

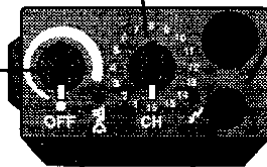
CHANNEL SWITCH 1-16

REMOTE CONTROL

(normally covered with a lid)

ON / OFF

and
volume control



TRANSMIT LED

Red = high power
Green = low power

GREEN LED

slow flash = loudspeaker disabled
quick flash = call received

STANDBY KEY

enables/disables RX/TX.
When disabled, selective
call can still be received.

TONE KEY

If speaker is in standby,
it is opened at the first
press on this key.
At the second press
the call is transmitted.

PUSH TO TALK

ANTENNA

quarterwave
or
helix

TRANSMIT POWER

A press on this key
toggles between high
and low power

MICROPHONE

BATTERY LATCH

push upwards while
turning battery
counter-clockwise.

BATTERY

700 / 350 mAh

TP 4000
portable radio

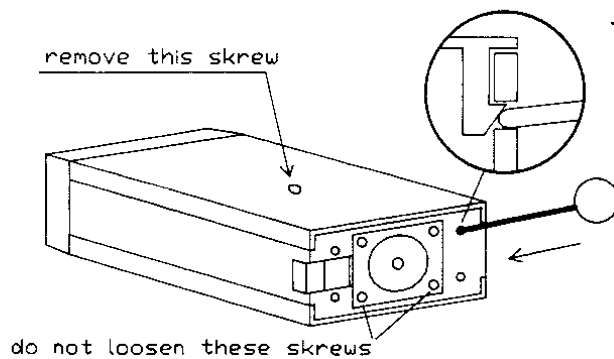


TP RADIO

DENMARK Phone: + 45 42 906048

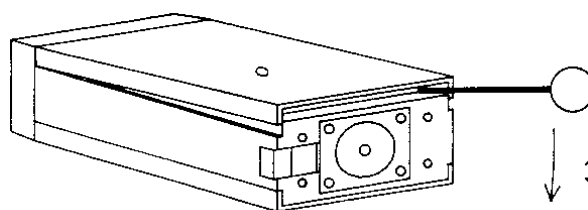
USER INSTRUCTION

DISASSEMBLY

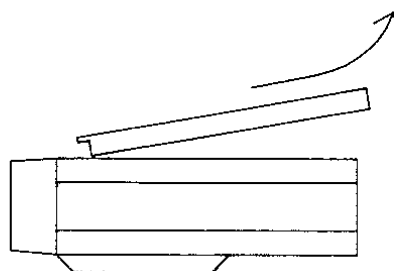


1. Remove the battery

2. Use a thin screwdriver (or similar tool) to release two inside hatches through holes in bottom plate

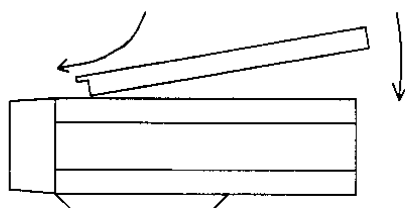


3. Insert tool between cover and bottom plate and lever cover upwards




4. Remove the lid by a turning motion away from the top of the set

ASSEMBLY



1. Push the cover towards the top of the set and click it into place at the bottom end

revision		DISASSEMBLY INSTRUCTION TP4000	scale	date	sign.
				91-07-30	
		 TP RADIO		drawing no.	

TP4705 is a small, light weight, hand-held 2-way communication radio, utilizing the latest synthesizer technology. It conforms to the standards set by the European Post and Telegraph committees (CEPT).

Technical data

General

Frequency range	:	370 - 470 MHz
Number of channels	:	10 (16)
Channel spacing	:	20/25 KHz
Frequency stability	:	+/- 5ppm (-20 to 55 °C)
RF bandwidth	:	15 MHz
Operating temp.	:	-20 to 55 °C
Supply voltage	:	9,6 Volts
Current drain	:	standby 22 mA TX 0,5W 0,5 A TX 5W 1,5 A
Battery capacity	:	standby 33 hours 5% TX (5W) 8 hours 12% TX (0,5W) 8 hours
Dimensions	:	38x63x180 mm (incl. 700mA bat)
Weight	:	500 grams (incl. 700mA bat)

TX

Output power	:	0,5/5 W
Spurious rejection	:	< 0,25 μ W
Max. deviation	:	+/- 4/5 KHz
Audio distortion	:	< 5%

RX

Sensitivity	:	better than 0,7 μ V EMF for 20 dB SINAD(P)
Spurious rejection	:	> 70 dB
Adjacent ch. rejection:	:	> 70 dB
IM rejection	:	>73 dB rel. sensitivity
Audio output power	:	0,5 W (8 ohm speaker 10% dist)

910521

TP4705

1/3

CALCULATING CHANNEL CODES FOR THE PROM

The reference divider ratio is found by using the following formula:

$$\frac{\text{reference x-tal frequency}}{\text{raster frequency} \times 2} = \text{reference divider ratio}$$

example: $\frac{6,4 \text{ MHz}}{0,0125 \times 2} = 256 \text{ (12,5 KHz raster)}$

The reference divider is 11 bits long and needs three 4-bit words when any frequency is programmed.

The N-divider and A-divider

The allowed range of the N-divider is 3 to 1023.
The N-divider is 10 bits long and is programmed with three 4-bit words.

The range of the A-divider is 0 to 127. It is 7 bits long and programmed with two 4-bit words.

The total division ratio N_t is calculated by using:

$$N_t = \frac{F_{vco}}{F_r}$$

where F_r is the raster frequency, normally 12,5 KHz.

We have:

$P = 128$

$N =$ an integer, the division ratio of the N-divider

$A =$ the division ratio of the A-divider

Use the following formulas:

$$N = \frac{N_t}{P} - \frac{A}{P}$$

and

$$A = N_t - (N \times P)$$

2/3

Lets take an example; we wish to find the division ratios for the receiver frequencies $F_{rx} = 460,000$ MHz and $F_{rx} = 461,000$ MHz.

1. Find N_t for channel 1 = 460,000 MHz by using:

$$N_t = \frac{F_{vco}}{F_r} = \frac{460 - 45 \text{ MHz}}{0,0125} = 33200$$

then we use:

$$N = \frac{N_t}{P} - \frac{A}{P} = \frac{33200}{128} - \frac{A}{128} = 259,375 - \frac{A}{P}$$

we take N as the highest integer e.i. $N = 259$
which leads to $A = 33200 - (259 \times 128) = 48$

2. For channel 2 = 461,000 we have:

$$N_t = \frac{461 - 45}{0,0125} = 33280$$

$$N = \frac{33280}{128} - \frac{A}{128} = 260 - \frac{A}{128}$$

If N is taken to be 260, then $A = 0$

These figures must be programmed into the PROM.

A PROM with 256 x 4 bits is used, and the channel architecture is the following:

The full channel information is eight 4-bit words. These 8 words are selected via the addresses A0, A1 and A2. The channel information is pictured below:

Data outputs	D0	D1	D2	D3	word no.
			N0	N1	1
	N2	N3	N4	N5	2
N-divider 10 bits	N6	N7	N8	N9	3
	A0	A1	A2	A3	4
A-divider 7 bits	A4	A5	A6		5
	R0	R1	R2	R3	6
	R4	R5	R6	R7	7
R-divider 11 bits	R8	R9	R10	R11	8

3/3

The PROM is used in the following manner:

PROM address

A0
 A1 > selects the 8 words
 A2

 A3
 A4 > channel selector max 16
 A5
 A6

 A7 > receive /transmit selector

In sets with normally 10 channels maximum, RX channels starts with channel 1, using address no. 8 - 0F, and channel 10 using 0 - 7.

TX channels starts with channel 1, using address 88 - 8F and channel 10, using 80 - 87.

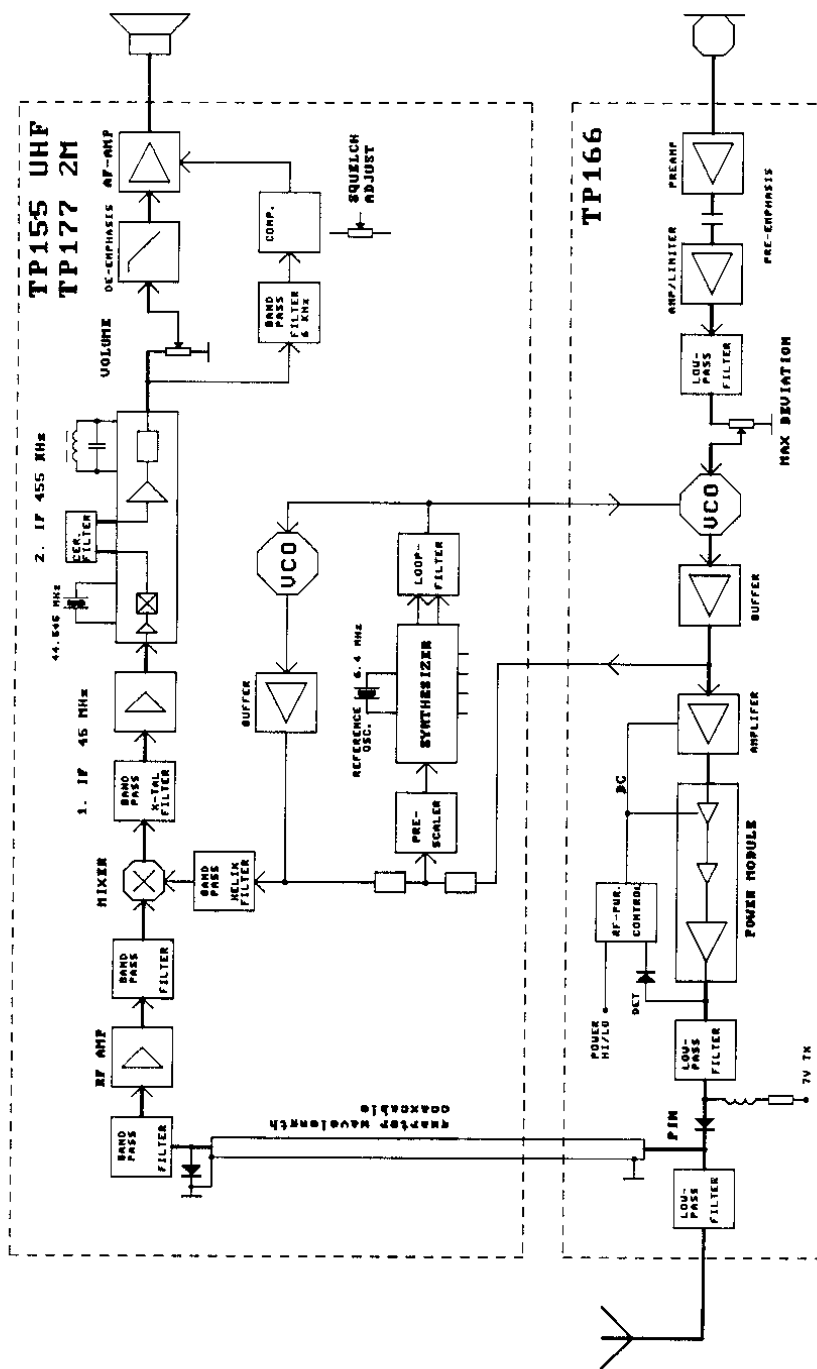
If we use our example and program the two channels, we have channel 1 - RX 460,000 MHz

	0	1	2	3	addr. HEX code	
N-bits			1	1	8	
N-bits	0	0	0	0	9	N = 259
N-bits	0	0	1	0	A	
A-bits	0	0	0	0	B	A = 48
A-bits	1	1	0		C	
R-bits	0	0	0	0	D	
R-bits	0	0	0	0	E	R = 256
R-bits	1	0	0	0	F	

and channel 2 - RX 461,000 MHz

	0	1	2	3	addr. HEX code	
N-bits			0	0	10	
N-bits	1	0	0	0	11	N = 260
N-bits	0	0	1	0	12	
A-bits	0	0	0	0	13	A = 0
A-bits	0	0	0		14	
R-bits	0	0	0	0	15	
R-bits	0	0	0	0	16	R = 256
R-bits	1	0	0	0	17	

In the TX-mode data is the same but the programming addresses must change according to the description.



Revision	Scale	Date	Item
98-12-20 JH		89-11-16	JH
93-01-07 JH		Revision No.	
TP RADIO			
E83-891112			

TP4705
Tuning instruction

Receiver

- | | | |
|---------|-----|--|
| PROM | 1. | Place a PROM in the socket and select the center channel. |
| 7,5V | 2. | Check that the regulated supply voltage is within 7,2 and 7,7 volts (IC13 pin 1). If it is not, adjust resistor R67. |
| VCO | 3. | Tune C56 to a loop voltage of 3,5 VDC on the measuring point marked "loop voltage". |
| | 4. | Check that loop voltage is within 1 and 6,5 volt on all channels. |
| LO | 5. | Tune helix filter H3 to max DC voltage on MP1. (center channel). The increase in voltage shall be more than 0,1 volt. |
| X-tal | 6. | Tune reference oscillator (C65) to nominal frequency (the VCO-frequency, Frx-45 MHz, is measured on MP1). |
| Demod. | 7. | Apply a standard modulated signal at the nominal frequency and adjust L6 for max. audio output. |
| Filters | 8. | Tune filters H1, H2 and L4 to max. DC voltage at MP2 - RSSI (Received Signal Strength Indicator) (signal amplitude 1 - 10 μ V) |
| SINAD | 9. | Check that sensitivity is better than 1 μ V EMF for 20 dB SINAD on all channels. |
| SQ. | 10. | Adjust squelch by turning R29 fully clockwise. |

Transmitter

- | | | |
|-------|----|--|
| 7,5V | 1. | Key transmitter and check that regulated supply voltage is within 7,2 and 7,7 volts (IC1 pin 1). If it is not, adjust resistor R3. |
| VCO | 2. | Tune C26 to 3,5 VDC loop voltage at center ch. |
| | 3. | Check that loop voltage is within 1 and 6,5 volt on all channels. |
| Power | 4. | With power switch in pos. H, adjust R37 to 4,5 W output power. |
| | 5. | Check that output power in pos. L is around 0,5W |
| Mod. | 6. | Apply 1KHz/ 200mV to input of mod. amplifier and adjust R15 to +/- 4,7 KHz deviation. |
| | 7. | Attenuate 20 dB (20mV) and check that deviation is within 2 and 4 KHz. |

930108

TP200
Technical description

1/1

TP200 is a printed circuit board functioning mainly as an interconnection and interfacing module. It is placed inside the "top" of the TP4000 handheld radio and holds all the knobs and switches to control the set.

TP200 acts as an interconnection module between receiver, transmitter and tone system. These are connected to TP200 via flat cables and mini-connectors.

Potentiometer R1 function as volume control and main switch.

With the binary coded switch O1 it is possible for the user to select one of sixteen channels.

Key S4 is used to toggle between high (default) and low transmitter power (5/0,5W). The transmit indicator will be red at high power and green at low power. The toggle function is performed by flip-flop IC1 and surrounding components which are needed for error-free switching. In low power position Q7 grounds R7 which in turn decreases reference voltage to transmit power circuit in TP166. Transmit indicators D2 will light only if Q6 is ON which is controlled by the lock-signal from the synthesizer. Any fault that causes an out-of-lock situation is then indicated to the user.

With key S5 a tone transmitter cycle can be started.

Key S3 toggles the standby function ON and OFF. When in standby mode, the green alert indicator D1 flashes at a very slow rate to show that receiver is blocked for normal channel traffic. In case of a correct received call, the rate of flashing becomes faster and a call signal is heard in the loudspeaker. The exact function is dependent of the specific software version.

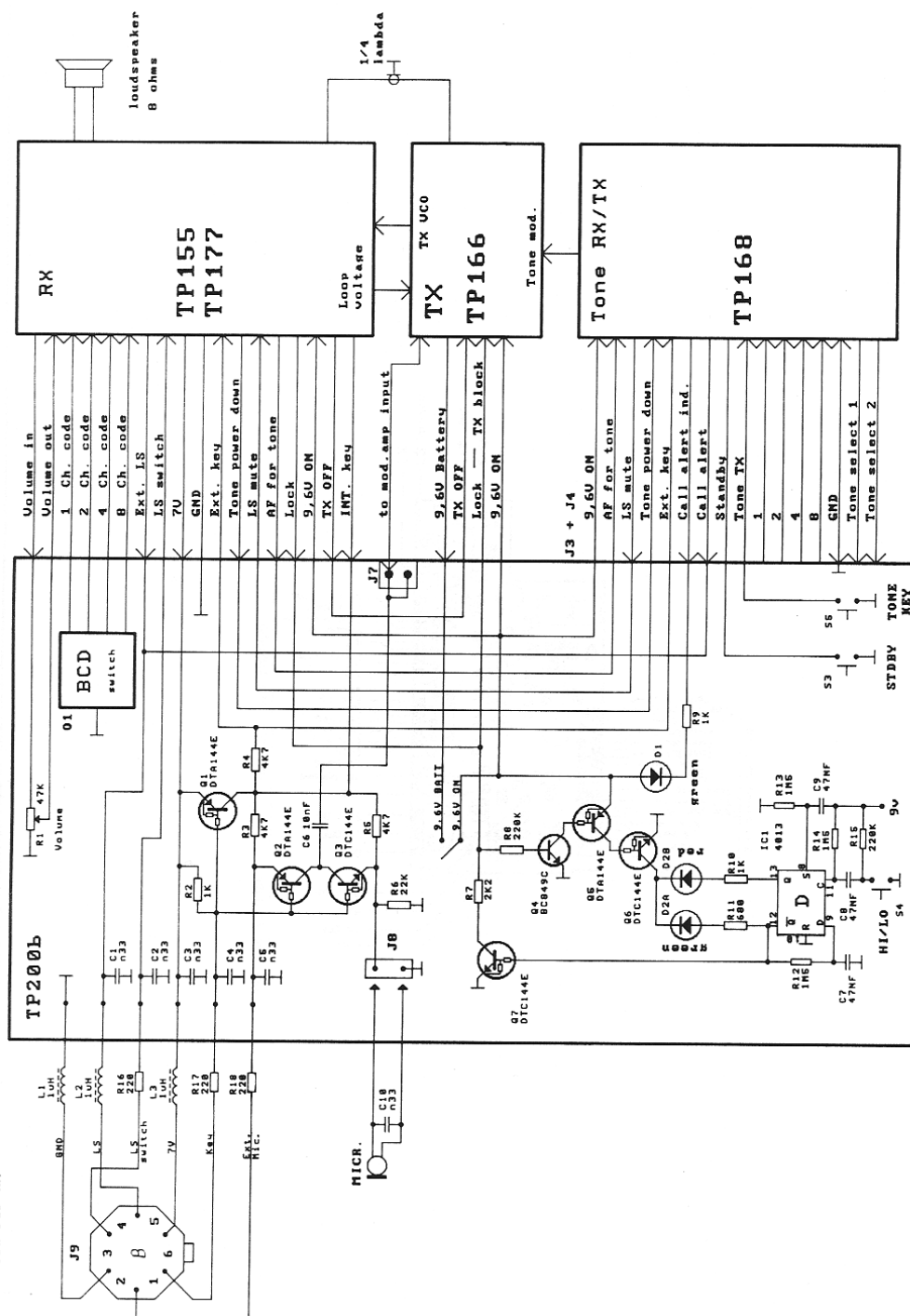
J9 connects a remote control to the radio. Via pin 4 the internal loudspeaker is disabled and the external speaker is connected to the amplifier output.

The remaining components are part of a microphone switch and key circuit.

The remote key turns Q1 ON and 7V is applied to "ext. key" via R4 and to the microphones via R3 and R5. It also switch Q2 ON and Q3 OFF to select the signal from external microphone.

When internal key is activated, signal switch Q2 and Q3 selects the internal microphone as Q3 is ON.

Resistor R4 makes it possible for the tone system to disable manual transmitter start during a tone transmission.



revision	91-00-26	00-10-00
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Main wiring with control unit :
topprint TP288

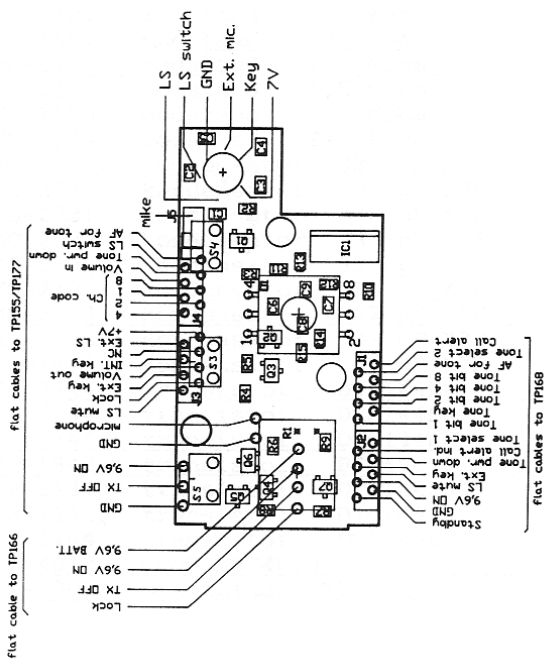
scale


date 92-10

— r i a n .

drawing no.

TP RADIO



revision	TP200b		scale	date 92-10-06	sign.
					
					drawing no.

TP155
Technical description

side 1 af 3

TP155 is a surface mounted printed circuit board with the receiving part of the TP4705 handheld radio. Apart from a complete UHF receiver from antenna to loud-speaker, it also contains functions such as programmable synthesizer, voltage regulators and RX/TX switching.

The following description is divided into three main parts: receiver, synthesizer and other functions.

Receiver

Across the antenna terminals is a PIN diode D1 which is a part of the transmit/receive switch.

The receiver frontend is based on two dual-gate MOSFETs and two helical bandpass filters H1 and H2, providing the necessary image rejection.

Q1 amplifies the antenna signal and Q2 converts it to the first IF of 45 MHz. These RF-stages are optimized to give good intermodulation rejection at low current drain. The coils L1 and L3 provides matching from the low filter impedance to the very high gate impedance.

A third helical filter H3 in the injection path, attenuates broadband noise from the VCO.

Local oscillator signal is injected into the mixer at the MOSFET source, and the IF signal is taken from the drain where it is fed to a 4-pole X-tal filter F1 and F2. The main function of this filter is to reject the image signal 910 KHz away and also to give approximately 20 dB of attenuation at the neighbour channel.

Q3 amplifies the signal and feeds it to the second IF integrated circuit IC1.

IC1 downconverts the 45 MHz signal to 455 KHz with a 44,545 MHz third overtone X-tal oscillator. L5 and C21 makes sure that the X-tal does not oscillate at the fundamental frequency. After mixing, the signal passes the main selectivity block F3, which is a ceramic filter. After filtering, the signal is amplified and limited and finally fed to the demodulator with tuned circuit L6 and C22. The audio signal at pin 8 is amplified and filtered in C23, R20, R21, R24 and C24.

At pin 10 a DC-voltage proportional to the received signal can be measured for tuning purposes (RSSI).

At pin 5 of IC1 the signal is fed to volume control/audio amplifier and to the squelch circuit.

TP155
Technical description

side 2 af 3

R23 and C31 provides de-emphasis and IC2 amplifies the audio signal to a 0,5 Watt level which drives an 8 ohm speaker. R25 and C33 assures that the amplifier does not oscillate at high frequencies, and Q7 and Q4 forms a power switch that makes it possible to mute the loudspeaker. This mute signal may come from one of four sources:

1. out of lock (D4B)
2. TX on (D4A)
3. squelch (D3B)
4. tone receiver (D3A)

First part of IC4 forms a 6 KHz bandpass filter/amplifier for the noise squelch. Without antenna signal the receiver noise at pin 1 of IC4 has sufficient amplitude to be detected in diodes D5A and B, and to overcome the comparator level and hysteresis in the second amplifier. The output is used to mute the loudspeaker and tone receiver.

Synthesizer

The receiver local oscillator is a voltage controlled oscillator (VCO) locked to the selected channel through frequency synthesis.

Q12 is the VCO transistor. It oscillates in a colpitts configuration with resonator L8 and feedback capacitors C54 and C55. To reduce low frequency noise from the voltage regulator, the supply voltage is filtered in Q11, R44 and C50. Output is taken from a very low resistance in the drain-circuit (R45), in order to achieve isolation from variations in the load.

Transistor Q10 amplifies the VCO-signal and L7 matches the transistor to the low impedance of filter H3.

Through resistor R38 a small part of this signal is fed to IC3 the prescaler. Here, the signal is divided by 128 or 129 depending of the modulus control signal from IC6 pin 18. After division, the signal is further divided inside IC6 and finally compared to a 12,5 KHz reference signal in a phase/frequency comparator. The 12,5 KHz frequency is chosen as the smallest possible increment that can be programmed, and it is derived by division from the 6,4 MHz X-tal (X2).

The phase-comparator has a digital and an analog output (PDB and PDA). Together, these signals controls the loop filter IC5, wich in turn controls the VCO-frequency through a variable capacitance diode D6. The analog output takes care of the fine tuning and the digital of the coarse or large frequency steps.

TP155

side 3 af 3

Technical description

When out of lock, pin 3 on IC6 goes high (0,6V), Q14 turns on and discharges C51. The resulting "high" voltage on IC11D pin 4 mutes the loudspeaker and, via Q13 also the transmitter.

The exact frequency of the VCO is thus determined by the division ratio of the signal divider inside IC6. This ratio is set by eight 4-bit codes from IC7, the channel memory. This is a bipolar fuse-prom containing information on the needed channels (max 10 RX and 10 TX channels). Each channel has a corresponding 4-bit address code which is latched in IC8, a 4-bit D-type register. This register receives its information from the channel selector and both input and output are compared in a 4-bit magnitude comparator IC9.

If the channel selector is changed, pin 3 on IC9 goes low thus starting oscillator IC11B which in turn starts a new programming cycle (pin 14 on IC6). At the same time IC6 pin 13 is set low, Q16 supplies 5V to the prom and the internal counter of IC6 addresses the prom which delivers the eight 4-bit words to the divider latches.

For each programming cycle the prom is enabled in only 150 μ S hereby reducing power consumption to a minimum.

Other functions

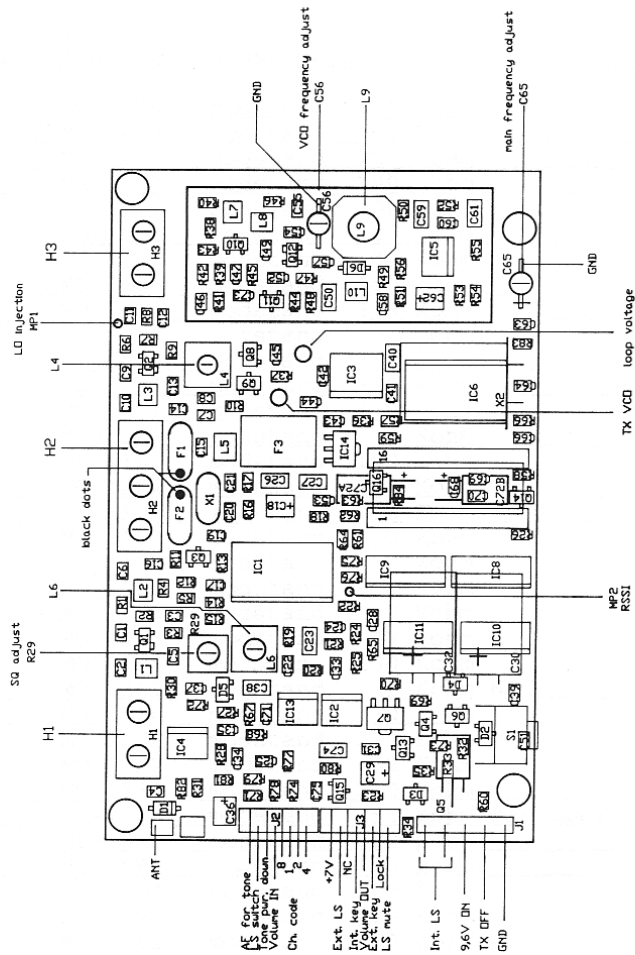
TP155 is supplied with battery voltage 9,6 V. Two low power regulators provide the necessary voltage conversion and stabilization.

IC14 is a 5V regulator supplying prescaler, synthesizer and the logic circuits.

IC13 is the main 7,5V regulator for all the RF-circuits. In order to reduce noise Q15 forms an active filter for the sensitive microphone (7V for TP165).

Key switch S1, after being looped to the microphone switch circuit at TP165, passes noise filter R73-C39 to schmitt-trigger IC10B. The output of this gate (pin 4) activates the transmitter on TP166 via R60, and also disables the RX VCO via Q8 and Q9. After a logic shift in IC10D it also starts a new programming cycle and change the address A7 on the prom to switch to the TX channels.

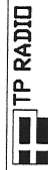
Diode D4A mutes the loudspeaker when Transmitter is ON.



Frequency band	H1	H2	H3
430 - 470 MHz	21A	21	21B
			TX/D

revision	scale	date	sign.
	21	90-09-20	VH
			drawing no.

Component layout TP155d



TP166
Technical description

side 1 af 2

TP166 is a surface mounted printed circuit board with the transmitter part of the TP4705 handheld radio. It performs the function of modulation processing, frequency generation, power amplification and antenna switch.

The VCO is almost identical to that of TP155. A dual-gate MOSFET oscillates on a frequency determined by coil L2, capacitors C24 and C25, and voltage on the variable capacitance diode D1. Q2, R20 and C22 reduces noise from voltage regulator IC1 and the isolation amplifier stage Q4 has a loose coupling to the VCO due to the low value of drain resistor R21.

A second variable capacitance diode D2 is coupled to the resonator via a small capacitance C52. This diode is used to frequency modulate the oscillator with the voice signal from the microphone.

The buffered signal from Q4 is fed to the prescaler input on TP155, and the loop filter output returns to the transmitter VCO through filter R17/C19/R19 to D1. In this way, the TX VCO is phase locked to a reference oscillator according to the selected channel and the PROM.

The output from Q4 is further amplified in Q5 and finally in the power amplifier module IC3. Emitter of Q5 also supplies IC3 pin 3 with DC bias voltage for the output transistors.

On IC3 pin 5 the signal level is 5 watt. To attenuate harmonics L6, L7, L8, L9 and capacitors form a low-pass filter. The last two sections is physically placed at the antenna connector in order to improve performance.

Diode D3 and capacitors C43 and C40 detects the output level and feeds it via potentiometer R37 to a comparator Q8/Q7. The comparator reference level on the base of Q7 is determined by voltage divider R32/R33, which can be changed with the H/L switch on the control panel. The output from Q7 drives Q6 which in turn apply a DC voltage to Q5 and first driver stage of IC3. The result is a stabilization of the output power to a level adjusted with R37 (usually 5W), or to low power (0,5W) if selected.

TP166
Technical description

side 2 af 2

PIN diode D4 together with D1 on TP155 and a quarter wavelength piece of coaxcable between them, forms the antenna switch. A DC-path is established from resistor R38 via L5/L7 through both diodes to ground on TP155.

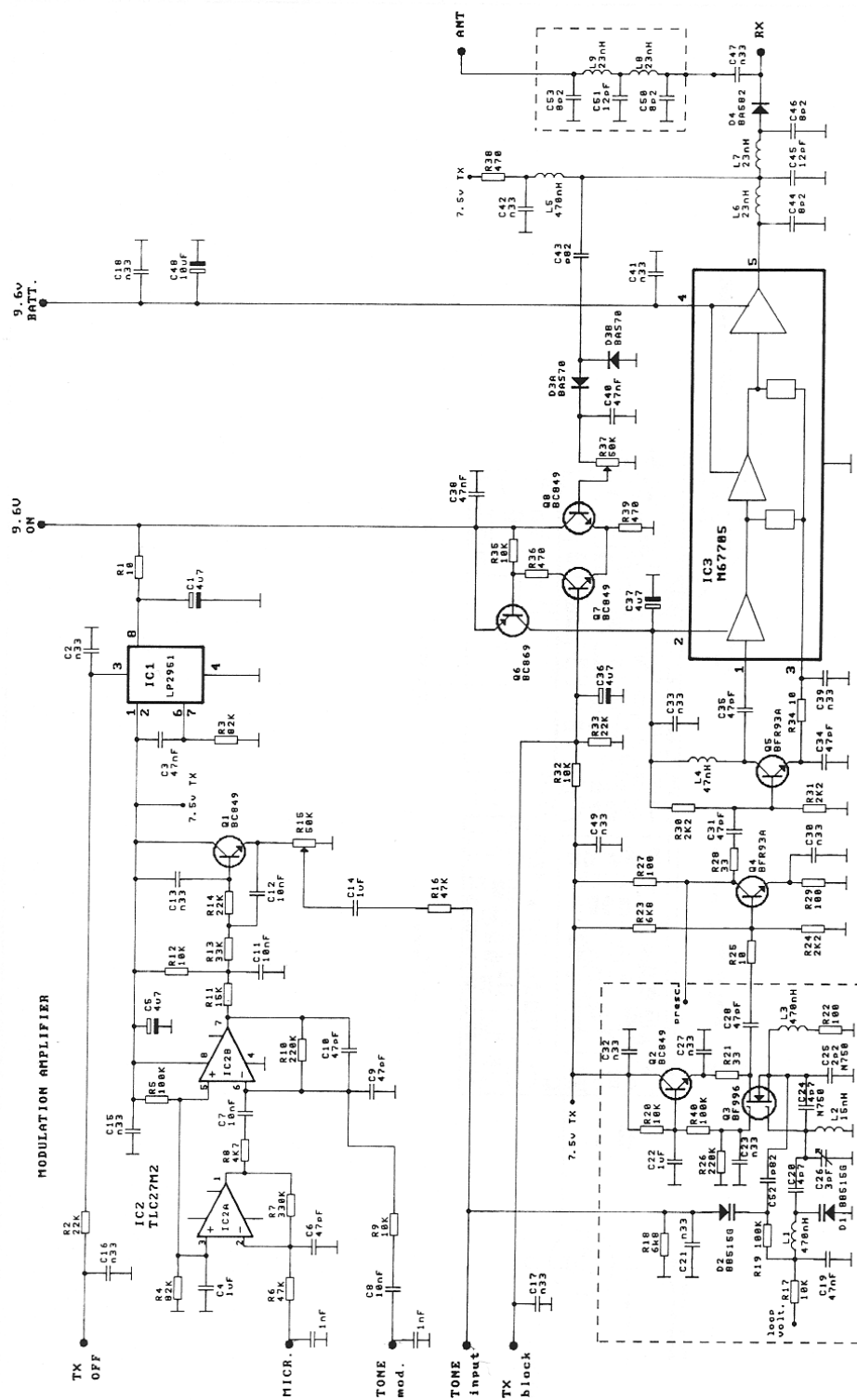
In transmit mode, a DC current flowing through the diodes causes them to enter the low impedance state, approx. 1 ohm. This low impedance is transformed in the cable to a high impedance as seen at the transmitter end (C47/D4). The receiver is virtually disconnected from the antenna and TX power is delivered to the antenna.

In receive mode both diodes are in the high impedance state thereby disconnecting transmitter and all the antenna signal is delivered to the receiver input.


In IC2A the microphone signal is amplified 26 dB before it is pre-emphasized in C7/R8. IC2B provides further gain and also acts as a limiter when the signal amplitude is high enough to limit on the supply voltage. A second input to IC2B is used to modulate the transmitter with tones.

Capacitors C6 and C9 prevents RF interference.

Q1 forms a lowpass filter to reject harmonics from reaching the modulation diode. Potentiometer R15 adjusts the maximum frequency deviation (usually 5KHz).



030

revision	UHF TX module for TP 4888			scale	date	sign.
91-85-07 JH	TP166d				98-86-28	
	 TP RADIO			drawing no.		
				EA3-9002		

[illegible]

930108

TP168
Technical description

1/1

TP168 is a surface mounted printed circuit board including the CCIR and ZVEI signalling system for the TP4000 series handheld radio.

The heart in this sequential tone coder/decoder is the microcontroller IC4, MC68HC705.

This microcontroller has a built-in EPROM which contains the system software for either the CCIR version or ZVEI version.

The only external memory is IC3, a serial coded EEPROM. In this PROM all customer data is located. You may read and write to the EEPROM via a normal Personal Computer through a special clip-on adaptor for IC1.

A special program is available from TP Radio for this purpose.

The input circuit IC4 and IC5 improves the signal to noise ratio of the input signal.

IC2 is a 5v regulator and also provides a reset signal for the microcontroller.

A tonesignal at the "AF input" terminal goes via IC4 and IC5 to the controller input pin 37. If the signal is recognized as one of the valid tone sequencies, the controller emits, via pin 27 through Q6 and Q7, a "Call alert" tone.

At the same time the "Call alert indicator" LED starts flashing via pin 8 through Q4.

A "low" at the "Standby" terminal will via pin 28 of the controller, mute the receiver. The "Call alert indicator" LED indicates the standby mode by a slow flashing frequency.

When the tone key is activated, "Tone Tx" and pin 18 of IC1 goes "low" and a tone transmit routine is started.

The key is activated via pin 10 through D3. The microphone is muted via the transistor Q3.

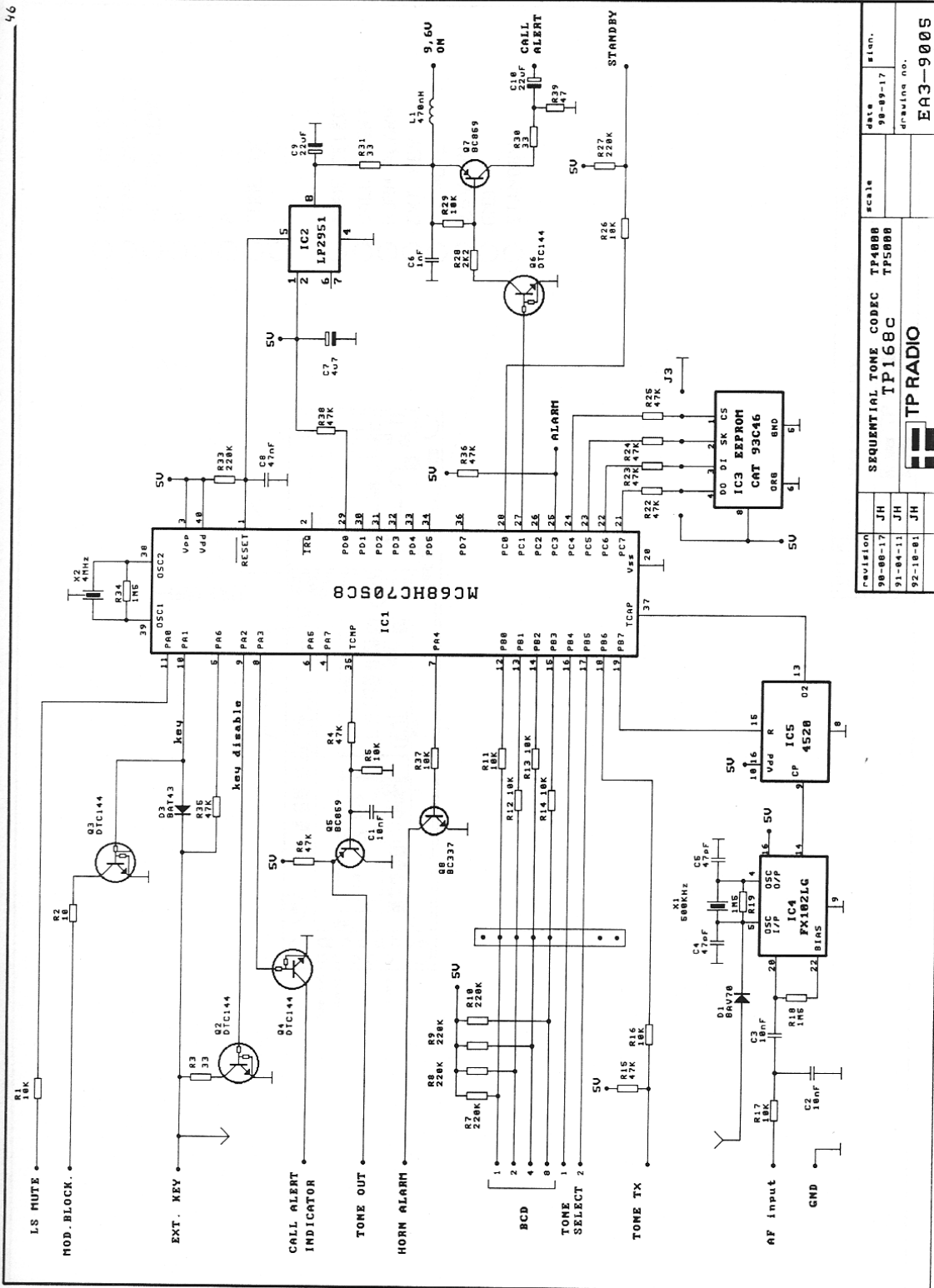
The position of the tone switches is checked via the pins 12 through 17, and the complete tone sequence is via pin 35 and Q5 led to the "Tone out" terminal on to the modulation amplifier.

Transmission of a special alarm call may be started by activating the PTT and the tone key at the same time. The alarm routine is started via pin 5 of IC1.

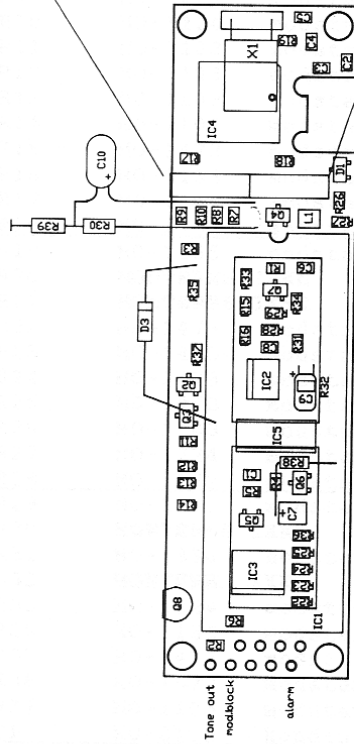
The pins 21 through 24 are used for the communication between the controller and the EEPROM.

The clock frequency of IC1 and IC4 is controlled by ceramic resonators.

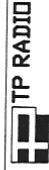
The total supply current of the sequential tone CODEC is 4 - 5mA.

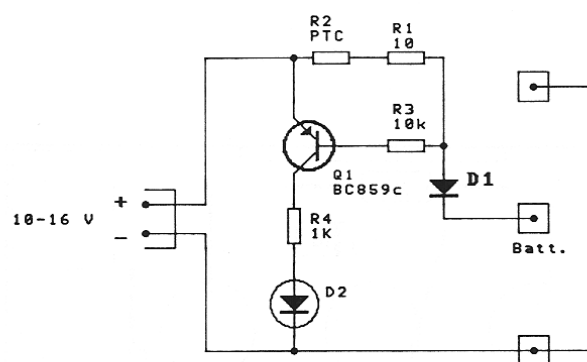


- ☐ CALL ALERT
- ☐ TONE SELECT 2
- ☐ AF FOR TONE
- ☐ 8
- ☐ 4
- ☐ 2
- ☐ TONE TX
- ☐ 1
- ☐ TONE SELECT 1
- ☐ CALL ALERT IND.
- ☐ HORN ALARM
- ☐ EXT. KEY
- ☐ LS MUTE
- ☐ 96V ON
- ☐ GND
- ☐ STANDBY



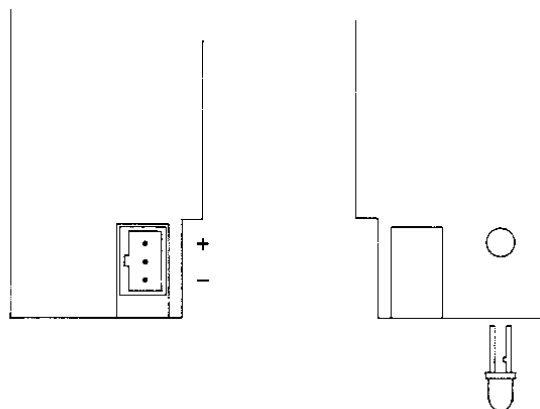
REVISION	SEQUENTIAL	TONE CODEC	TP168C	scale	21	date	sign.
92-10-01	JH					91-04-10	
						drawing no.	



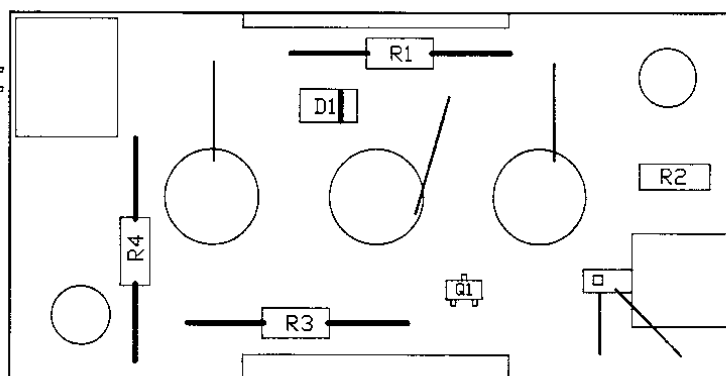


revision		DASHBOARD CHARGER TP176b	scale	date	sign.
				90-08-17	
		TP RADIO		drawing no.	
				EA4-9004	

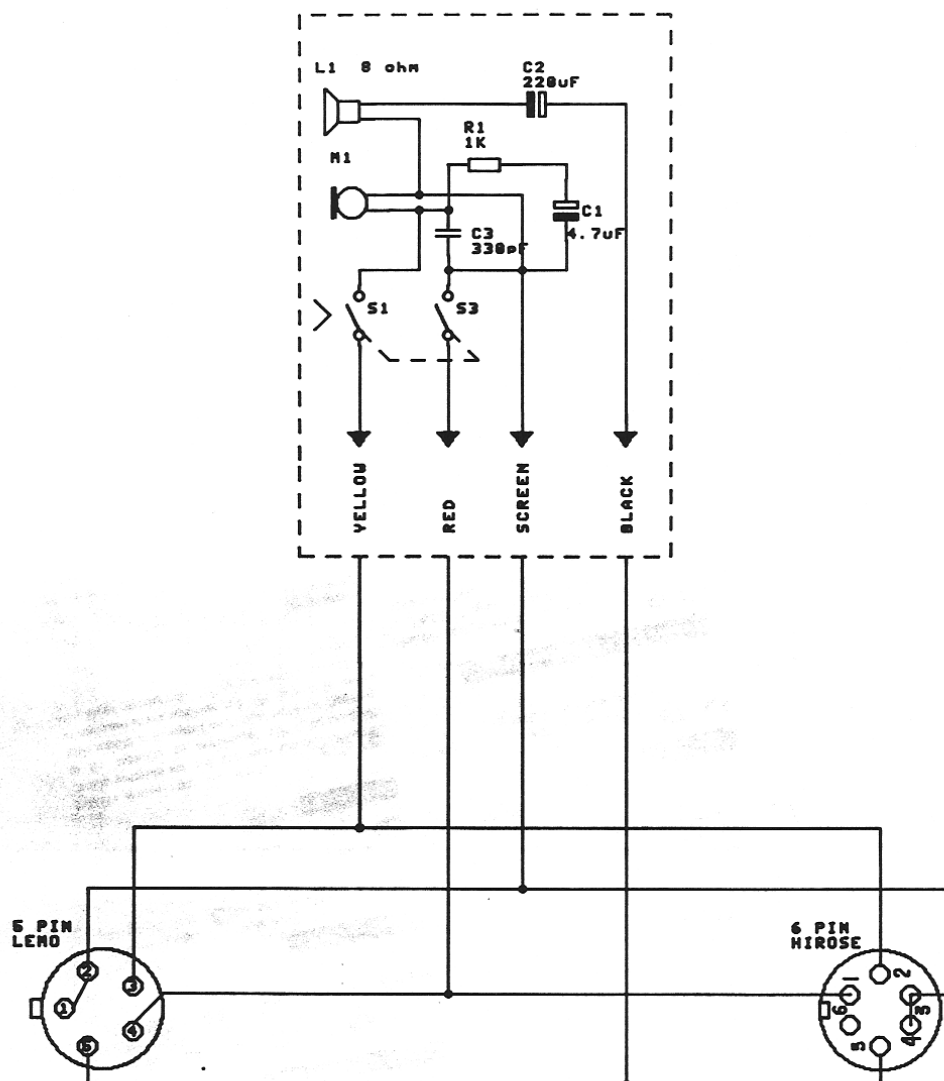
yellow
+
brown




LED
D2



revision		COMPONENT LAYOUT TP176b	scale 2:1	date	sign.
				90-08-20	
		TP RADIO		drawing no.	



revision		SPEAKER/MICROPHONE FOR TP4888 with HIROSE or LENO connector	scale	date	sign.
				11/01-93	JS
		 TP RADIO		drawing no.	
				EA4-9301	