6 receives its signal from the Group Gate, Q29. Since Q29's base is driven by the Clear output, FF6 input k is held at logic level "0" as long as the Clear output is at logic "1". The j input is tied to logic "1" through R86.

The FF6 outputs do not change state when the group call ends, but remain at:

6 = "1"  
 $\bar{6}$  = "0"

until the carrier falls away and a cancelling pulse clears FF6.

Decoder IC7<sub>c</sub> goes "0" at the end of the last tone, clearing Read-out Gate FF4: 4 = "0"  
 $\bar{4}$  = "1"

Approx. 40 ms later, the Clear output returns to "0".

The Call Lamp lights and the AF Muting is cancelled (terminals 34 and 47 grounded). The Alarm, however, does not go ON for a group call as the logic "1" at FF6 output 6 keeps Q41 ON (and Q42 OFF).

Individual Counter FF1 - FF3 and Group Counter FF5 clear.

AF Gate a is set for a new call.

When an RF carrier is occupying the channel, Q34 holds terminal 45 (OCCUPIED) at chassis ground potential and Q36 is held OFF through E16. In the case of a group call, FF6 output  $\bar{6}$  goes "0" after the last digit is received and the L0 signal holds Q35 OFF. Collector of Q35 tends to go H1, but Q34 and E16 prevent this.

When the RF carrier disappears terminal 45 goes H1, reverse biasing E16; with Q35 OFF, Q36 and Q37 can go ON, sending a positive pulse to Q38 whose collector then goes L0, presetting FF4.

output 4 goes "1"  
output  $\bar{4}$  goes "0"

The Call Lamp turns OFF and the AF Muting ON.

The negative pulse from Q38 also clears FF6.

output 6 goes "0"  
output  $\bar{6}$  goes "1"

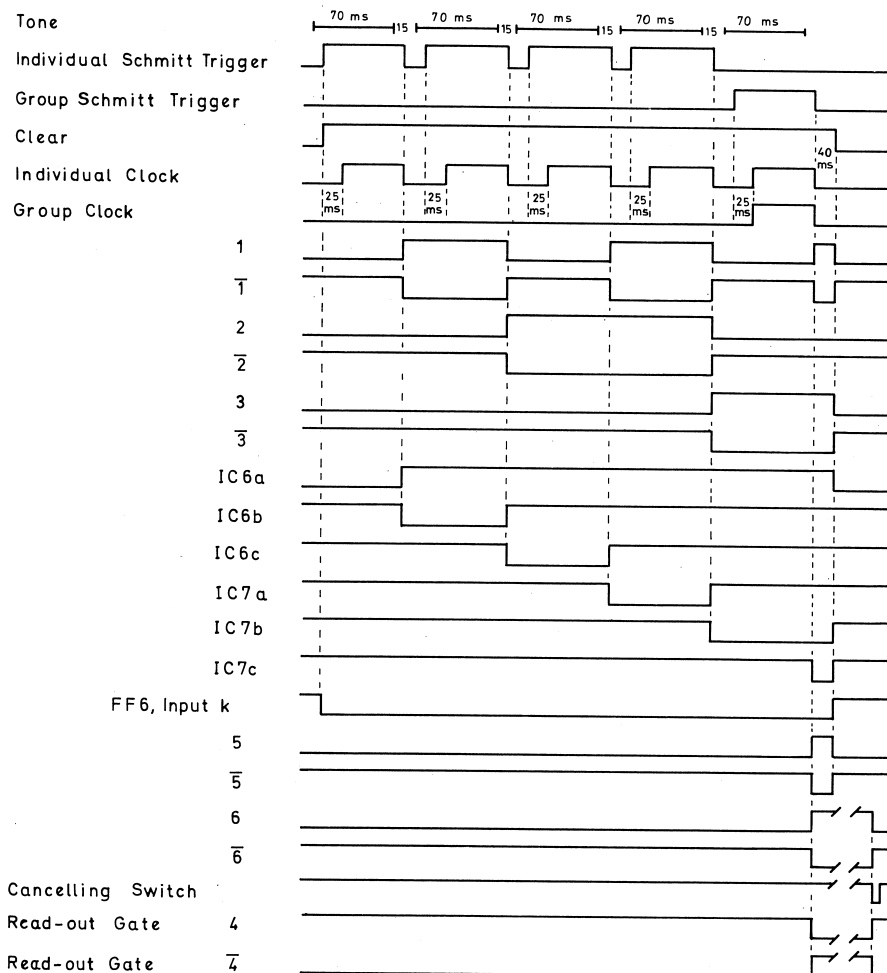
A delay of about 300 ms is introduced in order to avoid possible problems due to fading.

The tone receiver is now ready for a new call.

Pulse sequences for 5-tone signals with one group digit are as follows:

## SR7841

## PULSE SEQUENCE, 5 Tones with 1 Group Digit

Group Call, Two Group Digits

The first 3 tones of a 5-tone signal take place just as described for individual calling. Now the receiver is ready for the fourth tone (digit). Notice the change between strapping lugs 3 and 4.

AF Gate d sets coil L1 for the frequency that would normally be the 4th tone of the sequence. At the same time, AF gate f sets coil L2 for the first group tone.

If the last two tones have the same frequencies as the 4th and 5th tone of the individual code, the result will be a normal individual call. However, if they have the group digit frequencies, the Group Q Multiplier will respond to them.

The Group circuits take over from the Individual circuits; the Group Schmitt Trigger drives the Clear circuit and the Group Clock. The Individual Clock follows the Group Clock, as just described in the preceding section.

When the 4th tone ends, IC7<sub>a</sub> goes "1", inhibiting AF Gates d and f. FF5 output  $\bar{5}$  will be at logic state "0", inhibiting Decoder IC7<sub>b</sub> and thereby also AF Gate e (which only functions for individual calls).

The logic "0" from output  $\bar{5}$  is also present at the base of Q21, so AF Gate g is open for the 2nd group digit (5th tone of the sequence).

When the final tone ceases FF6 outputs go:

output 6 = "1"

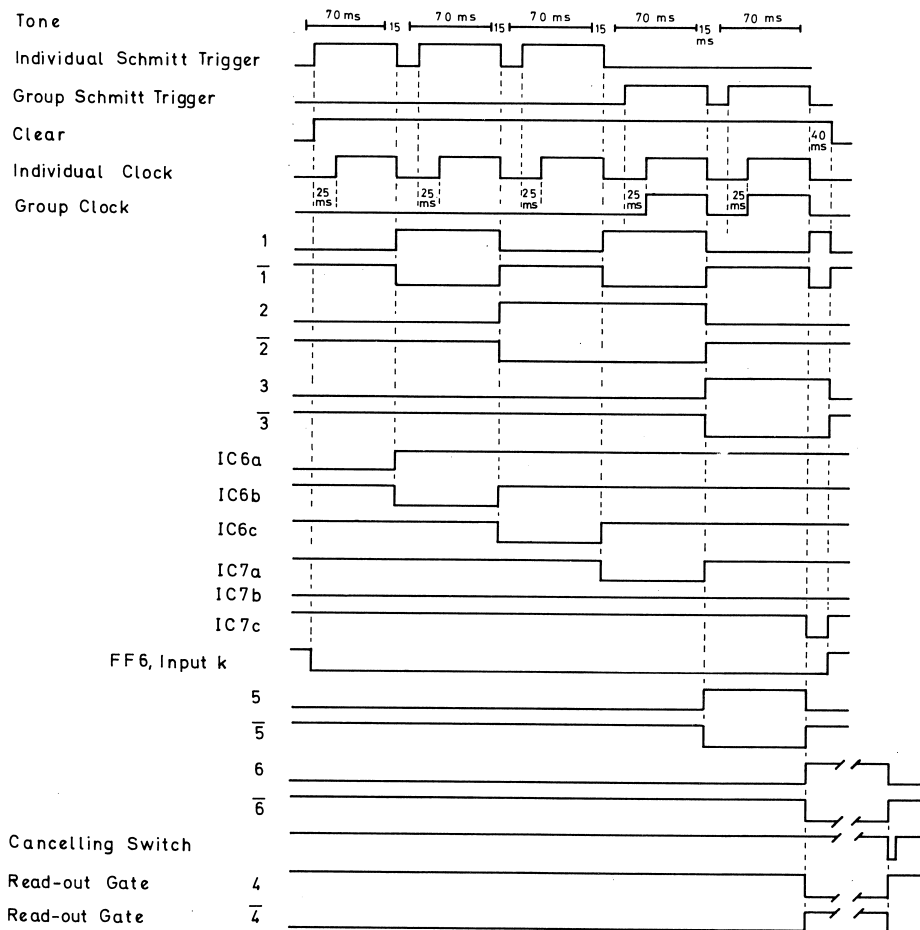
output  $\bar{6}$  = "0"

Clearing circuit action, Alarm suspension as well as clearing and resetting of the Counters, Read-out Gate, AF Gates, etc. all occur as previously described in the section on group calling with only one group digit.

Pulse sequences for 5-tone signals with two group digits are as follows:

## SR7841

PULSE SEQUENCE, 5 Tones with 2 Group Digits



## Circuit Description

### Input Stage (Q1, IC1, Q2, Q3)

The pre-emphasis network includes Q1, R4, and C4.

IC1 is a linear amplifier. Signal clipping begins when the signal amplitude approaches the supply voltage level (5 V). Full amplitude limiting occurs when the input signal is 6 dB above the nominal 110 mV value.

R5 and R8 determine the amplifier gain. Voltage divider R6 and R7 sets the DC output level.

The limiting action and the narrow pass-band of the subsequent Q Multiplier ensure selectivity. Tones differing by at least 4.5% from the resonant frequency will not be able to trigger the tone receiver.

Transistors Q2 and Q3 are arranged so that they present an extremely low output impedance (on the order of  $1 \Omega$ ) which is suitable as a common return connection for the resonant circuit in the following stage.

### Individual Q Multiplier (Q4)

The Q Multiplier involves a parallel resonant circuit, L1 and C8. This is very loosely coupled to the transistor, Q4, in order to maintain a constant Q over the entire tone range. C8 in the resonant circuit is grounded through the output impedances of the driver transistors while the relevant terminals of coil L1 are alternately grounded through the AF Gates, a - e (Q15 - Q19)

A portion of the tone signal is reapplied to L1 in phase by means of a feedback winding in the collector circuit of Q4, approximately doubling the Q of L1.

To offset the effect of temperature upon the Q of L1 an NTC resistor, R19, is inserted in the emitter circuit of Q4. R19, aided by R17 and R18, maintains a nearly flat temperature response from  $-30^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$ . The Group Q Multiplier (Q22) is identical with the Individual Q Multiplier.

Individual Amplifier (IC2)

The signal from the Q Multiplier is DC coupled to the non-inverting input of IC2. Amplifier gain, and thus trigger level for the Schmitt Trigger, is adjustable by changing the value of R20. The Group Amplifier (IC8) is identical with the Individual Amplifier.

Individual Detector (Q5, E1, E2)

Emitter follower Q5 drives the voltage doubling rectifier circuit. The Group Detector (Q23, E9, E10) is identical with the Individual Detector.

Individual Schmitt Trigger (IC3)

The Schmitt Trigger is an operational amplifier working as a threshold detector to control the Clock and the Clear settings. The threshold voltage is set by network R29, E3, and R30.

In stand by the state of the non-inverting input is logic "0", thus the trigger output is also "0". When the rectified DC voltage from the Detector surpasses the threshold the Schmitt Trigger switches state and the output goes "1". The Group Schmitt Trigger (IC9) is identical with the Individual Schmitt Trigger.

Individual Clock (Q6, Q7, Q8)

The Individual Clock toggles Counter FF1 after first introducing a 25 ms delay in order to prevent erratic operation. The Clock output pulse is delayed until the Schmitt Trigger has displayed a logic "1" output state for approx. 25 ms. Delay time is adjustable by means of R35.

In stand by the output state of IC3 is "0", holding Q6, Q7, and Q8 ON. Clock output is also "0". When IC3 triggers, its output goes logic "1". This cuts off Q6, and C16 begins charging through R34 in parallel with R35. After the set delay time, Q7 becomes reverse biased and cuts off, turning Q8 OFF. Clock output at the collector of Q8 goes "1".

When the tone ends, the Schmitt Trigger returns to its quiescent state and Q6 goes ON and C16 discharges rapidly through Q6 and R36, turning Q7, then Q8 ON. Clock output switches to logic state "0" and FF1 toggles.

Group Clock (Q25 - Q27)

The Group Clock toggles Group Counter FF5. Circuit operation, including the 25 ms delay, is the same as for the Individual Clock.

Q28 drives the Individual Clock so that its output follows the output of the Group Clock. When the collector of Q27 (Group Clock output) goes HI, Q28 conducts, grounding the base of Q8 whose collector (Individual Clock output) goes HI.

Clear Circuit (Q9 - Q12, E5, E6, E13)

The Clear circuit sets the Counter to stand by approx. 40 ms after the last correct tone arrives. Where the tone code is correct for the receiver setting the last tone will, of course, be the 5th tone (4th tone with 4-tone signalling). In the event of an incorrect tone code, the tone receiver will respond normally until one of the tones in the false sequence fails to match the resonant frequency set up by the AF Gates. Since each tone lasts for about 70 ms, the Clear circuit will have reset the Counter to stand by before the incorrect tone expires and prior to the arrival of the next tone.

Emitter follower Q9 is driven by the Schmitt Trigger outputs through diode E5 or through E13. In stand by, E5 (E13) cannot conduct, and Q9 is OFF. Q10, Q11, and Q12 are all ON, and output is at logic "0".

When one of the Schmitt Trigger outputs goes "1", E5 or E13 conducts, turning Q9 ON. C18 discharges through Q9, whereby Q10, Q11, and Q12 go OFF (output state "1"). The Counter is now able to start counting.

At the end of a tone E5 (E13) stops conducting (trigger output at "0" again) and C18 charges through R42 and R43. The charge building up on C18 eventually overcomes the emitter bias and turns Q10 ON. Emitter voltage for Q10, and thus the time elapsing before the Clear circuit returns to its quiescent state, is determined by voltage divider R45 and R46. When Q10 conducts, it turns Q11 and Q12 ON, as well, resetting the counter to stand by.



The 40 ms delay is measured as the time elapsed between the Schmitt Trigger output "0" and when the Clear output goes "1".

Tones in a sequence arrive with maximum 15 ms interval between them, which is fast enough to keep the Clear output at "1".

When battery voltage is initially applied to the circuit a positive pulse is fed through E6 to the base of Q11, driving Q12 into saturation and ensuring that the Counter is cleared and ready to accommodate an incoming call.

#### Individual Counter FF1 - FF3 (IC4<sub>a</sub>, IC5<sub>a</sub>, IC5<sub>b</sub>)

The Individual Counter is composed of three J-K master-slave flip-flops with their J-K inputs all tied to logic state "1" through resistor R87. Each FF will thus toggle whenever it receives a clock pulse at the same time that its Clear input is held at "1". The Clock stage toggles FF1, FF1 toggles FF2, and FF2 toggles FF3.

FF1 has a Preset as well as a Clear function, allowing the tone receiver to be strapped to either 4-tone or 5-tone sequences.

Truth tables for these two models follow:

#### Truth Table for the Individual Counter

<u>5-tone</u>	<u>1</u>	<u><math>\bar{1}</math></u>	<u>2</u>	<u><math>\bar{2}</math></u>	<u>3</u>	<u><math>\bar{3}</math></u>
Cleared (pending call)	0	1	0	1	0	1
After first tone	1	0	0	1	0	1
After second tone	0	1	1	0	0	1
After third tone	1	0	1	0	0	1
After fourth tone	0	1	0	1	1	0
After fifth tone	1	0	0	1	1	0
40 mS after last tone (cleared, pending call)	0	1	0	1	0	1

<u>4-tone</u>	<u>1</u>	<u><math>\bar{1}</math></u>	<u>2</u>	<u><math>\bar{2}</math></u>	<u>3</u>	<u><math>\bar{3}</math></u>
Preset (pending call)	1	0	0	1	0	1
After first tone	0	1	1	0	0	1
After second tone	1	0	1	0	0	1
After third tone	0	1	0	1	1	0
After fourth tone	1	0	0	1	1	0
40 mS after last tone (cleared, pending call)	1	0	0	1	0	1

The truth table for group calls will be similar.

#### Group Counter FF5 - FF6 (IC10<sub>a</sub>, IC10<sub>b</sub>)

The Group Counter comprises two J-K master-slave flip-flops which are coupled quite similarly to FF1 - FF3 in the Individual Counter except that the K input of FF6 is controlled by Group Gate Q29.

#### Group Gate (Q29) and Blocking Gate (Q24)

These two gates prevent inadvertent cancelling of the group call set-up when or if the group call tone sequence is retransmitted.

During the tone signalling sequence, inverter Q29 holds the FF6 K input at logic state "0" to inhibit the Counter from switching output states and thus cancelling the call set-up.

After the group call is set up, Q24 will be held ON by FF4 output  $\bar{4}$ . The logic "1" level at this output turns Q24 ON, placing a short circuit across the Group Schmitt Trigger output so that no new group signal can reach the clock circuits.

The Blocking Gate has another function; when the loudspeaker is turned ON, an incoming group call must not be able to interrupt the connection. Since FF4 output  $\bar{4}$  is at logic state "1" whenever the speaker is ON (as when a call comes through or when set up by the LS IN / OUT push button via terminal 32), Q24 short circuits the Group Schmitt Trigger as just explained.

#### Truth Tables for Group Counter

<u>One Group Digit</u>	<u>5</u>	<u><math>\bar{5}</math></u>	<u>6</u>	<u><math>\bar{6}</math></u>
Cleared (pending call)	0	1	0	1
After first tone	1	0	1	0
40 ms later (Clear circuit output returns to "0")	0	1	1	0
300 ms after carrier disappears (Squelch Delay triggers Cancelling Switch)	0	1	0	1

<u>Two Group Digits</u>	<u>5</u>	<u><math>\bar{5}</math></u>	<u>6</u>	<u><math>\bar{6}</math></u>
Cleared (pending call)	0	1	0	1
After first tone	1	0	0	1
After second tone	0	1	1	0
40 ms later (Clear circuit output returns to "0")	0	1	1	0
300 ms after carrier disappears (Squelch Delay triggers Cancelling Switch)	0	1	0	1

Decoder (IC6, IC7)

Each Decoder IC contains 3 separate, 3-input TTL NAND gates.

The output of a NAND gate is L0 (logic "0") only when all of its inputs are HI (logic "1").

In stand by, 5-tone mode, the output of IC6<sub>a</sub> is always "0". In the 4-tone mode, the output of IC6<sub>b</sub> will be "0", instead.

At the end of a correct tone call IC7<sub>c</sub> presents a logic "0" to the Read-out Gate and to the Alarm circuit. The Alarm output, terminal 37, goes "0" through Q42, but only for individual calls. Group calls do not activate the Alarm circuit.

Individual AF Gates a, b, c, d, e (Q15 - Q19)

The AF Gates are controlled from the Decoder NAND gates, IC6<sub>a</sub> - IC7<sub>b</sub>. When a transistor base is driven L0 (logic "0") by a NAND gate, that transistor will conduct and ground the coil terminal connected to its collector.

Group AF Gates f and g (Q20, Q21)

For tone signals with only one group digit, Q21 is controlled from IC7<sub>b</sub>. Q20 is not connected.

For signals having two group digits, the first Group AF Gate, Q20, is connected in parallel with the fourth Individual AF Gate, Q18. Both gates are driven by IC7<sub>a</sub>. The second (last) Group AF Gate, Q21, is driven directly by FF5 output  $\bar{5}$ .

Alarm Circuit (Q39 - Q42, E18)

In stand by, Q39 is ON and E18 cannot conduct. Q40 and Q41 are both ON, and Q42 is OFF.

A correct call turns Q39 OFF and C46 charges through E18, causing Q40 and Q41 to turn OFF, driving Q42 ON, and connecting terminal 37 (ALARM) to chassis ground.

After approximately 40 ms (the clear delay) IC7<sub>c</sub> goes "1" and turns Q39 ON again. E18 can no longer conduct and C46 discharges through R114. After the delay caused by the time constant of C46 - R114, Q40 and Q41 turn ON and disconnect the Alarm circuit common return through Q42. The Alarm stays ON for approximately 1 second.

Group calls, however, do not activate the Alarm circuit. After receipt of the last group tone, FF6

output 6 goes "1". E19 then conducts, holding Q41 ON, thus Q42 stays cut off.

AF Muting and Key Lock Switch (Q30, Q31, E14)

The AF Muting and the Key Lock are controlled by the output of Read-out Gate IC4<sub>b</sub> (output  $\bar{4}$ ).

In stand by the outputs of Q30 and Q31 are HI ( $\sim +10$  V), E14 conducts and the loudspeaker is muted through terminal 34.

As long as the potential at terminal 51 is HI, the transmitter keying function is also disabled.

When the Read-out Gate is activated, output  $\bar{4}$  goes "1", and Q30 and Q31 conduct, suspending the AF Muting and Key Lock functions.

Call and Occupied Lamp Switches (Q32, Q33, Q34)

The Call Lamp Switch, Q33, lights the Call Lamp by grounding it through terminal 47.

Terminal 49, in parallel with terminal 47, is provided for automatic muting of the vehicle's broadcast band radio, and requires an auxiliary relay.

At the end of a tone sequence, output 4 of FF4 goes "0", cutting Q32 OFF and turning Q33 ON, to complete the common return path for terminals 47 and 49.

Whenever the channel is occupied a DC voltage from the Squelch circuit, via terminal 41, turns Q34 ON, grounding the Occupied Lamp through terminal 45.

Cancelling Switch (Q38)

When the radiotelephone 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 is switched ON, C41 discharges through Q38 which goes ON briefly, presetting the Read-out Gate.

The Cancelling Switch also serves to cancel out the call set-up when a group call expires. Receiving a pulse from the Delay circuit, Q38 then forwards a logic "0" to the preset input of FF4, the Read-out Gate.

Squelch Delay (Q35 - Q37)

Fading can be a problem when receiving a group call. To ensure uninterrupted reception, a time delay of approx. 300 ms is introduced before

allowing the Cancelling Switch to clear down the connection. The delay is measured from the time that terminal 45 goes HI to when Q38 Collector goes L0.

After a group call is set up, FF6 output  $\bar{6}$  goes "0" and Q35 goes OFF. As long as the RF carrier is present, Q34 is still ON and E16 conducts, keeping Q36 OFF. When the carrier disappears, Q34 goes OFF, E16 can no longer conduct, and C39 begins to charge through R98. Approx. 300 ms later, Q36 goes ON, turning Q37 ON. Q37 feeds a positive pulse to Q38, which in turn applies a negative pulse ("0") to the Read-out Gate preset, cancelling the group call.

This same pulse from Q38 also clears FF6, and the tone receiver is ready for a new call.

## Technical Specifications

### Supply Power

Nominal: 13.6 V

Minimum: 10.5 V

Maximum: 16.0 V

### Current Drain

Stand by: 115 mA  $\pm$  15 mA

### Regulated Voltages

Nominal 8.9 V and 4.9 V

### Temperature Range

Operating range:  $-25^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$

Functioning range:  $-30^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$

### Input Impedance

$\geq 6 \text{ K}\Omega$

### Equalization

Preemphasis (by RC function)  $f_c = 1000\text{Hz}$

### Signal Input Level

Nominal at 1000 Hz: 110 mV

### Signalling Code

Sequence of 4 or 5 tone bursts of 70 ms  $\pm$  15 ms duration with maximum 15 ms interval between tone bursts.

### Tone Signal Frequencies

<u>Coil terminal</u>	<u>Tone frequency</u>
1	970 Hz
2	1060 Hz
3	1160 Hz
4	1270 Hz
5	1400 Hz
6	1530 Hz
7	1670 Hz
8	1830 Hz
9	2000 Hz
10	2200 Hz
11	2400 Hz
12	2600 Hz
13	2800 Hz

### Frequency Accuracy

Coil tuned for 1060 Hz:  $\leq 0.4\%$  for all tones

### Frequency Stability

(typically  $\leq 0.5\%$ )  $\leq 1.0\%$

### Selectivity

Frequencies differing from  $f_o$  by 4.5% or more are unable to trigger the tone receiver.

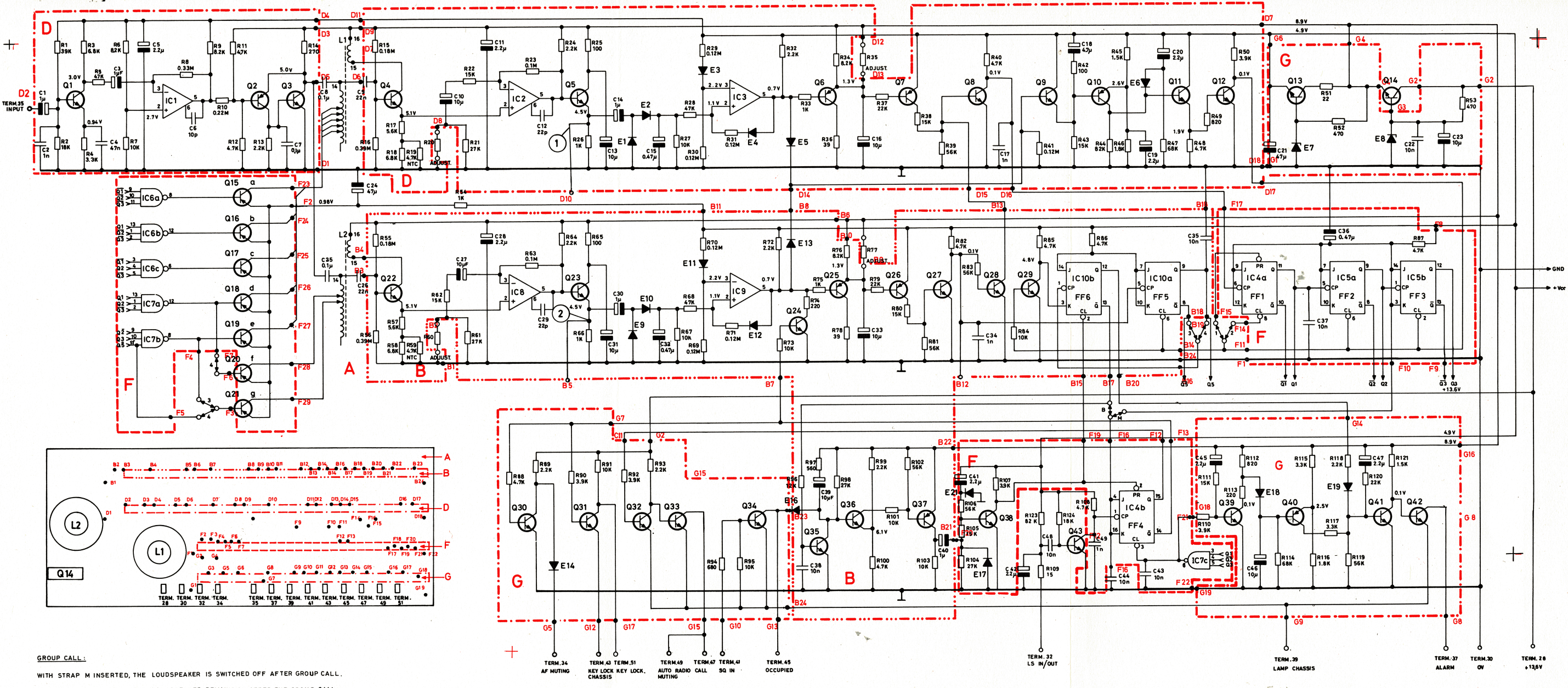
### Maximum Load Currents

Terminal 37	ALARM	100 mA (for 1.2 sec)
Terminal 47	CALL	100 mA
Terminal 45	OCCUPIED	100 mA
Terminal 51		
and 43	KEY LOCK	10 mA
Terminal 34	AF MUTING	$I_{\text{load min.}}$ 0.75 mA for $V_{\text{out}} = 8 \text{ V}$

### AF Muting

In conjunction with  
terminal 18 of CF701:  $\geq 60 \text{ dB}$

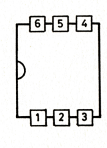
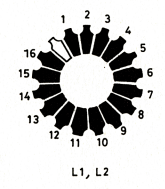




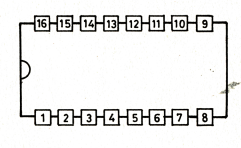
**GROUP CALL:**  
 WITH STRAP M INSERTED, THE LOUDSPEAKER IS SWITCHED OFF AFTER GROUP CALL.  
 WITH STRAP B INSERTED, THE LOUDSPEAKER REMAINS ON AFTER THE GROUP CALL.

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

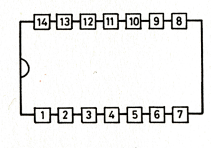
	Vcc PIN	GND PIN
IC1	2	6
IC2	2	6
IC3	2	6
IC4	5	13
IC5	4	11
IC6	14	7
IC7	14	7
IC8	2	6
IC9	2	6
IC10	4	11



IC1, IC2, IC3.  
IC8, IC9



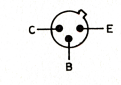
IC4



IC5, IC6, IC7, IC10

TOP VIEW

- 4-TONE SEQUENTIAL RECEIVER: INSERT STRAP 1
- 5-TONE SEQUENTIAL RECEIVER: INSERT STRAP 2
- 4-TONE SEQUENTIAL RECEIVER WITH 1-TONE GROUP CALL: INSERT STRAPS 1 AND 3
- 4-TONE SEQUENTIAL RECEIVER WITH 2-TONE GROUP CALL: INSERT STRAPS 1 AND 4
- 5-TONE SEQUENTIAL RECEIVER WITH 1-TONE GROUP CALL: INSERT STRAPS 2 AND 3
- 5-TONE SEQUENTIAL RECEIVER WITH 2-TONE GROUP CALL: INSERT STRAPS 2 AND 4



Q1, Q3, Q4, Q5, Q8, Q9, Q11, Q12, Q13,  
Q22, Q23, Q24, Q27 - Q39, Q41, Q42.



Q2, Q6, Q7, Q10, Q15 - Q21,  
Q25, Q26, Q35, Q37, Q40.



Q14

BOTTOM VIEW

# SEQUENTIAL TONE RECEIVER SEKVENSTONEMODTAGER

SR7841

D401.706/2



**Storno**

**Storno**

TYPE	NO.	CODE	DATA
SR7841		10. 2456	Sequential Tone Receiver
	C1	73. 5135	1 $\mu$ F -20+50% tantal
	C2	76. 5069	1nF 10% polyester. FL
	C3	73. 5135	1 $\mu$ F -20+50% tantal
	C4	76. 5072	47nF 10% polyester. FL
	C5	73. 5129	2.2 $\mu$ F -20+50% tantal
	C6	74. 5135	10pF 5% ceram
	C7	76. 5070	10nF 10% polyester. FL
	C8	76. 5068	0.1 $\mu$ F 1% polystyren TB
	C9	76. 5071	22nF 10% polyester. FL
	C10	73. 5109	10 $\mu$ F 20% tantal
	C11	73. 5129	2.2 $\mu$ F -20+50% tantal
	C12	74. 5106	22pF $\pm$ 0. 5pF ceram
	C13	73. 5109	10 $\mu$ F 20% tantal
	C14	73. 5114	1 $\mu$ F 20% tantal
	C15	73. 5125	0. 47 $\mu$ F 20% tantal
	C16	73. 5109	10 $\mu$ F 20% tantal
	C17	76. 5069	1nF 10% polyester. FL
	C18	73. 5126	4. 7 $\mu$ F 20% tantal
	C19	73. 5129	2.2 $\mu$ F -20+50% tantal
	C20	73. 5129	2.2 $\mu$ F -20+50% tantal
	C21	73. 5124	47 $\mu$ F 20% tantal
	C22	76. 5070	10nF 10% polyester. FL
	C23	73. 5109	10 $\mu$ F 20% tantal
	C24	73. 5124	47 $\mu$ F 20% tantal
	C25	76. 5068	0. 1 $\mu$ F 1% polystyr TB
	C26	76. 5071	22nF 10% polyester. FL
	C27	73. 5109	10 $\mu$ F 20% tantal
	C28	73. 5129	2.2 $\mu$ F -20/+50% tantal
	C29	74. 5106	22pF $\pm$ 0. 5pF ceram
	C30	73. 5114	1 $\mu$ F 20% tantal
	C31	73. 5109	10 $\mu$ F 20% tantal
	C32	73. 5125	0. 47 $\mu$ F 20% tantal
	C33	73. 5109	10 $\mu$ F 20% tantal
	C34	76. 5069	1nF 10% polyester. FL
	C35	74. 5109	10nF -20/+80% ceram PL
	C36	73. 5134	0. 47 $\mu$ F -20+50% tantal
	C37	74. 5109	10nF -20/+80% ceram PL
	C38	74. 5109	10nF -20/+80% ceram PL
	C39	73. 5109	10 $\mu$ F 20% tantal
	C40	73. 5135	1 $\mu$ F -20/+50% tantal
	C41	73. 5129	2.2 $\mu$ F -20+50% tantal
	C42	73. 5129	2.2 $\mu$ F -20+50% tantal
	C43	74. 5109	10nF -20+80% ceram PL
	C44	74. 5109	10nF -20+80% ceram PL
	C45	73. 5129	2.2 $\mu$ F -20+50% tantal
	C46	73. 5109	10 $\mu$ F 20% tantal

TYPE	NO.	CODE	DATA	
	C47	73. 5129	2. 2 $\mu$ F -20+50% tantal	10V
	R1	80. 5068	39k $\Omega$ 5% carbon film	0. 1W
	R2	80. 5064	18k $\Omega$ 5% carbon film	0. 1W
	R3	80. 5059	6. 8k $\Omega$ 5% carbon film	0. 1W
	R4	80. 5055	3. 3k $\Omega$ 5% carbon film	0. 1W
	R5	80. 5069	47k $\Omega$ 5% carbon film	0. 1W
	R6	80. 5060	8. 2k $\Omega$ 5% carbon film	0. 1W
	R7	80. 5061	10k $\Omega$ 5% carbon film	0. 1W
	R8	80. 5079	0. 33M $\Omega$ 5% carbon film	0. 1W
	R9	80. 5060	8. 2k $\Omega$ 5% carbon film	0. 1W
	R10	80. 5077	0. 22M $\Omega$ 5% carbon film	0. 1W
	R11	80. 5057	4. 7k $\Omega$ 5% carbon film	0. 1W
	R12	80. 5057	4. 7k $\Omega$ 5% carbon film	0. 1W
	R13	80. 5053	2. 2k $\Omega$ 5% carbon film	0. 1W
	R14	80. 5042	270 $\Omega$ 5% carbon film	0. 1W
	R15	80. 5076	0. 18M $\Omega$ 5% carbon film	0. 1W
	R16	80. 5080	0. 39M $\Omega$ 5% carbon film	0. 1W
	R17	80. 5058	5. 6k $\Omega$ 5% carbon film	0. 1W
	R18	80. 5059	6. 8k $\Omega$ 5% carbon film	0. 1W
	R19	89. 5009	4. 7k $\Omega$ 20% NTC	0. 6W
	R20	80. 50xx	Adjusted 5% carbon film	0. 1W
	R21	80. 5066	27k $\Omega$ 5% carbon film	0. 1W
	R22	80. 5063	15k $\Omega$ 5% carbon film	0. 1W
	R23	80. 5073	0. 1M $\Omega$ 5% carbon film	0. 1W
	R24	80. 5053	2. 2k $\Omega$ 5% carbon film	0. 1W
	R25	80. 5037	100 $\Omega$ 5% carbon film	0. 1W
	R26	80. 5049	1k $\Omega$ 5% carbon film	0. 1W
	R27	80. 5061	10k $\Omega$ 5% carbon film	0. 1W
	R28	80. 5069	47k $\Omega$ 5% carbon film	0. 1W
	R29	80. 5074	0. 12M $\Omega$ 5% carbon film	0. 1W
	R30	80. 5074	0. 12M $\Omega$ 5% carbon film	0. 1W
	R31	80. 5074	0. 12m $\Omega$ 5% carbon film	0. 1W
	R32	80. 5053	2. 2k $\Omega$ 5% carbon film	0. 1W
	R33	80. 5049	1k $\Omega$ 5% carbon film	0. 1W
	R34	80. 5060	8. 2k $\Omega$ 5% carbon film	0. 1W
	R35	80. 50xx	Adjusted 5% carbon film	0. 1W
	R36	80. 5032	3 $\Omega$ 5% carbon film	0. 1W
	R37	80. 5065	22k $\Omega$ 5% carbon film	0. 1W
	R38	80. 5063	15k $\Omega$ 5% carbon film	0. 1W
	R39	80. 5070	56k $\Omega$ 5% carbon film	0. 1W
	R40	80. 5057	4. 7k $\Omega$ 5% carbon film	0. 1W

**SEQUENTIAL TONE RECEIVER**  
**SEKVENSTONEMODTAGER**

**SR7841**

X401. 695 /2

**Storno**

**Storno**

TYPE	NO.	CODE	DATA	
	R41	80.5074	0.12M $\Omega$ 5%	carbon film
	R42	80.5037	100 $\Omega$ 5%	carbon film
	R43	80.5063	15k $\Omega$ 5%	carbon film
	R44	80.5072	82k $\Omega$ 5%	carbon film
	R45	80.5051	1.5k $\Omega$ 5%	carbon film
	R46	80.5052	1.8k $\Omega$ 5%	carbon film
	R47	80.5071	68k $\Omega$ 5%	carbon film
	R48	80.5057	4.7k $\Omega$ 5%	carbon film
	R49	80.5048	820 $\Omega$ 5%	carbon film
	R50	80.5056	3.9k $\Omega$ 5%	carbon film
	R51	80.5229	22 $\Omega$ 5%	carbon film
	R52	80.5245	470 $\Omega$ 5%	carbon film
	R53	80.5245	470 $\Omega$ 5%	carbon film
	R54	80.5049	1k $\Omega$ 5%	carbon film
	R55	80.5076	0.18M $\Omega$ 5%	carbon film
	R56	80.5080	0.39M $\Omega$ 5%	carbon film
	R57	80.5058	5.6k $\Omega$ 5%	carbon film
	R58	80.5059	6.8k $\Omega$ 5%	carbon film
	R59	89.5009	4.7k $\Omega$ NTC 20%	
	R60	80.50xx	Adjusted 5%	carbon film
	R61	80.5066	27k $\Omega$ 5%	carbon film
	R62	80.5063	15k $\Omega$ 5%	carbon film
	R63	80.5073	0.1M $\Omega$ 5%	carbon film
	R64	80.5053	2.2k $\Omega$ 5%	carbon film
	R65	80.5037	100 $\Omega$ 5%	carbon film
	R66	80.5049	1k $\Omega$ 5%	carbon film
	R67	80.5061	10k $\Omega$ 5%	carbon film
	R68	80.5069	47k $\Omega$ 5%	carbon film
	R69	80.5074	0.12M $\Omega$ 5%	carbon film
	R70	80.5074	0.12M $\Omega$ 5%	carbon film
	R71	80.5074	0.12M $\Omega$ 5%	carbon film
	R72	80.5053	2.2k $\Omega$ 5%	carbon film
	R73	80.5061	10k $\Omega$ 5%	carbon film
	R74	80.5041	220 $\Omega$ 5%	carbon film
	R75	80.5049	1k $\Omega$ 5%	carbon film
	R76	80.5060	8.2k $\Omega$ 5%	carbon film
	R77	80.50xx	Adjusted 5%	carbon film
	R78	80.5032	39 $\Omega$ 5%	carbon film
	R79	80.5065	22k $\Omega$ 5%	carbon film
	R80	80.5063	15k $\Omega$ 5%	carbon film
	R81	80.5070	56k $\Omega$ 5%	carbon film
	R82	80.5057	4.7k $\Omega$ 5%	carbon film
	R83	80.5070	56k $\Omega$ 5%	carbon film
	R84	80.5061	10k $\Omega$ 5%	carbon film
	R85	80.5057	4.7k $\Omega$ 5%	carbon film
	R86	80.5057	4.7k $\Omega$ 5%	carbon film
	R87	80.5057	4.7k $\Omega$ 5%	carbon film
	R88	80.5057	4.7k $\Omega$ 5%	carbon film

TYPE	NO.	CODE	DATA	
	R89	80.5053	2.2k $\Omega$ 5%	carbon film
	R90	80.5056	3.9k $\Omega$ 5%	carbon film
	R91	80.5061	10k $\Omega$ 5%	carbon film
	R92	80.5056	3.9k $\Omega$ 5%	carbon film
	R93	80.5053	2.2k $\Omega$ 5%	carbon film
	R94	80.5047	680 $\Omega$ 5%	carbon film
	R95	80.5061	10k $\Omega$ 5%	carbon film
	R96	80.5062	12k $\Omega$ 5%	carbon film
	R97	80.5046	560 $\Omega$ 5%	carbon film
	R98	80.5066	27k $\Omega$ 5%	carbon film
	R99	80.5053	2.2k $\Omega$ 5%	carbon film
	R100	80.5057	4.7k $\Omega$ 5%	carbon film
	R101	80.5061	10k $\Omega$ 5%	carbon film
	R102	80.5070	56k $\Omega$ 5%	carbon film
	R103	80.5061	10k $\Omega$ 5%	carbon film
	R104	80.5066	27k $\Omega$ 5%	carbon film
	R105	80.5063	15k $\Omega$ 5%	carbon film
	R106	80.5070	56k $\Omega$ 5%	carbon film
	R107	80.5056	3.9k $\Omega$ 5%	carbon film
	R108	80.5057	4.7k $\Omega$ 5%	carbon film
	R109	80.5027	15.2 5%	carbon film
	R110	80.5056	3.9k $\Omega$ 5%	carbon film
	R111	80.5063	15k $\Omega$ 5%	carbon film
	R112	80.5048	820 $\Omega$ 5%	carbon film
	R113	80.5041	220 $\Omega$ 5%	carbon film
	R114	80.5071	68 $\Omega$ 5%	carbon film
	R115	80.5055	3.3k $\Omega$ 5%	carbon film
	R116	80.5052	1.8k $\Omega$ 5%	carbon film
	R117	80.5055	3.3k $\Omega$ 5%	carbon film
	R118	80.5053	2.2k $\Omega$ 5%	carbon film
	R119	80.5070	56k $\Omega$ 5%	carbon film
	R120	80.5065	22k $\Omega$ 5%	carbon film
	R121	80.5051	1.5k $\Omega$ 5%	carbon film
	R123	80.5072	82 K $\Omega$ 5%	carbon film
	R124	80.5064	18 K $\Omega$ 5%	carbon film
	L1	61.1148	Tone coil	
	L2	61.1148	Tone coil	
	E1	99.5237	1N4148 Diode	
	E2	99.5237	1N4148 Diode	
	E3	99.5237	1N4148 Diode	
	E4	99.5237	1N4148 Diode	
	E5	99.5237	1N4148 Diode	

**SEQUENTIAL TONE RECEIVER  
SEKVENSTONEMODTAGER**

**SR7841**

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**Storno**

**Storno**

TYPE	NO.	CODE	DATA
	E6	99. 5237	1N4148 Diode
	E7	99. 5114	5.6V 5% Zenerdiode
	E8	99. 5042	9.1V 5% Zenerdiode
	E9	99. 5237	1N4148 Diode
	E10	99. 5237	1N4148 Diode
	E11	99. 5237	1N4148 Diode
	E12	99. 5237	1N4148 Diode
	E13	99. 5237	1N4148 Diode
	E14	99. 5237	1N4148 Diode
	E16	99. 5237	1N4148 Diode
	E17	99. 5237	1N4148 Diode
	E18	99. 5237	1N4148 Diode
	E19	99. 5237	1N4148 Diode
	Q1	99. 5143	BC108 Transistor
	Q2	99. 5144	BC214L Transistor
	Q3	99. 5743	BC108 Transistor
	Q4	99. 5143	BC108 Transistor
	Q5	99. 5143	BC108 Transistor
	Q6	99. 5144	BC214L Transistor
	Q7	99. 5144	BC214L Transistor
	Q8	99. 5143	BC108 Transistor
	Q9	99. 5143	BC108 Transistor
	Q10	99. 5144	BC214L Transistor
	Q11	99. 5143	BC108 Transistor
	Q12	99. 5143	BC108 Transistor
	Q13	99. 5143	BC108 Transistor
	Q14	99. 5246	TIP31 Transistor
	Q15	99. 5144	BC214L Transistor
	Q16	99. 5144	BC214L Transistor
	Q17	99. 5144	BC214L Transistor
	Q18	99. 5144	BC214L Transistor
	Q19	99. 5144	BC214L Transistor
	Q20	99. 5144	BC214L Transistor
	Q21	99. 5144	BC214L Transistor
	Q22	99. 5143	BC108 Transistor
	Q23	99. 5143	BC108 Transistor
	Q24	99. 5143	BC108 Transistor
	Q25	99. 5144	BC214L Transistor
	Q26	99. 5144	BC214L Transistor
	Q27	99. 5143	BC108 Transistor
	Q28	99. 5143	BC108 Transistor
	Q29	99. 5143	BC108 Transistor
	Q30	99. 5143	BC108 Transistor
	Q31	99. 5143	BC108 Transistor
	Q32	99. 5143	BC108 Transistor

0. 25W  
0. 25W

**SEQUENTIAL TONE RECEIVER  
SEKVENSTONEMODTAGER**

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TYPE	NO.	CODE	DATA
	Q33	99. 5143	BC108 Transistor
	Q34	99. 5143	BC108 Transistor
	Q35	99. 5143	BC108 Transistor
	Q36	99. 5143	BC108 Transistor
	Q37	99. 5144	BC214L Transistor
	Q38	99. 5143	BC108 Transistor
	Q39	99. 5143	BC108 Transistor
	Q40	99. 5144	BC214L Transistor
	Q41	99. 5143	BC108 Transistor
	Q42	99. 5143	BC108 Transistor
	Q43	99. 5117	BC167 Transistor
	IC1	14. 5017	TAA861 Operational Amplifier
	IC2	14. 5017	TAA861 Operational Amplifier
	IC3	14. 5017	TAA861 Operational Amplifier
	IC4	14. 5009	Dual J-K, master slave FF/clear- preset
	IC5	14. 5008	Dual J-K, master slave FF/clear
	IC6	14. 5007	Triple 3-input NAND-gate
	IC7	14. 5007	Triple 3-input NAND-gate
	IC8	14. 5017	TAA861 Operational Amplifier
	IC9	14. 5017	TAA861 Operational Amplifier
	IC10	14. 5008	Dual J-K, master slave FF/clear