5000 SERIES CTCSS/VOTING/PIPTONE OPTIONS PCB

INTRODUCTION

The CTCSS/Voting/Piptone PCB is an option which may be fitted to the FR5000 series base stations. When fitted, it is located in the Control Module where it is mounted on the Control Logic PCB and electrically connected to the Front Panel PCB.

CTCSS

The CTCSS circuits provide sub-audio signalling facilities for FR5000 series base stations when used in CTCSS (Continuous Tone Controlled Squelch System) applications. In the receive mode, the decode facility is used to inhibit the audio path to the loudspeaker pending receipt of the correct tone. In the encode mode, activated by the press-to-transmit switch, the sub-audio tone is used to modulate the outgoing carrier.

Voting

The Voting circuits facilitate the automatic selection of the 'best' of a number of base station sites within range of a calling mobile. The Voting requirement is for the equipment to ensure that only intelligible signals are considered for selection purposes, and to automatically select the strongest signal. The basis for assessing the signal strength is receiver noise and carrier level as measured at the base station.

Piptone

Where a requirement exists to indicate that a channel is 'busy' provision is made to key the transmitter when the squelch opens to enable the transmission of a piptone. The piptone generator, when activated by a piptone enable input from the Control Logic PCB, provides a tone which is combined with the CTCSS tone and fed to the transmitter audio circuitry.

SUMMARY OF DATA

CTCSS

Signalling Format	Continuous sub-audio tone. Standard EIA CTCSS tones

CTCSS Encoder

Maximum No. of Tones	38
Tone Frequency Range	67,0Hz - 250,3Hz (Refer to Table 1 for specific frequencies)
Frequency Accuracy	Better than ±5% relative to nominal EIA frequency over the operating temperature range
Amplitude Stability	Less than ±1dB variation with frequency and temperature
Harmonic Distortion	Less than 5%
Risetime	Less than 50ms to 90% output level after removing inhibit

Reference Oscillator Frequency	1MHz	
Encode Level	15% Deviation	Nominal, adjustable between 8 and 16%

CTCSS Decoder

Frequency Accuracy	Better than 0,5%	
Selectivity	±0,5% minimum, ±3% maximum with a typical value of 1,7%	
Response Time	Less than 250ms	
Decode Sensitivity	0,2µV	

CTCSS Filter

Passband Gain	0dB ±0,5dB at 1kHz	
Passband Ripple	Less than ±0,5dB over the range 300Hz to 3kHz, relative to 1kHz	
Stopband Attenuation	Greater than 40dB over the range 67Hz to 250Hz	

Voting

Voting Frequencies (Hz)	2707 or No Tone - Squelch closed 2730 - Squelch open, no threshold exceeded 2791 - Threshold 1 exceeded 2852 - Threshold 2 exceeded 2913 - Threshold 3 exceeded 2972 - Threshold 4 exceeded	
Voting Frequency Tolerance	±1Hz	
Voting Level	-24dBm	
Voting Threshold Levels	0,6µV 1,0µV 2,0µV 5,0µV	Nominal, adjustable to suit customer requirements

Voting Filter

Passband gain	0dB ± 0,5dB at 1kHz	
Passband ripple	Less than ±0,5dB over the range 300 - 2500Hz, relative to 1kHz	
Standard attenuation	Greater than 30dB over the range 2,7kHz to 3kHz	

Piptone

Piptone Frequency		950 - 1100Hz
Piptone Level		60% Deviation Nominal, adjustable to suit customer requirements
Piptone Repitition Rate	2 Seconds (approx.)	

INSTALLATION

Note: (i) Refer to Fig.1 throughout this installation procedure.
(ii) Before installation ensure that all Links and Switches are set for the functions and frequencies required.

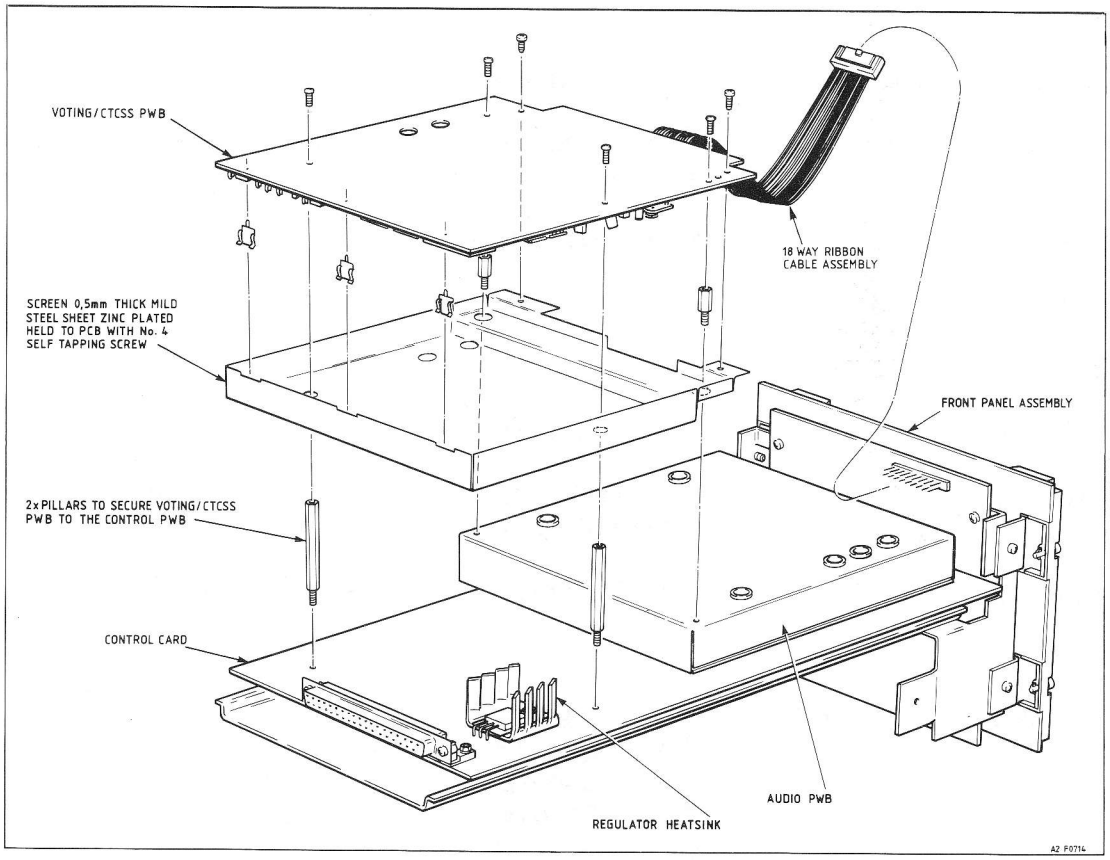

Fig.1 Installation

Installation Items

Description	Part No	Remarks
Pillar 7,1mm long	BT04074	2 off
Pillar 35mm long	BT04075	2 off

(1) Release the securing fasteners and withdraw the Control Module on its runners to gain access to the Control Logic PCB.

(2) Remove and retain the two M3 screws securing the Control Logic PCB to the plate assembly, fit the two 35mm hexagonal pillars provided in their place.

(3) Remove and retain the two rearmost M3 screws securing the screen assembly to the Control Audio PCB, fit the two 7,1mm hexagonal pillars provided in their place.

(4) Using the four screws retained at steps (2) and (3) secure the CTCSS/Voting/Piptone PCB to the four pillars.

(5) Connect the 20-way ribbon cable to PLB on the Control Module Front Panel PCB.

(6) Ensure all Links on the Control Logic and Options PCB's are correctly set for the options required.

(7) Relocate the Control Module in the shelf and lock the securing fasteners.

DETAILED DESCRIPTION

CTCSS

A separate IC, type FX365, is used for both the decode and encode functions. This permits duplex operation, with different decode and encode frequencies if necessary. The required 5 volt supply is provided by IC7(c).
A 1MHz clock frequency, generated by the oscillator in the decoder, IC15, and crystal XL1, is used to clock IC15 and, via pin 2, encoder IC16. Incoming Rx audio is applied to IC7(b), a low-pass filter with gain, which attenuates noise and speech signals above the tone signalling frequency range.
The signal level at the decoder input is preset at the factory and should not normally require adjustment, if however it becomes necessary to increase the decoder sensitivity or reduce 'falsing' RV3 may be adjusted. To increase decoder sensitivity turn RV3 clockwise (with PCB viewed from the non-component side), to reduce decoder 'falsing' turn RV3 anti-clockwise. When a tone is detected a 'low' output from IC15 pin 13 is fed to TR1, cutting it off, which produces a 'high' output to PLA pin 7. The 'low' output from IC15 pin 13 is also fed to TR2, cutting it off, which illuminates LED2, the Tone Valid indicator. The decode frequencies are set by DIL switch SA. The decoder can be overridden by linking LK10(b) D-E.

The CTCSS encoder is activated by the removal of the Disable CTCSS input at PLA pin 4 which connects to IC16 pin 17. The encoder output from IC16 pin 16 is fed via C33 to:-

(i) RV2, the set CTCSS LEVEL potentiometer, where it is combined with the output from the piptone generator and fed via summing amplifier IC7(d) to PLA pin 3

(ii) IC7(a) and its associated circuitry, illuminating LED3, the CTCSS TONE GENERATED indicator.

The encode frequencies are set by DIL switch SB.

Voting (ASSORT)

The output of Voting Encoder, IC14, is a sinewave, the frequency of which varies in steps between 2707Hz and 2972Hz according to the state of the squelch and the received signal strength.
With LK6 linked B-C no tone is produced when the squelch is closed, with LK6 linked A-B the lowest tone is produced when the squelch is closed. The next higher frequency corresponds to the squelch being open but no RF threshold level being exceeded.
Receiver noise at PLA pin 1 is fed via C27 and R43 to active rectifier, IC2(b) and associated components, which produces a DC level which corresponds to the receiver noise level. This DC is fed via IC8(a) to position C of links LK1-4.
A Carrier Level input at PLA pin 6 is fed via IC8(b) and associated circuitry to position A of links LK1-4.
The +14V DC at PLA pin 5 is applied across potential divider network R36,44, the input to IC2(a) being taken from their junction. IC2(a) output, a +7V DC reference is fed via R48 to potentiometers RV4-7 which set the four signal level thresholds. The comparators, IC9(a-d), can operate on either receiver noise DC or carrier level DC ,depending on the settings of LK1-4. Normally the lower two levels operate on receiver noise (links set B-C), and the two higher levels operate on carrier level (links set A-B).

The output from the comparators is fed to a series of OR gates IC12(b-d) which prevent invalid frequencies being generated if the thresholds are incorrectly set. Thus if any comparator operates before other comparators with a lower threshold level then the transmission gates associated with the lower levels are also opened.

Transmission gates IC13(a-d) are used to switch resistors R62-67 into the oscillator timing circuit as the thresholds are exceeded, thus increasing the tone frequency. The sinewave output from IC14 pin 2 is fed via R76, C40, R84 and TR4 to amplifier IC3(b) the gain of which is controlled by RV10, ASSORT LEVEL. IC3(b) output from pin 7 is fed via C42 to PLA pin 10 as ASSORT Tone. If the 'Disable ASSORT' input, PLA pin 16, is 'high' TR3 conducts, cutting off TR4 so that there is no voting tone output.
The voting encoder can be disabled by setting LK9 to B-C.

Piptone

A 'high' input on PLA pin 12 causes relaxation oscillator IC1(a) to apply a positive pulse to Wien Bridge oscillator IC1(b) approximately every 2 seconds producing a piptone. The output of IC1(a) is also fed via D1, R9 to LED1, PIPTONE indicator, causing it to flash at approximately 2 second intervals. The piptone, at a level set by RV1, PIPTONE LEVEL, is combined with the generated CTCSS tone in summing amplifier IC7(d) and then routed to the transmitter audio circuitry.
To enable the piptone level to be set, LK10(a) is linked A-B, causing the tone to be generated continuously.

Audio Filters

The receiver audio on PLA pin 9 is fed directly to a low-pass filter and, via Link 7 a high-pass filter. The low-pass filter comprising IC3(a), IC4(a,b), IC8(d), IC10(a-d) and their associated circuitry is used to remove speech frequencies within the frequency range of the voting tones, the notch frequencies being set by RV11-13. The high-pass filter comprising IC5(a,b), IC6(a,b), IC11(a-d) and their associated circuitry is used to remove CTCSS tones from the incoming Rx audio, and pass speech frequencies above 300Hz, the notch frequencies being set by RV14-16. Both filters are active seventh-order elliptic function filters and have a nominal unity gain in their respective passband. The low-pass filter is by-passed when LK7 is in the B-C position, the high-pass filter is by-passed when LK8 is in the B-C position. With both LK7 and LK8 in the A-B position both filters are in circuit. If filtered audio is required, LK25 on the Control Logic PCB must be linked B-C.

CTCSS Frequency Setting Up Procedure

Switch SA sets CTCSS encode frequency, switch SB sets CTCSS decode frequency. For Voting/Piptone Option both switches should be set to the 'No tone' position.

Nominal Frequency (Hz)	Switch Positions					
	1	2	3	4	5	6
67,0	0	0	0	0	0	0
71,9	0	0	0	0	0	1
74,4	1	0	0	0	0	0
77,0	0	0	0	0	1	1
79,7	0	1	0	0	0	0
82,5	1	0	0	0	0	1
85,4	1	1	0	0	0	0
88,5	1	0	0	0	1	1
91,5	0	0	1	0	0	0
94,8	0	1	0	0	0	1
97,4	1	0	1	0	0	0
100,0	0	1	0	0	1	1
103,5	1	1	0	0	0	1
107,2	1	1	0	0	1	1
110,9	0	0	1	0	0	1
114,8	0	0	1	0	1	1
118,8	1	0	1	0	0	1
123,0	1	0	1	0	1	1
127,3	0	1	1	0	0	1
131,8	0	1	1	0	1	1
136,5	1	1	1	0	0	1
141,3	1	1	1	0	1	1
146,2	0	0	0	1	0	1
151,4	0	0	0	1	1	1
156,7	1	0	0	1	0	1
162,2	1	0	0	1	1	1
167,9	0	1	0	1	0	1
173,8	0	1	0	1	1	1
179,9	1	1	0	1	0	1
186,2	1	1	0	1	1	1
192,8	0	0	1	1	0	1
203,5	0	0	1	1	1	1
210,7	1	0	1	1	0	1
218,1	1	0	1	1	1	1
225,7	0	1	1	1	0	1
233,6	0	1	1	1	1	1
241,8	1	1	1	1	0	1
250,3	1	1	1	1	1	1
No tone	1	1	1	1	0	0

0 = open, 1 = closed.

Table 1

TEST PROCEDURE

Test Equipment Required

Note: Refer to Part I, Table 3.1 for suitable types

10	RF Signal Generator	13	Modulation Meter
2	AF Generator	12	Frequency Counter
15	Thruline Wattmeter	4	Digital Voltmeter
19	SINAD Meter		

Note: (i) Before carrying out the following procedure ensure that the base station transmitter and receiver are correctly aligned
(ii) For the CTCSS modulating frequency use the customer's frequency if known, or, if not known, 100,0Hz

Linking Information

Functions

LK1-4	A-B	Carrier Level
	B-C	Noise Level
LK5	A-B	Squelch. (Always set A-B)
	B-C	Rx Call
LK6	A-B	Voting tone when squelch closed
	B-C	No voting tone when squelch closed
LK7	A-B	Low pass filter in circuit
	B-C	Low pass filter out of circuit
LK8	A-B	High pass filter in circuit
	B-C	High pass filter out of circuit
LK9	A-B	Assort voting tone on
	B-C	Assort voting tone off
LK10a	A-B	Pip tone on at all times (Engineering mode)
	B-C	Pip tone keyed (active high)
LK10b	D-E	CTCSS tone lock off
	E-F	CTCSS tone lock enabled

Option	Option Board Links										
	LK1	LK2	LK3	LK4	LK5	LK6	LK7	LK8	LK9	LK10a	LK10b
CTCSS/Voting/Pip	B-C	B-C	A-B	A-B	A-B	A-B	A-B	A-B	A-B	B-C	E-F
Voting/Pip	B-C	B-C	A-B	A-B	A-B	A-B	A-B	B-C	A-B	B-C	E-D
CTCSS/Pip	B-C	B-C	A-B	A-B	A-B	A-B	B-C	A-B	B-C	B-C	E-F
CTCSS Decode/Pip	B-C	B-C	A-B	A-B	A-B	A-B	B-C	A-B	B-C	B-C	E-F

Ensure LK25 on the Control Logic PCB is linked B-C.

CTCSS Decode

(1) Set Links 1-10 on the options PCB for the CTCSS Decode/Pip option

(2) Set the signal generator frequency to the channel in use, output level 1mV with no CTCSS modulation and connect to the receiver antenna. Check that the Squelch Indicator on the Control Module front panel is extinguished.

(3) Link LK10b E-D, check that the Squelch Indicator on the Control Module front panel is lit. Reset LK10b E-F.

(4) Modulate the signal generator with the CTCSS frequency in use at 15% deviation, check that LED2, TONE VALID, on the options PCB and the Squelch Indicator on the Control Module front panel are lit.

(5) Reduce the signal generator output level to 0,2µV, check that LED2, TONE VALID, on the options PCB remains lit. Reduce the signal generator output to 0µV, check that LED2, TONE VALID, on the options PCB is extinguished.

CTCSS Encode

(1) Set Links 1-10 on the Options PCB for the CTCSS/Pip option

(2) Connect the modulation meter, via the thruline wattmeter, to the transmitter antenna socket, key the transmitter with no external modulation applied and adjust RV2, CTCSS LEVEL on the options PCB to give 15% deviation.

(3) Set the AF generator to 600mV at 1kHz and connect to SKA pin 14 on the transmitter driver module, adjust RV3, DEVIATION, on the Control Audio PCB to give 100% deviation.

(4) Set the AF generator to each of the following modulating frequencies in turn, 300Hz, 700Hz, 1kHz, 2kHz and 3kHz and check that the Peak System Deviation (+ve and -ve) at each frequency does not exceed:-
±5kHz for 25kHz Channel Spacing Equipments.
±4kHz for 20kHz Channel Spacing Equipments.
±2,5kHz for 12,5kHz Channel Spacing Equipments.

Voting

(1) Set Links 1-10 on the Options PCB for the Voting/Pip option

(2) With no RF input to the receiver and the squelch closed check that the Voting tone frequency is 2707Hz ±1Hz, if necessary adjust RV9 on the options PCB to achieve this frequency.

(3) Using the voltmeter check that the line level at PLA pin 10 is -24dBm (49mV), if necessary adjust RV10 on the options PCB, ASSORT LEVEL, to achieve this figure.

(4) Set the RF signal generator frequency to that of the channel in use, modulated with 1kHz at 60% deviation and connect to the receiver antenna socket. With the RF signal generator output at 0µV check that the four threshold level LED's, LED4-7, on the options PCB are extinguished.

(5) Set RV4-7 on the options PCB fully counter-clockwise.

(6) Set the signal generator output level to 0,6µV, turn the RF off then on and slowly rotate RV4 until LED7, LEVEL 1, JUST illuminates; check that the frequency is 2971Hz ±7Hz.

(7) Set the signal generator output level to 1,0µV, turn the RF off then on and slowly rotate RV5 until LED6, LEVEL 2, JUST illuminates; check that the frequency is 2852Hz ±5Hz.

(8) Set the signal generator output level to 2,0µV, turn the RF off then on and slowly rotate RV6 until LED5, LEVEL 3, JUST illuminates; check that the frequency is 2913Hz ±2Hz.

(9) Set the signal generator output level to 5,0µV, turn the RF off then on and slowly rotate RV7 until LED4, LEVEL 4, JUST illuminates; check that the frequency is 2972Hz ±1Hz. If necessary adjust RV8 on the Options PCB to achieve this frequency.

(10) Disable voting by fitting a temporary link between LK3 pin 4B and -ve on the Control Logic PCB, set the signal generator output to 1mV, unmodulated, check that the rejection is greater than 40dB down. Remove the temporary link.

Receiver Audio Response

(1) Defeat CTCSS encoder by linking LK10(b) D-E; defeat Voting by linking LK9 B-C.

(2) Set the signal generator output to 1mV with 60% deviation and check the frequency response at the line output at the frequencies tabulated below:-

Option	250Hz		300Hz		1kHz	3kHz	
	Min(dB)	Max(dB)	Min(dB)	Max(dB)	0dB ref	Min(dB)	Max(dB)
CTCSS Decode	-60	-30	+7,5	+11,4	0dB ref	-12,5	-8,6
Voting	-	-	+7,5	+11,4	0dB ref	-80	-40
CTCSS Decode + Voting	-60	-30	+7,0	+11,9	0dB ref	-80	-40

Piptone

(1) Set links 1-10 on the Options Board for CTCSS/Voting/Pip. Link LK12 A-B on the Control Logic PCB. Link LK10a on the Options Board A-B.

(2) Defeat CTCSS Tone by fitting a temporary link between LK3 pin 5B and -ve on the Control Logic PCB; key transmitter with no external modulation applied and adjust RV1, PIPTONE LEVEL, for 60% deviation.

(3) Using the frequency counter, check that the Piptone frequency is between 950 - 1100Hz.

WARNING
During the following check the Transmitter will key when the squelch opens

(4) Link LK10a B-C. Set the signal generator to the frequency of the channel in use at an output of 1mV, check that the PIPTONE indicator, LED1 on the Options Board flashes

(5) Remove the temporary link between LK3 pin 5B and -ve on the Control Logic PCB, fitted at step (2)

CAUTION
The surface mount potentiometers RV11-16 are difficult to adjust due to the shallow slot for the adjusting tool, extra care is therefore needed.

Note: RV11-16 are preset at the factory and should only be adjusted if a filter has been repaired or the filter response does not meet specification, do not attempt adjustment before checking the filter response.

CTCSS Filter

(1) Ensure that RV14,15,16 are set to their mid position. Link LK7 B-C, LK8 A-B.

(2) Connect the AF generator to the Options PCB PLA pin 9 and the distortion analyser to the Options PCB PLA pin 8.

(3) Set the AF generator to 142,0Hz at 1V, using the set level function and maximum sensitivity on the distortion analyser, carefully adjust RV14 to obtain the greatest rejection (measured in dB).

(4) Set the AF generator to 252,4Hz at 1V, using the set level function and maximum sensitivity on the distortion analyser, carefully adjust RV15 to obtain the greatest rejection (measured in dB).

(5) Set the AF generator to 222,9Hz at 1V, using the set level function and maximum sensitivity on the distortion analyser, carefully adjust RV16 to obtain the greatest rejection (measured in dB).

(6) Set the AF generator to 1000Hz at 300mV, check that the distortion analyser, set to 'voltmeter', reads 300mV ±18mV. Using the distortion analyser set level function adjust the sensitivity vernier for a reading of 0dB.

(7) Set the AF generator in turn to the frequencies listed below and check that the reading on the distortion analyser is within the given limits.

Frequency (Hz)	Output Level (dB relative to 1000Hz)	
	Minimum	Maximum
67	-	-40
250	-	-40
300	-0,5	+0,5
1000	0	0
2000	-0,5	+0,5
3000	-0,5	+0,5

Voting Filter

(1) Ensure that RV11,12,13 are set to their mid position. Link LK7 A-B, LK8 B-C.

(2) Connect the AF generator to the Options PCB PLA pin 9 and the distortion analyser to the Options PCB PLA pin 8.

(3) Set the AF generator to 2851Hz at 1V, using the set level function and maximum sensitivity on the distortion analyser, carefully adjust RV11 to obtain the greatest rejection (measured in dB).

(4) Set the AF generator to 2698Hz at 1V, using the set level function and maximum sensitivity on the distortion analyser, carefully adjust RV12 to obtain the greatest rejection (measured in dB).

(5) Set the AF generator to 4150Hz at 1V, using the set level function and maximum sensitivity on the distortion analyser, carefully adjust RV13 to obtain the greatest rejection (measured in dB).

(6) Set the AF generator to 1000Hz at 300mV, check that the distortion analyser, set to 'voltmeter', reads 300mV ±18mV. Using the distortion analyser set level function adjust the sensitivity vernier for a reading of 0dB.

(7) Set the AF generator in turn to the frequencies listed below and check that the reading on the distortion analyser is within the given limits.

Frequency (Hz)	Output Level (dB relative to 1000Hz)	
	Minimum	Maximum
300	-0,5	+0,5
1000	0	0
2000	-0,5	+0,5
2500	-0,5	+0,5
2700	-	-30
3000	-	-30

VOTING/CTCSS PCB ASSEMBLY
AT29061

Cct Ref	Description	Part No	Remarks
Semiconductors & IC's			
IC1	IC Dual op amp MC1458D	3513 999 45004	
IC2	IC Dual op amp 4558	FU99806/SM	
IC3-6	IC Dual op amp MC1458D	3513 999 45004	
IC7	IC SMD LM348D	3513 999 45003	
IC8/9	IC SMD LM324 op amp	3513 999 45005	
IC10,11	IC SMD LM348D	3513 999 45003	
IC12	IC 4071B	FU99408/SM	
IC13	IC 4066B	3513 999 35019	
IC14	IC mono function gen	FU03750	
IC15,16	IC CTCSS encode/decode	FU99815/SM	
TR1-3	Transistor BCX19	FV99102/SM	
TR4	Transistor SMD BSR58	FV99156/SM	
D1	Diode Hyb Cct BAW56	3513 999 15001	
D2	Diode Hyb Cct BAV70	3513 999 15000	
D3	Diode Hyb Cct BAV99	3513 999 15002	
D4-7	Diode Hyb Cct BAS16	3513 999 15003	
Resistors			
R1,2	47k ±5% 0,125W SMD	3513 999 80056	
R3	36k ±2% 0,25W m film	PM99319	
R4	20k ±2% 0,25W m film	PM99313	
R5	47k ±5% 0,125W SMD	3513 999 80056	
R6	10k ±5% 0,125W SMD	3513 999 80048	
R7	100k ±5% 0,125W SMD	3513 999 80060	
R8	1k ±5% 0,125W SMD	3513 999 80036	
R9	1k5 ±5% 0,125W SMD	3513 999 80038	
R10	10k ±5% 0,125W SMD	3513 999 80048	
R11	3k3 ±5% 0,125W SMD	3513 999 80042	
R12	10k ±5% 0,125W SMD	3513 999 80048	
R13	3k3 ±5% 0,125W SMD	3513 999 80042	
R14	47k ±5% 0,125W SMD	3513 999 80056	
R15	22k ±5% 0,125W SMD	3513 999 80052	
R16	47k ±5% 0,125W SMD	3513 999 80056	
R17	10k ±5% 0,125W SMD	3513 999 80048	
R18	1M ±5% 0,125W SMD	3513 999 80072	
R19	56k ±5% 0,125W SMD	3513 999 80057	
R20	47k ±5% 0,125W SMD	3513 999 80056	
R21	22k ±5% 0,125W SMD	3513 999 80052	
R22-25	100k ±5% 0,125W SMD	3513 999 80060	
R26	820k ±5% 0,125W SMD	3513 999 80071	
R27	330k ±5% 0,125W SMD	3513 999 80066	
R28-31	4k7 ±5% 0,125W SMD	3513 999 80044	
R32	1k ±5% 0,125W SMD	3513 999 80036	
R33	47k ±5% 0,125W SMD	3513 999 80056	
R34	1k5 ±5% 0,125W SMD	3513 999 80038	
R35,36	10k ±5% 0,125W SMD	3513 999 80048	
R37	3k3 ±5% 0,125W SMD	3513 999 80042	
R38	68k ±5% 0,125W SMD	3513 999 80058	
R39	6k8 ±5% 0,125W SMD	3513 999 80046	
R40	47k ±5% 0,125W SMD	3513 999 80056	
R41	4k7 ±5% 0,125W SMD	3513 999 80044	
R42	68k ±5% 0,125W SMD	3513 999 80058	
R43	4k7 ±5% 0,125W SMD	3513 999 80044	
R44	10k ±5% 0,125W SMD	3513 999 80048	
R45	18k ±5% 0,125W SMD	3513 999 80051	
R46	10k ±5% 0,125W SMD	3513 999 80048	
R47	15k ±5% 0,125W SMD	3513 999 80050	
R48,49	1k5 ±5% 0,125W SMD	3513 999 80038	
R50	33k ±5% 0,125W SMD	3513 999 80054	
R51	180k ±5% 0,125W SMD	3513 999 80063	
R52	1k5 ±5% 0,125W SMD	3513 999 80038	
R53	15k ±5% 0,125W SMD	3513 999 80050	
R54	180k ±5% 0,125W SMD	3513 999 80063	
R55	1k5 ±5% 0,125W SMD	3513 999 80038	
R56	4k7 ±5% 0,125W SMD	3513 999 80044	
R57	180k ±5% 0,125W SMD	3513 999 80063	
R58	1k5 ±5% 0,125W SMD	3513 999 80038	
R59	4k7 ±5% 0,125W SMD	3513 999 80044	
R60	180k ±5% 0,125W SMD	3513 999 80063	
R61	1k5 ±5% 0,125W SMD	3513 999 80038	
R62	56k2 ±1% 0,25W m film	PM99107	

Cct Ref	Description				Part No	Remarks
Resistors (Cont'd)						
R63	2k15	±1%	0,25W	m film	PM99090	
R64	46k4	±1%	0,25W	m film	PM99106	
R65	2k15	±1%	0,25W	m film	PM99090	
R66	38k3	±1%	0,25W	m film	PM99105	
R67	31k6	±1%	0,25W	m film	PM99104	
R68,69	4k7	±5%	0,125W	SMD	3513 999 80044	
R70	22k	±5%	0,125W	SMD	3513 999 80052	
R71	27k	±2%	0,25W	m film	PM99316	
R72	6k81	±1%	0,25W	m film	PM99096	
R73	464	±1%	0,25W	m film	PM99082	
R74	26k1	±1%	0,25W	m film	PM99103	
R75	8k25	±1%	0,25W	m film	PM99097	
R76	4k7	±5%	0,125W	SMD	3513 999 80044	
R77	220	±5%	0,125W	SMD	3513 999 80028	
R78,79	10k	±1%	0,25W	m film	PM99098	
R80	47k	±5%	0,125W	SMD	3513 999 80056	
R81-83	10k	±5%	0,125W	SMD	3513 999 80048	
R84,85	22k	±5%	0,125W	SMD	3513 999 80052	
R86	10k	±5%	0,125W	SMD	3513 999 80048	
R87	1k5	±5%	0,125W	SMD	3513 999 80038	
R88	8k25	±1%	0,25W	m film	PM99097	
R89	12k1	±1%	0,25W	m film	PM99099	
R90	10k	±1%	0,25W	m film	PM99098	
R91	8k2	±2%	0,25W	m film	PM99304	
R92	20k	±2%	0,25W	m film	PM99313	
R93	10k	±1%	0,25W	m film	PM99098	
R94	17k8	±1%	0,25W	m film	PM99101	
R95	10k	±1%	0,25W	m film	PM99098	
R96	8k2	±2%	0,25W	m film	PM99304	
R97	24k	±2%	0,25W	m film	PM99315	
R98	10k	±1%	0,25W	m film	PM99098	
R99	3k16	±1%	0,25W	m film	PM99092	
R100	10k	±1%	0,25W	m film	PM99098	
R101	8k2	±2%	0,25W	m film	PM99304	
R102	10k	±1%	0,25W	m film	PM99098	
R103	4k64	±1%	0,25W	m film	PM99094	
R104	22k	±5%	0,125W	SMD	3513 999 80052	
R105	10k	±5%	0,125W	SMD	3513 999 80048	
R106,107	100k	±5%	0,125W	SMD	3513 999 80060	
R108	56k	±2%	0,25W	m film	PM99324	
R109	10k	±1%	0,25W	m film	PM99098	
R110	1k	±1%	0,25W	m film	PM99086	
R111	10k	±1%	0,25W	m film	PM99098	
R112	22k	±2%	0,25W	m film	PM99314	
R113	10k	±1%	0,25W	m film	PM99098	
R114	1k	±1%	0,25W	m film	PM99086	
R115	10k	±1%	0,25W	m film	PM99098	
R116	36k	±2%	0,25W	m film	PM99319	
R117	10k	±1%	0,25W	m film	PM99098	
R118	1k	±1%	0,25W	m film	PM99086	
R119	10k	±1%	0,25W	m film	PM99098	
R120	33k	±2%	0,25W	m film	PM99318	
R121	56k	±2%	0,25W	m film	PM99324	
R122	110k	±2%	0,25W	m film	PM99331	
R123,124	100k	±5%	0,125W	SMD	3513 999 80060	
R125	3k3	±5%	0,125W	SMD	3513 999 80042	
R126	1k5	±5%	0,125W	SMD	3513 999 80038	
R127	5k1	±2%	0,25W	m film	PM99299	
R128,129	1k	±5%	0,125W	SMD	3513 999 80036	
R130	10k	±5%	0,125W	SMD	3513 999 80048	
R131	100k	±5%	0,125W	SMD	3513 999 80060	
RV1,2	10k	±20%	Pot skel lin		PL01478	
RV3	2k2	±20%	Pot skel lin		PL99001	
RV4-7	47k	±20%	Pot skel lin		PL01498	
RV8,9	4k7	±20%	Pot skel lin		PL01486	
RV10	10k	±20%	Pot skel lin		PL01478	
RV11-13	5k	±25%	Pot lin		PL99560/SM	
RV14-16	10k	±25%	Pot		3513 999 95007	
Capacitors						
C1	22	±20%	25V	elec	PS99421	
C2,3	47p	±5%	50V	SMD	3513 999 55321	
C4,5	3n3	±5%	200V	SMD	CN99154	
C6	47p	±5%	50V	SMD	3513 999 55321	

Cct Ref	Description				Part No	Remarks
Capacitors (Cont'd)						
C7-9	10	±20%	16V	elec	PS99855	
C10	68p	±5%	50V	SMD	3513 999 55323	
C11	33p	±5%	50V	SMD	3513 999 55319	
C12,13	100n	±10%	200V	SMD	3513 999 55017	
C14						Not Used
C15	47p	±5%	50V	SMD	3513 999 55321	
C16	680p	±5%	50V	SMD	CN99053	
C17	33n	±5%		pes	PQ99539	
C18	10n	±5%		cer	PN99906	
C19,20	10	±20%	16V	elec	PS99855	
C21,22	47p	±5%	50V	SMD	3513 999 55321	
C23	100n	±20%	50V	pes	PQ99556	
C24	47p	±5%	50V	SMD	3513 999 55321	
C25	470n	±20%	50V	elec	PS99867	
C26	47p	±5%	50V	SMD	3513 999 55321	
C27	10n	±5%		cer	PN99906	
C28-31	47p	±5%	50V	SMD	3513 999 55321	
C32	1	±20%	100V	elec	PS99455	
C33	10	±20%	16V	elec	PS99855	
C34	47p	±5%	50V	SMD	3513 999 55321	
C35	10n	±10%	200V	SMD	3513 999 55492	
C36	10	±20%	16V	elec	PS99855	
C37	10n	±2%	200V	mica	PP25012	
C38	1	±20%	100V	elec	PS99455	
C39	10	±20%	16V	elec	PS99855	
C40	10n	±10%	200V	SMD	3513 999 55492	
C41	47p	±5%	50V	SMD	3513 999 55321	
C42,43	10	±20%	16V	elec	PS99855	
C44	100n	±10%	200V	SMD	3513 999 55017	
C45	47p	±5%	50V	SMD	3513 999 55321	
C46,47	6n8	±5%		cer	PN99905	
C48	47p	±5%	50V	SMD	3513 999 55321	
C49	6n8	±5%		cer	PN99905	
C50	47p	±5%	50V	SMD	3513 999 55321	
C51	6n8	±5%		cer	PN99905	
C52	47p	±5%	50V	SMD	3513 999 55321	
C53	6n8	±5%		cer	PN99905	
C54	47p	±5%	50V	SMD	3513 999 55321	
C55	6n8	±5%		cer	PN99905	
C56	47p	±5%	50V	SMD	3513 999 55321	
C57	6n8	±5%		cer	PN99905	
C58	47p	±5%	50V	SMD	3513 999 55321	
C59	6n8	±5%		cer	PN99905	
C60,61	47p	±5%	50V	SMD	3513 999 55321	
C62,63	100	±20%	25V	elec	PS99424	
C64	3n3	±2,5%	63V	pp	PQ99618	
C65	4n7	±2,5%	63V	pp	PQ99619	
C66	47n	±5%		pes	PQ99534	
C67,68	47p	±5%	50V	SMD	3513 999 55321	
C69	10n	±2,5%	63V	pp	PQ99621	
C70	6n8	±2,5%	63V	pp	PQ99620	
C71	10n	±2,5%	63V	pp	PQ99621	
C72,73	47p	±5%	50V	SMD	3513 999 55321	
C74	10n	±2,5%	63V	pp	PQ99621	
C75	560p	±5%	50V	SMD	CN99033	
C76	6n8	±2,5%	63V	pp	PQ99620	
C77	3n3	±2,5%	63V	pp	PQ99618	
C78	10n	±2,5%	63V	pp	PQ99621	
C79,80	47p	±5%	50V	SMD	3513 999 55321	
C81	10n	±2,5%	63V	pp	PQ99621	
C82	1n5	±5%	50V	SMD	3513 999 55420	
C83	10n	±2,5%	63V	pp	PQ99621	
C84	10	±20%	16V	elec	PS99855	
C85,86	47p	±5%	50V	SMD	3513 999 55321	
C87	1	±20%	100V	elec	PS99455	
C88	10n	±10%	200V	SMD	3513 999 55492	
C89-92	47p	±5%	50V	SMD	3513 999 55321	
C93-99	10	±20%	16V	elec	PS99855	
C100	3n3	±5%	200V	SMD	CN99154	
C101	2µ2	±20%	50V	elec	PS99871	

Cct Ref	Description	Part No	Remarks
Miscellaneous			
	Clip	QA04097	3/Screen
	Header straight male 1 pos'n	3513 504 00121	
	Header straight male 3 pos'n	FC00837/03	
	Holder LED	QA05846	1/LED1-7
	Lead Assembly	AT70237	
LED1-7	LED red	FV05860	
	Link connector	FC99060	
	Mount foam 25 x 12 x 1,5mm	FR05020	1/C37
	Plug PCB mtd rt angle 2 x 2	FP99173	
	Plug PCB mtd rt angle 2 x 4	FP99197	
	Plug PCB mtd straight 2 x 2	FP99172	
	Screen CTCSS/ASSORT	BT26415	
	Scr st tap pozi No4 x 6,5mm	QJ08227/X	2/Screen-PCB
	Switch min dil 8-way	FS99031	
	Tab mtg ½" x ½" x 1,5mm	FR05017	1/XL1
XL1	Xtal 1MHz holder QC45	FC06165	
Installation Items			
	Pillar 7,5mm long	BT04074	
	Pillar 35mm long	BT04075	
	Scr st pan pozi M3 x 6mm	QJ11901/X	2/Control audio PCB, 2/Control logic PCB, 4/Voting CTCSS PCB-pillars