MOTOROLA SOLUTIONS

VX-450 Series

UHF Band
Service Manual

Motorola Solutions, Inc.

EC094U91B

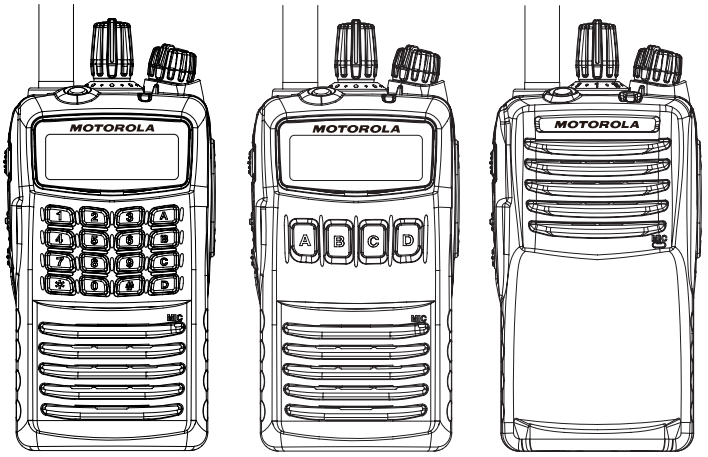
Introduction

This manual provides the technical information necessary for servicing the VX-450 Series Transceiver.

Servicing this equipment requires expertise in handing surface-mount chip components. Attempts by non-qualified persons to service this equipment may result in permanent damage not covered by the warranty, and may be illegal in some countries.

Two PCB layout diagrams are provided for each double-sided board in this transceiver. Each side of the board is referred to by the type of the majority of components installed on that side ("Side A" or "Side B"). In most cases one side has only chip components (surface-mount devices), and the other has either a mixture of both chip and leaded components (trimmers, coils, electrolytic capacitors, ICs, etc.), or leaded components only.

As described in the pages to follow, the advanced microprocessor design of the VX-450 Series Transceiver allows a complete alignment of this transceiver to be performed without opening the case of the radio; all adjustments can be performed from the front panel, using the "Alignment Mode" menu.



16 KEY TYPE 4 KEY TYPE NON KEY TYPE

While we believe the information in this manual to be correct, Motorola Solutions assumes no liability for damage that may occur as a result of typographical or other errors that may be present. Your cooperation in pointing out any inconsistencies in the technical information would be appreciated.

Important Note

This transceiver is assembled using Pb (lead) free solder, based on the RoHS specification.
Only lead-free solder (Alloy Composition: Sn-3.0Ag-0.5Cu) should be used for repairs performed on this apparatus. The solder stated above utilizes the alloy composition required for compliance with the lead-free specification, and any solder with the above alloy composition may be used.

Contents

Specifications: USA (NA) & Except EIA (CE) Models

General

Frequency range:	400-470 MHz (Version A)
	450-520 MHz (Version D, Except EIA (CE) Model)
	450-512 MHz (Version D, USA (NA) Model)
	350-390 MHz (Version I)
	300-340 MHz (Version K)
Channel / Group:	512 CH / 32 Groups (VX-459, VX-454)
	32 CH / 2 Group (VX-451)
Power Supply Voltage:	7.4 V DC ± 10%
Current Consumption:	1.8 A (5 W TX)
Channel Spacing:	12.5 / 20 / 25 kHz
PLL Steps:	5 / 6.25 kHz
IP Rating:	IP57
Operating Temperature Range:	–22 °F to +140 °F (–30 °C to +60 °C)
Charging Temperature Range:	+32 °F to +113 °F (0 °C to +45 °C)
Frequency Stability:	±2.5ppm
RF Input-Output:	50 Ohms
Dimension (H x W x D):	4.3 x 2.3 x 1.3 inches (109 x 58.5 x 34 mm) (VX-451 with FNB-V112LI)
	4.3 x 2.3 x 1.7 inches (109 x 58.5 x 43 mm) (VX-451 with FNB-V113LI)
	4.3 x 2.3 x 1.4 inches (109 x 58.5 x 35 mm) (VX-451 with FNB-V133LI-UNI)
	4.3 x 2.3 x 1.7 inches (109 x 58.5 x 43 mm) (VX-451 with FNB-V134LI-UNI)
	4.3 x 2.3 x 1.4 inches (109 x 58.5 x 36 mm) (VX-454/-459 with FNB-V112LI)
	4.3 x 2.3 x 1.8 inches (109 x 58.5 x 45 mm) (VX-454/-459 with FNB-V113LI)
	4.3 x 2.3 x 1.5 inches (109 x 58.5 x 37 mm) (VX-454/-459 with FNB-V133LI-UNI)
	4.3 x 2.3 x 1.8 inches (109 x 58.5 x 45 mm) (VX-454/-459 with FNB-V134LI-UNI)
Weight (Approx.):	10.4 oz (296 g) (VX-451 with FNB-V112LI, Antenna, Belt Clip)
	12.0 oz (340 g) (VX-451 with FNB-V113LI, Antenna, Belt Clip)
	9.9 oz (281 g) (VX-451 with FNB-V133LI-UNI, Antenna, Belt Clip)
	11.6 oz (330 g) (VX-451 with FNB-V134LI-UNI, Antenna, Belt Clip)
	11.4 oz (322 g) (VX-454/-459 with FNB-V112LI, Antenna, Belt Clip)
	12.9 oz (366 g) (VX-454/-459 with FNB-V113LI, Antenna, Belt Clip)
	10.8 oz (307 g) (VX-454/-459 with FNB-V133LI-UNI, Antenna, Belt Clip)
	12.6 oz (356 g) (VX-454/-459 with FNB-V134LI-UNI, Antenna, Belt Clip)

Receiver *(Measurement per TIA/EIA-603)*

Circuit Type:	Double Conversion Super-heterodyne
Sensitivity (12dB SINAD):	0.25 µV
Adjacent Channel Selectivity:	70/65 dB (W/N)
Hum and Noise:	45/40 dB (W/N)
Intermodulation:	70/65 dB (W/N)
Spurious Image Rejection:	70 dB
Audio output:	700 mW (intemal @ 16 Ohms 5% THD)
	500 mW (extemal @ 4 Ohms 5% THD)

Transmitter *(Measurement per TIA/EIA-603)*

Output Power:	5 / 2.5 / 1 /0.25 W
Modulation:	16K0F3E/11K0F3E
Maximum Deviation:	±5.0 kHz / ±2.5 kHz
Conducted Spurious Emissions:	70 dB below carrier
FM Hum & Noise:	45 dB / 40 dB
Audio Distortion:	< 3% @ 1kHz

Specifications subject to change without notice or obligation.

Specifications: EIA (CE) Model

General

Frequency range:	400-470 MHz
Channel / Group:	512 CH / 32 Groups (VX-459, VX-454)
	32 CH / 2 Group (VX-451)
Power Supply Voltage:	7.4 V DC ± 10%
Current Consumption:	1.8 A (5 W TX)
Channel Spacing:	12.5 / 20 / 25 kHz
PLL Steps:	5 / 6.25 kHz
IP Rating:	IP57
Operating Temperature Range:	–20 °C to +55 °C (–30 °C to +60 °C: Workable)
Charging Temperature Range:	5 °C to +35 °C
Frequency Stability:	±2.5ppm
RF Input-Output:	50 Ohms
Dimension (H x W x D):	109 x 58.5 x 34 mm (VX-451 with FNB-V112LI)
	109 x 58.5 x 43 mm (VX-451 with FNB-V113LI)
	109 x 58.5 x 35 mm (VX-451 with FNB-V133LI-UNI)
	109 x 58.5 x 43 mm (VX-451 with FNB-V134LI-UNI)
	109 x 58.5 x 36 mm (VX-454/-459 with FNB-V112LI)
	109 x 58.5 x 45 mm (VX-454/-459 with FNB-V113LI)
	109 x 58.5 x 37 mm (VX-454/-459 with FNB-V133LI-UNI)
	109 x 58.5 x 45 mm (VX-454/-459 with FNB-V134LI-UNI)
Weight (Approx.):	296 g (VX-451 with FNB-V112LI, Antenna, Belt Clip)
	340 g (VX-451 with FNB-V113LI, Antenna, Belt Clip)
	322 g (VX-454/-459 with FNB-V112LI, Antenna, Belt Clip)
	366 g (VX-454/-459 with FNB-V113LI, Antenna, Belt Clip)
	281 g (VX-451 with FNB-V133LI-UNI, Antenna, Belt Clip)
	330 g (VX-451 with FNB-V134LI-UNI, Antenna, Belt Clip)
	307 g (VX-454/-459 with FNB-V133LI-UNI, Antenna, Belt Clip)
	356 g (VX-454/-459 with FNB-V134LI-UNI, Antenna, Belt Clip)

Receiver *(Measurement per EN300 086)*

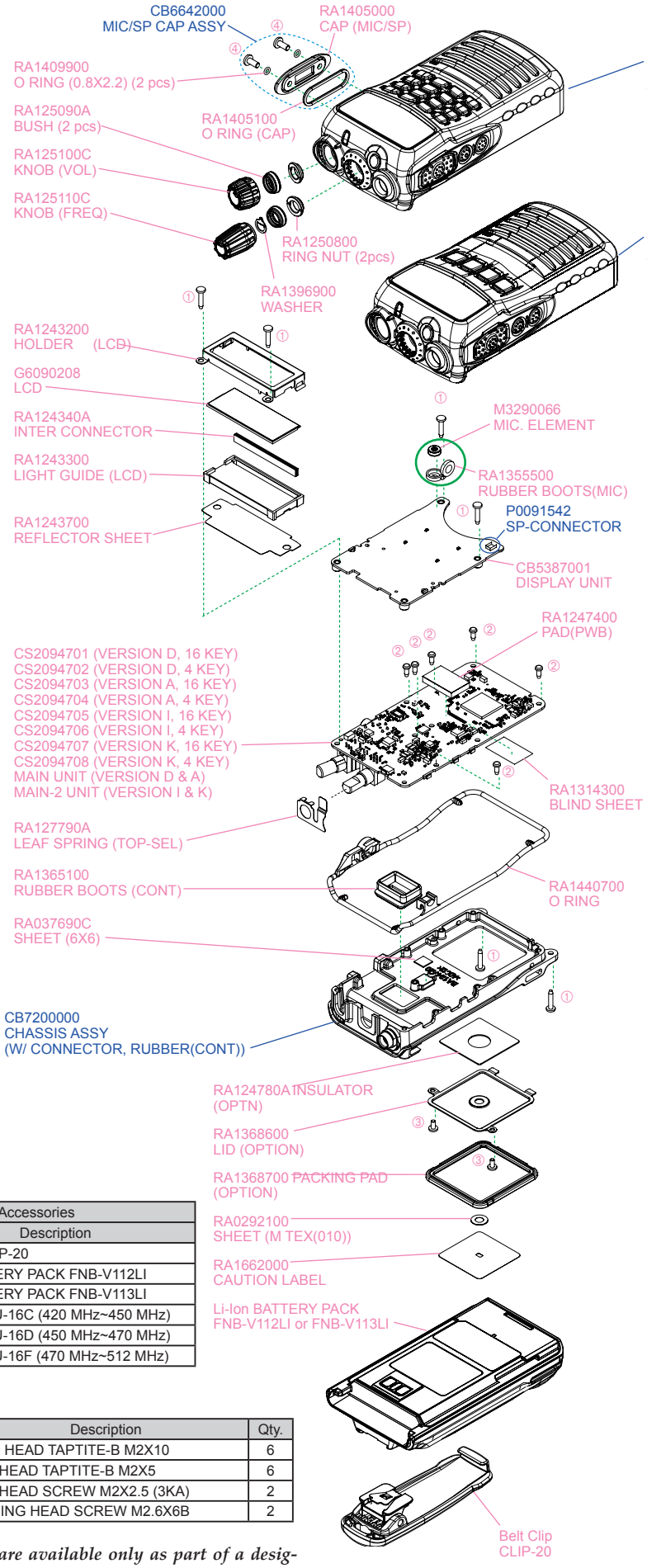
Circuit Type:	Double Conversion Super-heterodyne
Sensitivity (20 dB SINAD):	–2 dBµV
Adjacent Channel Selectivity:	70/65 dB (W/N)
Hum and Noise:	45/40 dB (W/N)
Intermodulation:	65 dB
Spurious Image Rejection:	70 dB
Audio output:	700 mW (intemal @ 16 Ohms 5% THD)
	500 mW (extemal @ 4 Ohms 5% THD)

Transmitter *(Measurement per EN300 086)*

Output Power:	5 / 2.5 / 1 /0.25 W
Modulation:	16K0F3E/11K0F3E
Maximum Deviation:	±5.0 kHz / ±2.5 kHz
Spurious Emissions:	–36 dBm (<1 GHz), –30 dBm (>1 GHz)
FM Hum & Noise:	45 dB / 40 dB
Audio Distortion:	< 3% @ 1kHz

Specifications subject to change without notice or obligation.

Exploded View & Miscellaneous Parts (16 key & 4 key Type)



Optional Accessories	
VXSTD P/N	Description
AAH12X501	Belt Clip CLIP-20
AAH07X501	Li-Ion BATTERY PACK FNB-V112LI
AAH08X501	Li-Ion BATTERY PACK FNB-V113LI
AAH72X502	Antenna ATU-16C (420 MHz~450 MHz)
AAH72X503	Antenna ATU-16D (450 MHz~470 MHz)
AAH72X504	Antenna ATU-16F (470 MHz~512 MHz)

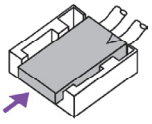
Ref.	VXSTD P/N	Description	Qty.
①	U24110001	BIND HEAD TAPTITE-B M2X10	6
②	U44105001	PAN HEAD TAPTITE-B M2X5	6
③	U07225001	PAN HEAD SCREW M2X2.5 (3KA)	2
④	U20206007	BINDING HEAD SCREW M2.6X6B	2

Non-designated parts are available only as part of a designated assembly.

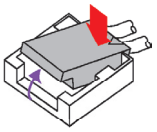
Please remove the speaker connector from DISPLAY Unit when you remove a FRONT Case of the transceiver.

SP-Connector Unmating Operation

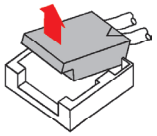
1. Hook the lever.



2. Pull up friction lock is released.

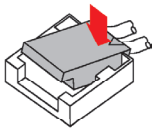


3. Positive lock is released and removal completes.

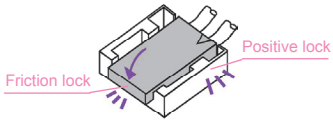


SP-Connector Mating Operation

1.Insert the cable side first.

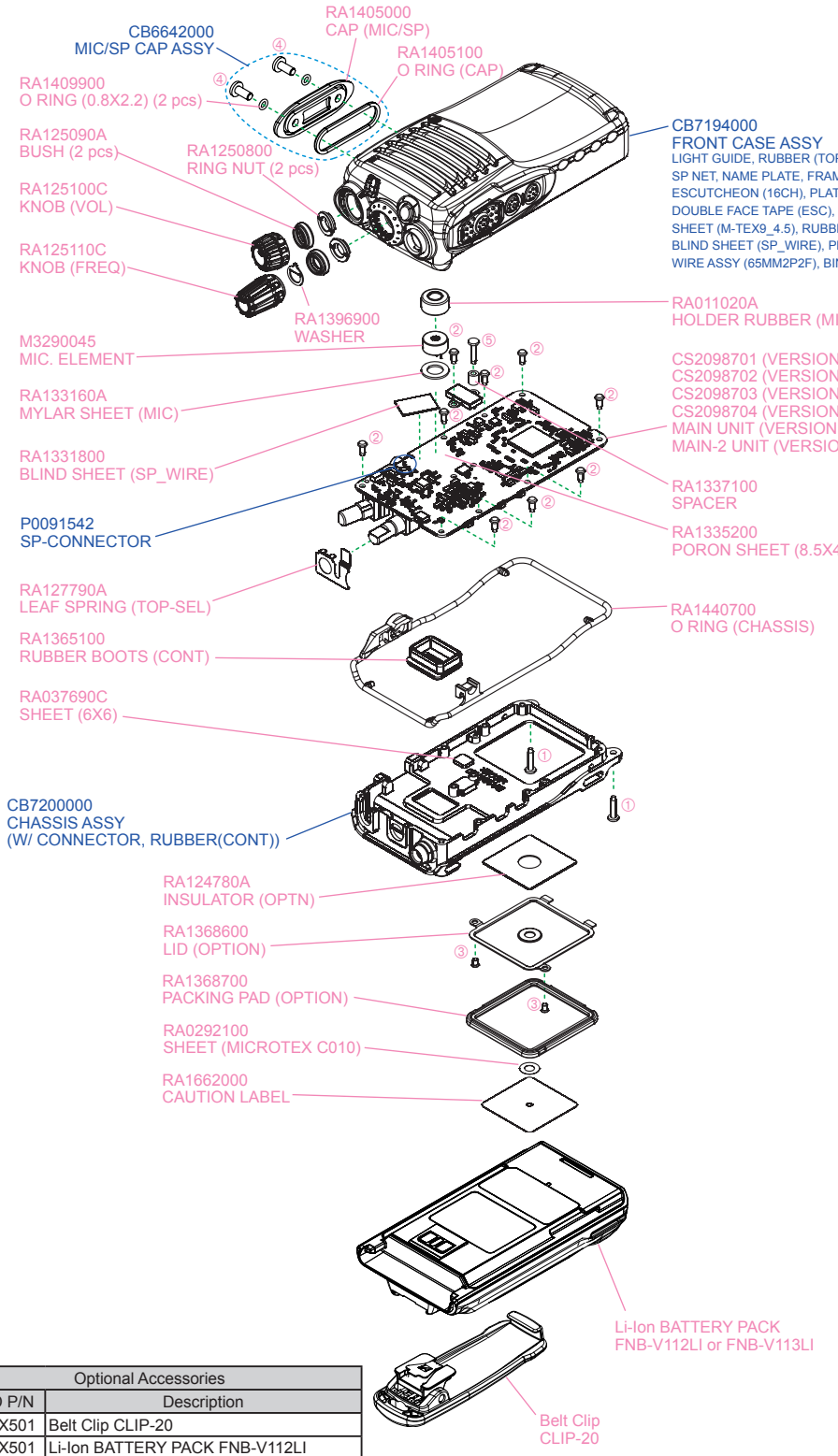


2.Press down at the lever side.



NOTE: Horizontal mating could damage the connector.

Exploded View & Miscellaneous Parts (Non key Type)



Optional Accessories	
VXSTD P/N	Description
AAH12X501	Belt Clip CLIP-20
AAH07X501	Li-Ion BATTERY PACK FNB-V112LI
AAH08X501	Li-Ion BATTERY PACK FNB-V113LI
AAH72X502	Antenna ATU-16C (420 MHz~450 MHz)
AAH72X503	Antenna ATU-16D (450 MHz~470 MHz)
AAH72X504	Antenna ATU-16F (470 MHz~512 MHz)

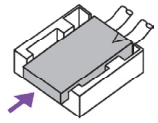
Ref.	VXSTD P/N	Description	Qty.
①	U24110001	BIND HEAD TAPTITE-B M2X10	2
②	U44105001	PAN HEAD TAPTITE-B M2X5	9
③	U07225001	PAN HEAD SCREW M2X2.5 (3KA)	2
④	U20206007	BINDING HEAD SCREW M2.6X6B	2
⑤	U44110002	PAN HEAD TAPTITE-B M2X10NI	1

Non-designated parts are available only as part of a designated assembly.

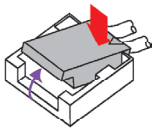
Please remove the speaker connector from DISPLAY Unit when you remove a FRONT Case of the transceiver.

SP-Connector Unmating Operation

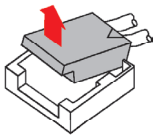
1. Hook the lever.



2. Pull up friction lock is released.

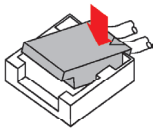


3. Positive lock is released and removal completes.

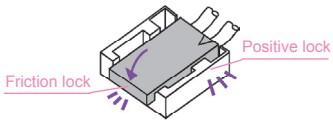


SP-Connector Mating Operation

1.Insert the cable side first.



2.Press down at the lever side.



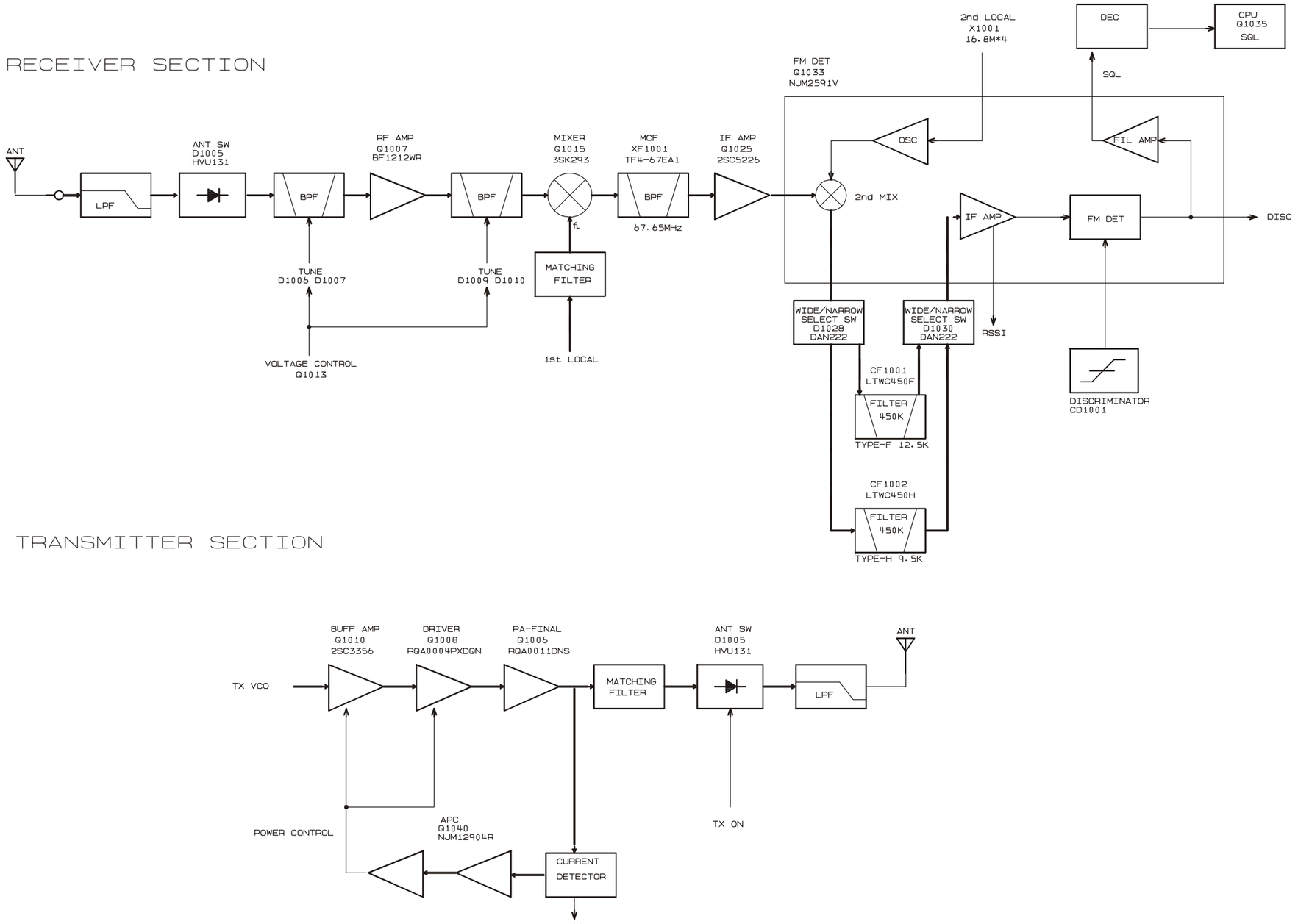
NOTE: Horizontal mating could damage the connector.

Parts List

REF.	DESCRIPTION	VALUE	V/W	TOL.	MFR'S DESIG	VXSTD P/N	VERS.	LOT.	SIDE	LAY ADR
					PCB with Components					
	MAIN UNIT (VERSION A & D)									
						CS2094702	VERSION D, 16 KEY & 4 KEY			
						CS2094704	VERSION A, 16 KEY & 4 KEY			
						CS2098701	VERSION D, NON KEY			
						CS2098702	VERSION A, NON KEY			
	MAIN-2 UNIT (VERSION I & K)									
						CS2094706	VERSION I, 16 KEY & 4 KEY			
						CS2094708	VERSION K, 16 KEY & 4 KEY			
						CS2098703	VERSION I, NON KEY			
						CS2098704	VERSION K, NON KEY			
	DISPLAY UNIT					CB5387001	16 KEY & 4 KEY			
					Mechanical Parts					
	FRONT CASE ASSY					CB7192000	16 KEY			
						CB7193000	4 KEY			
						CB7194000	NON KEY			
	CHASSIS ASSY					CB7200000				
	MIC/SP CAP ASSY					CB6642000				
	KNOB				VOL	RA125100C		1-		
	KNOB				FREQ	RA125110C		1-		
	HOLDER				LCD	RA1243200	16 KEY & 4 KEY	1-		
	LIGHT GUIDE				LCD	RA1243300	16 KEY & 4 KEY	1-		
	INTER CONNECTOR					RA124340A	16 KEY & 4 KEY	1-		
	SPONGE RUBBER				LCD	RA1243500	16 KEY & 4 KEY	1-		
	REFLECTOR SHEET					RA1243700	16 KEY & 4 KEY	1-		
	BINDING HEAD SCREW	2 pcs			M2.6X6B	U20206007		1-		
	BIND HEAD TAPTITE-B	6 pcs			2X10N	U24110001	16 KEY & 4 KEY	1-		
	BIND HEAD TAPTITE-B	2 pcs			2X10N	U24110001	NON KEY	1-		
	BIND HEAD TAPTITE-B	2 pcs			M2X5	U24105001	for Speaker	1-		
	PAN HEAD TAPTITE-B	6 pcs			M2X5	U44105001	16 KEY & 4 KEY	1-		
	PAN HEAD TAPTITE-B	9 pcs			M2X5	U44105001	NON KEY	1-		
	PAN HEAD SCREW	2 pcs			M2X2.5 (3KA)	U07225001		1-		
	PAN HEAD TAPTITE-B	1 pc			M2X10	U44110002	NON KEY	1-		

Parts List

REF.	DESCRIPTION	VALUE	V/W	TOL.	MFR'S DESIG	VXSTD P/N	VERS.	LOT.	SIDE	LAY ADR
MAIN UNIT (VERSION A & D)										
CD1001	CERAMIC DISC				ECDA450C24	H7901460		1-	B	c3
CF1001	CERAMIC FILTER				LTWC450F	H3900563		1-	B	a3
CF1002	CERAMIC FILTER				LTWC450H	H3900584		1-	B	b3
F 1001	CHIP FUSE	3.15A			FHC16 322ADTP	Q0000118		1-	A	B2
J 1008	CONNECTOR				DF57H-2P-1.2V(21)	P0091595	NON KEY	1-	A	B1
MC1001	MIC. ELEMENT				PF0-1055P	M3290045	NON KEY	1-	A	C2
Q 1006	FET				RQA0011DNS#G0	G3070507		1-	A	C2
S 1001	TACT SWITCH				EVQPUB02K	N5090167		1-	B	f4
S 1002	TACT SWITCH				EVQPUB02K	N5090167		1-	B	d4
S 1003	TACT SWITCH				EVQPUB02K	N5090167		1-	B	e4
S 1004	TACT SWITCH				EVQPUB02K	N5090167		1-	A	A1
S 1005	ROTARY SWITCH				TP7NBPC16 14.7F RY-10115	N0190198		1-	B	g2
SC1001	SHIELD CASE				VCO	RA1250300		1-	B	c2
TH1001	THERMISTOR				TH05 4B473FR	G9090150		1-	A	F3
VR1001	POT.				TP76N975N13.5FB503RY10034	J60800314		1-	B	g1
X 1001	TCXO	16.8MHz			HKE3149A 16.8MHZ	H9501060		1-	B	b2
X 1002	XTAL	32.768kHz			4809995L18 32.768KHZ	H0103407		1-	A	F1
XF1001	XTAL FILTER				MFT67P 67.650MHZ	H1102471		1-	B	d3
MAIN-2 UNIT (VERSION I & K)										
CD3001	CERAMIC DISC				ECDA450C24	H7901460		1-	B	c3
CF3001	CERAMIC FILTER				LTWC450F	H3900563		1-	B	a3
CF3002	CERAMIC FILTER				LTWC450H	H3900584		1-	B	b3
F 3001	CHIP FUSE	3.15A			FHC16 322ADTP	Q0000118		1-	A	B2
J 3008	CONNECTOR				DF57H-2P-1.2V(21)	P0091595	NON KEY	1-	A	B1
MC3001	MIC. ELEMENT				PF0-1055P	M3290045	NON KEY	1-	A	C1
Q 3006	FET				RQA0011DNS#G0	G3070507		1-	A	C2
S 3001	TACT SWITCH				EVQPUB02K	N5090167		1-	B	f4
S 3002	TACT SWITCH				EVQPUB02K	N5090167		1-	B	d4
S 3003	TACT SWITCH				EVQPUB02K	N5090167		1-	B	e4
S 3004	TACT SWITCH				EVQPUB02K	N5090167		1-	A	A3
S 3005	ROTARY SWITCH				TP7NBPC16 14.7F RY-10115	N0190198		1-	B	g2
SC3001	SHIELD CASE				VCO	RA1250300		1-	B	c2
TH3001	THERMISTOR				TH05 4B473FR	G9090150		1-	A	F3
VR3001	POT.				TP76N975N13.5FB503RY10034	J60800314		1-	B	g1
X 3001	TCXO	16.8MHz			HKE3149A 16.8MHZ	H9501060		1-	B	b2
X 3002	XTAL	32.768kHz			4809995L18 32.768KHZ	H0103407		1-	A	F1
XF3001	XTAL FILTER				MFT67P 67.650MHZ	H1102471	VERSION I	1-	B	d3
XF3001	XTAL FILTER				1D50811GQ6 50.85M	H1102491	VERSION K	1-	B	d3
DISPLAY UNIT (16 KEY & 4 KEY)										
DS2001	LCD				GS-35719-TFZWH	G6090208		1-	A	B2
J 2002	CONNECTOR				DF57H-2P-1.2V(21)	P0091595		1-	A	E3
MC2001	MIC. ELEMENT				EM240T	M3290066		1-	A	E1


RECEIVER SECTION
ANT
LPF
ANT SW
D1005
HVU131
BPF
RF AMP
Q1007
BF1212WR
BPF
MIXER
Q1015
3SK293
fL
MATCHING
FILTER
1st LOCAL
MCF
XF1001
TF4-67EA1
BPF
67.65MHz
IF AMP
Q1025
2SC5226
TUNE
D1006 D1007
TUNE
D1009 D1010
VOLTAGE CONTROL
Q1013
FM DET
Q1033
NJM2591V
2nd LOCAL
X1001
16.8M*4
DEC
CPU
Q1035
SQL
SQL
OSC
FIL AMP
2nd MIX
IF AMP
FM DET
DISC
RSSI
WIDE/NARROW
SELECT SW
D1028
DAN222
WIDE/NARROW
SELECT SW
D1030
DAN222
CF1001
LTWC450F
FILTER
450K
TYPE-F 12.5K
DISCRIMINATOR
CD1001
CF1002
LTWC450H
FILTER
450K
TYPE-H 9.5K
TRANSMITTER SECTION
TX VCO
BUFF AMP
Q1010
2SC3356
DRIVER
Q1008
RQA0004PXDQN
PA-FINAL
Q1006
RQA0011DNS
MATCHING
FILTER
ANT SW
D1005
HVU131
LPF
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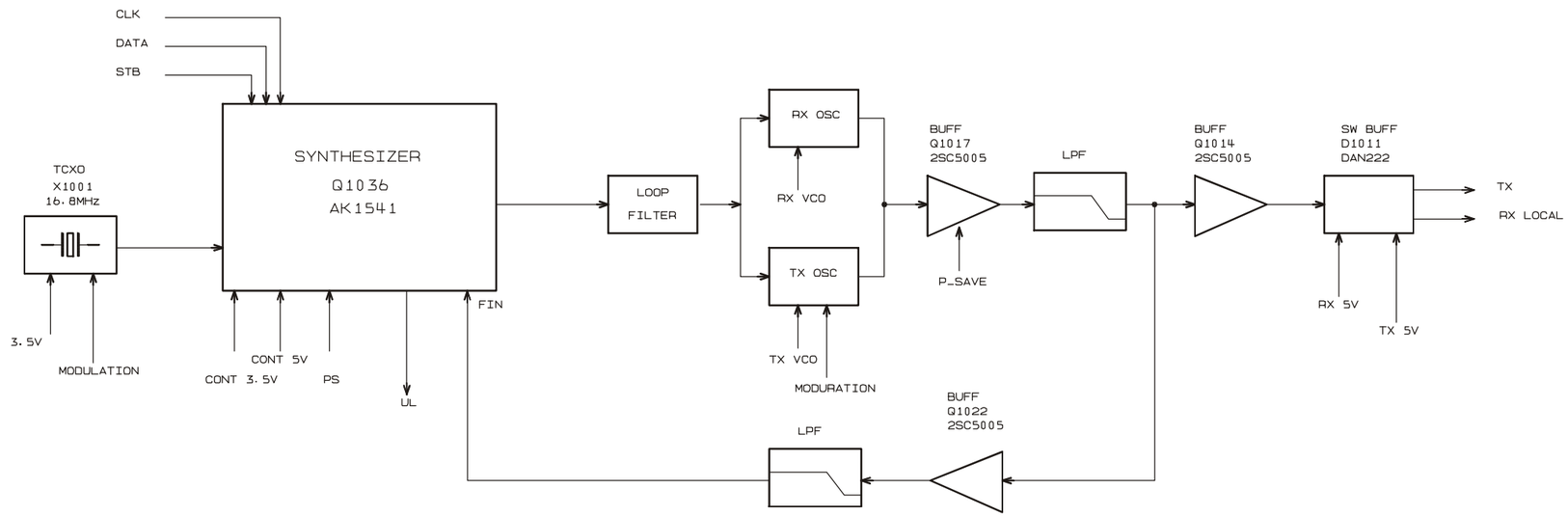
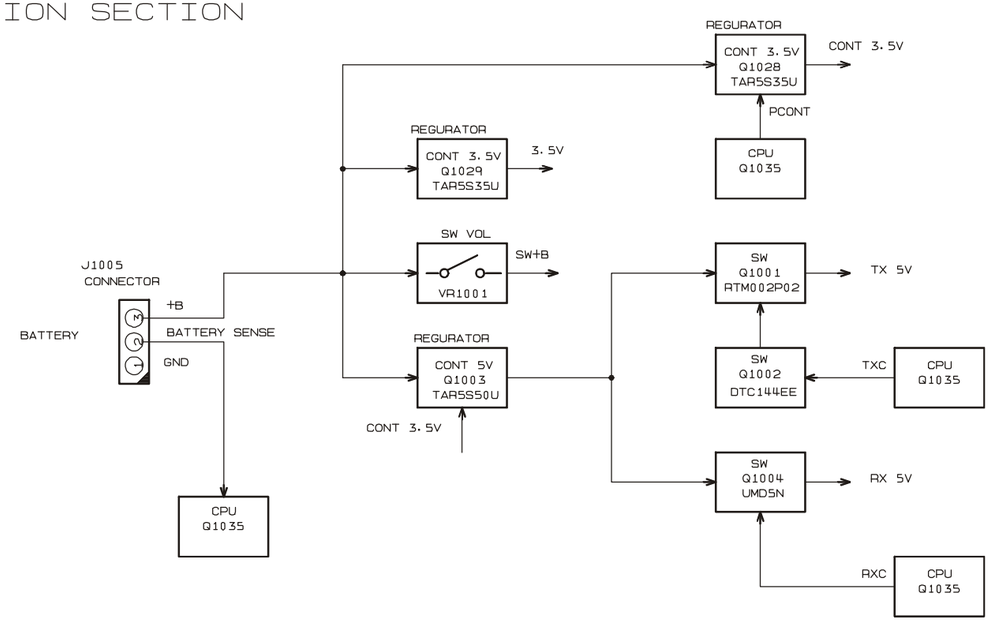
TX ON
POWER CONTROL
APC
Q1040
NJM12904R
CURRENT
DETECTOR
VCC

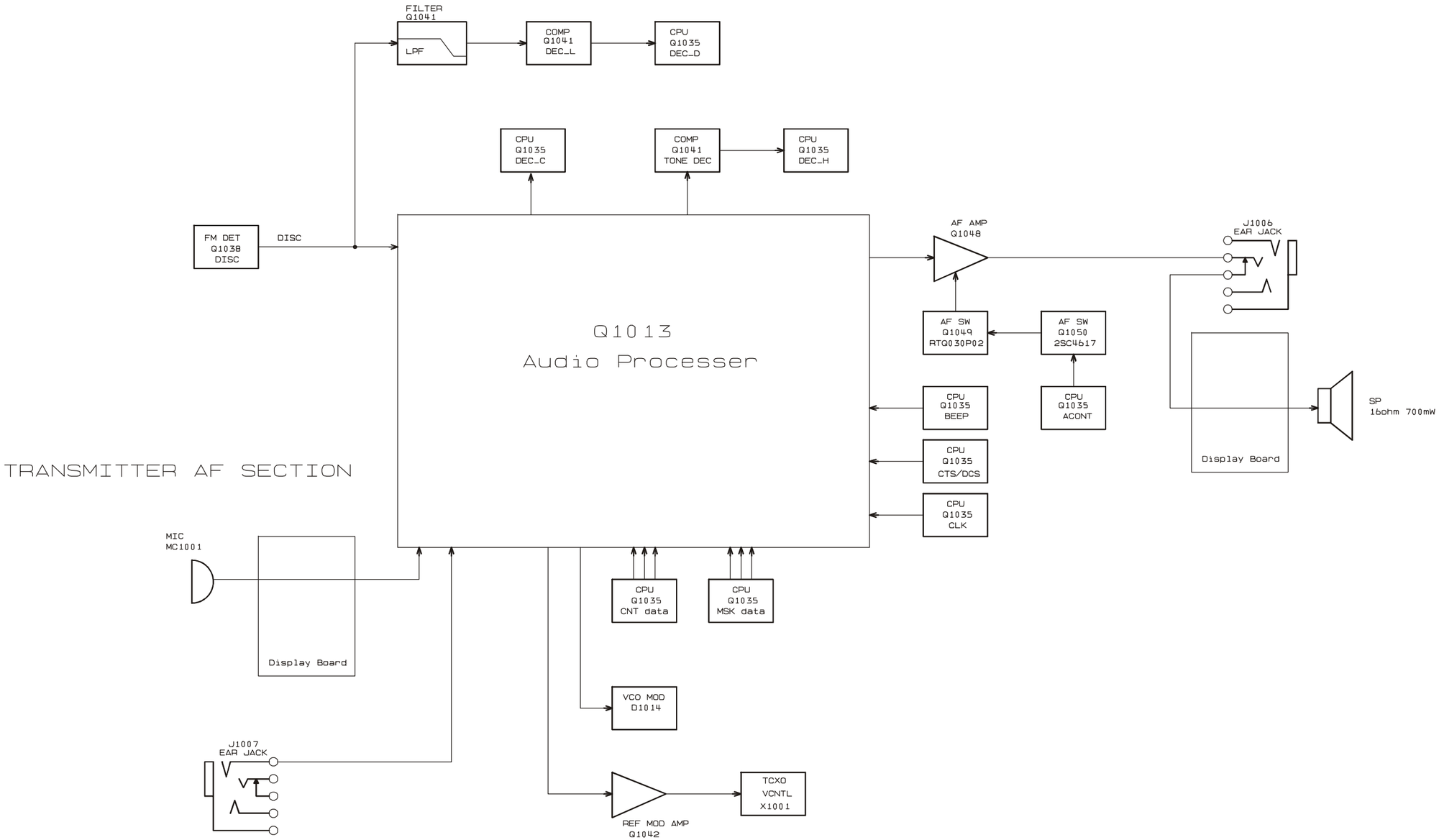
FREQUENCY GENERATION SECTION



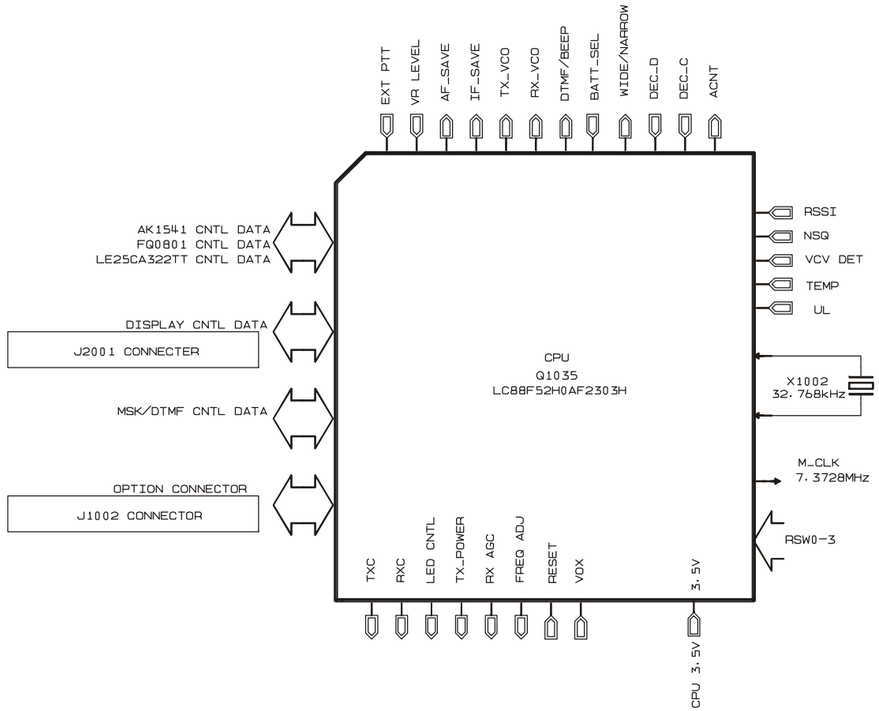
REGURATION SECTION



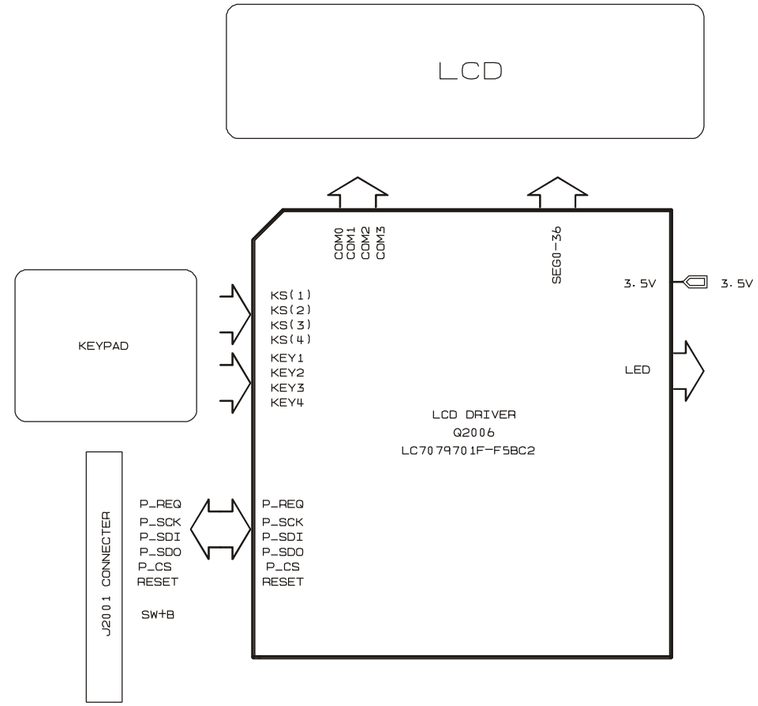
RECEIVER AF SECTION



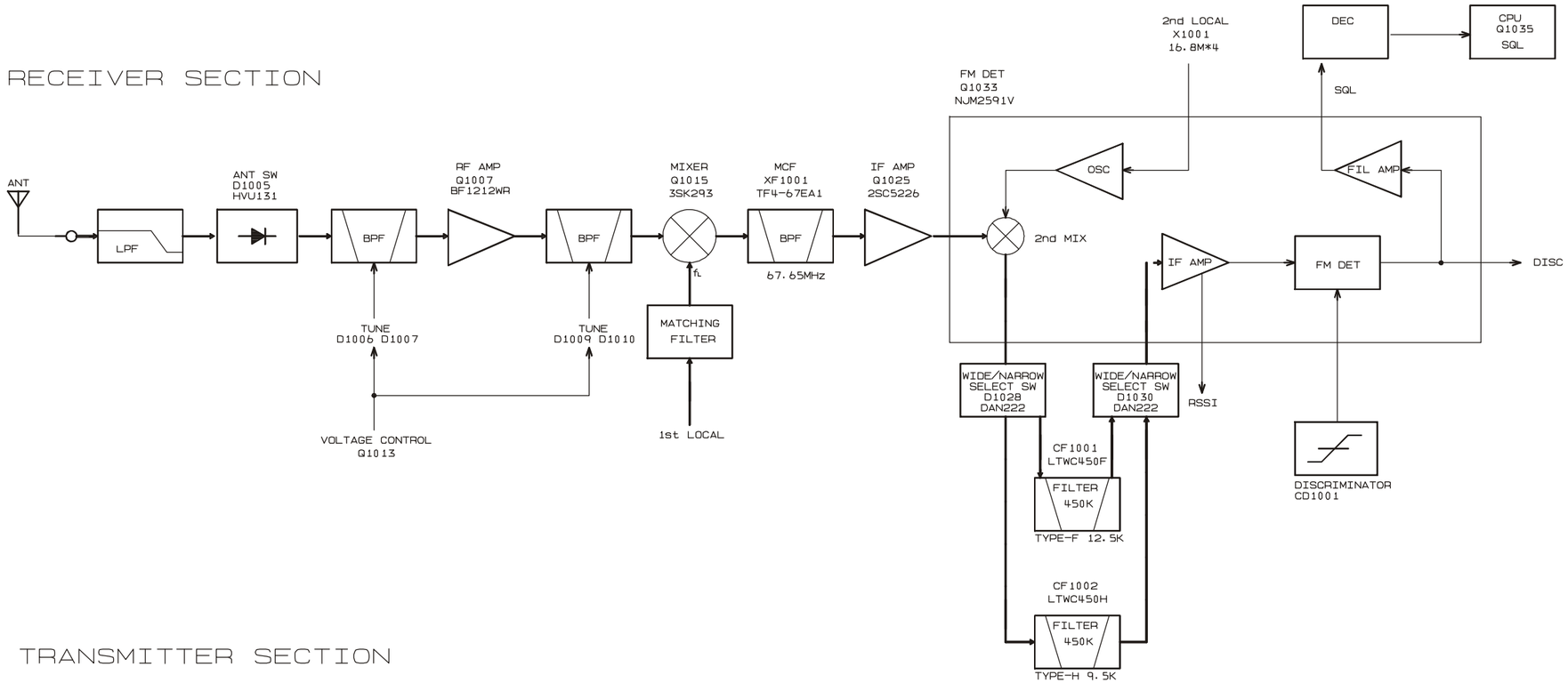
MAIN UNIT



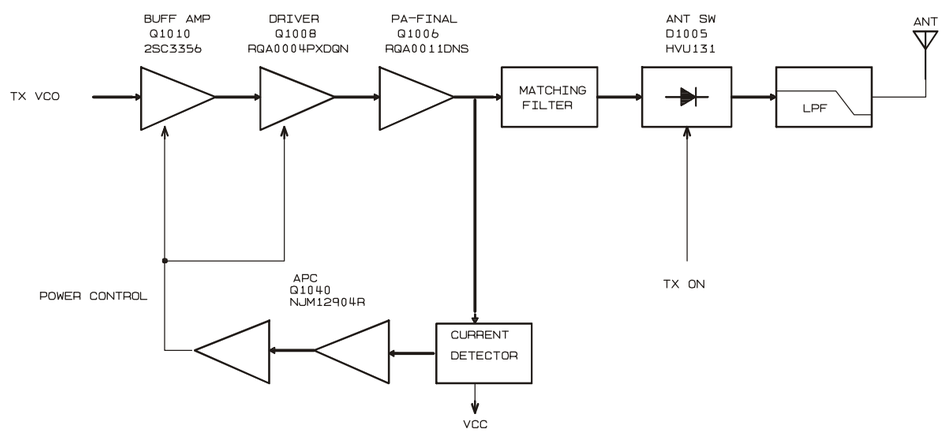
DISPLAY UNIT



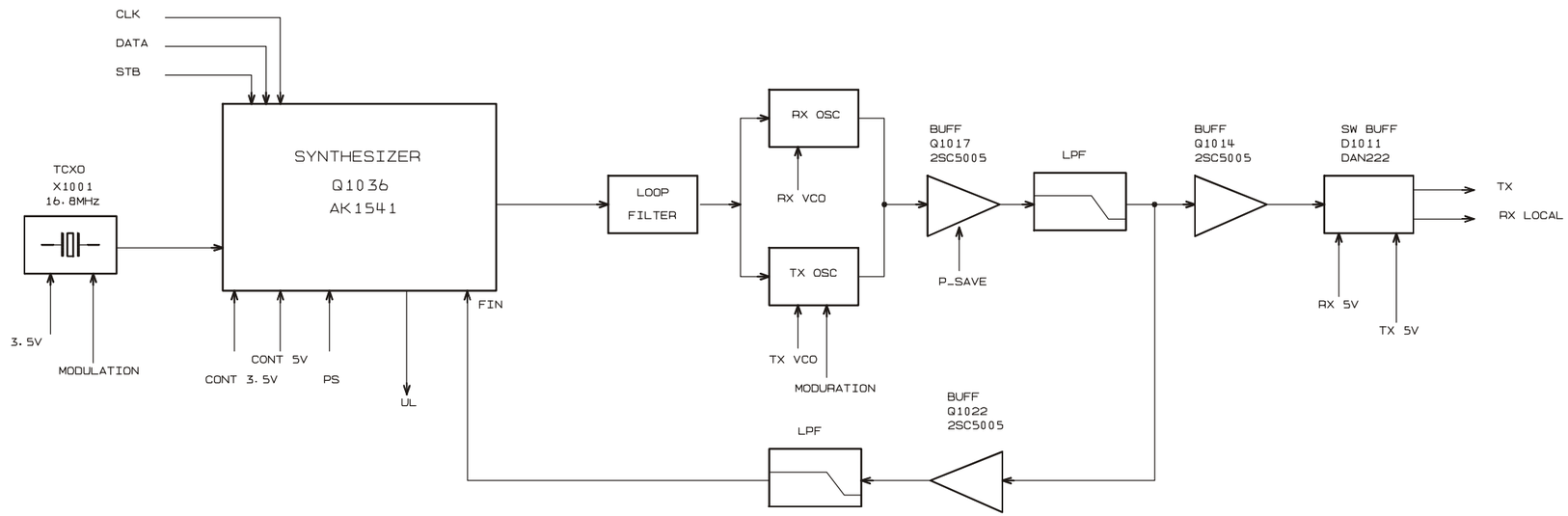
RECEIVER SECTION



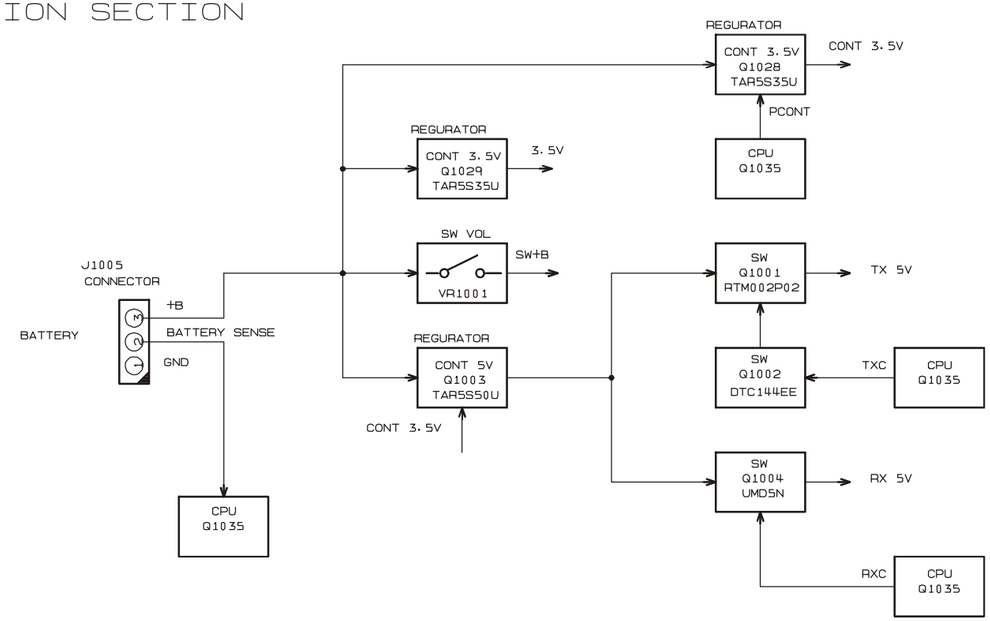
TRANSMITTER SECTION



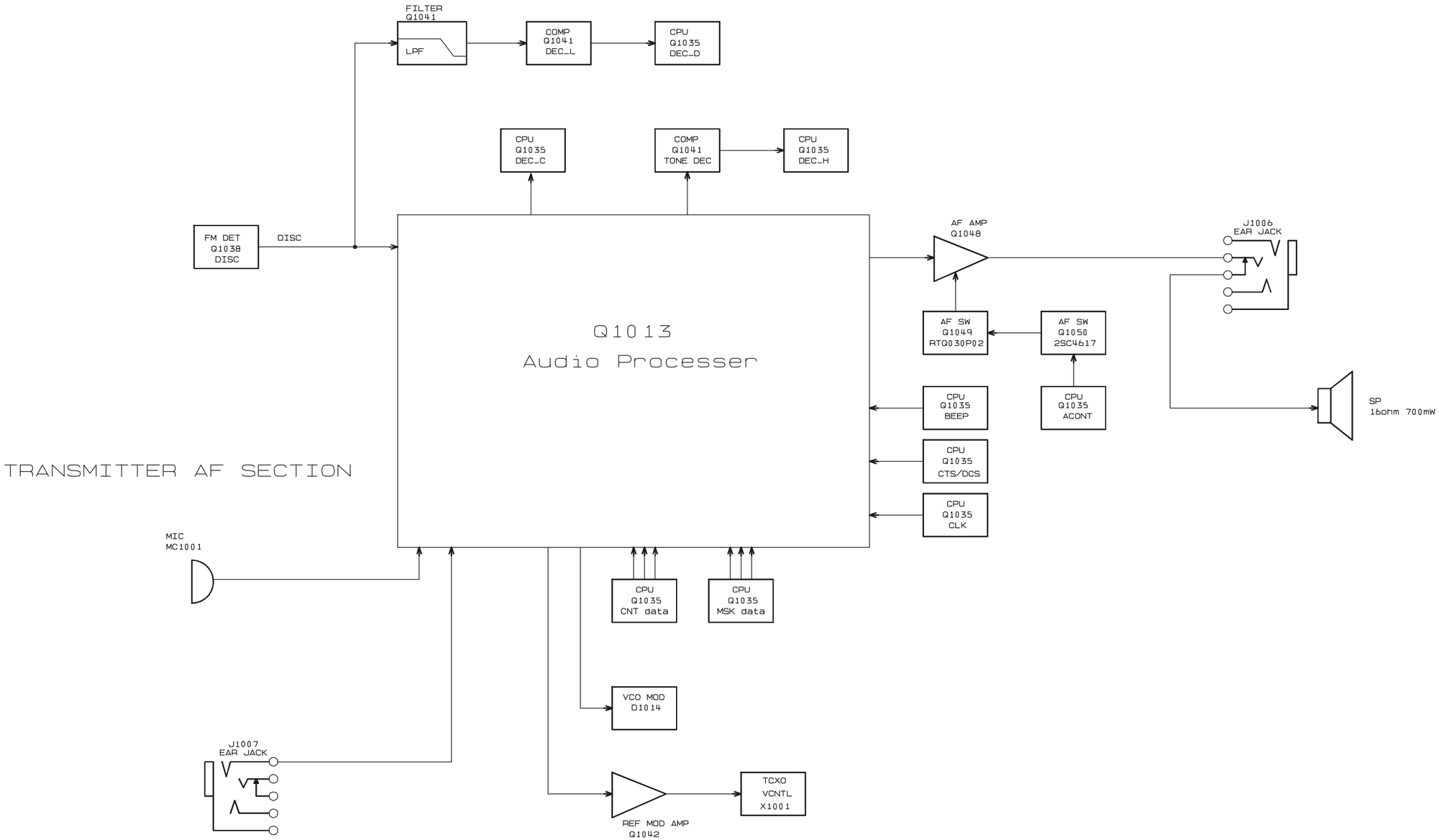
FREQUENCY GENERATION SECTION



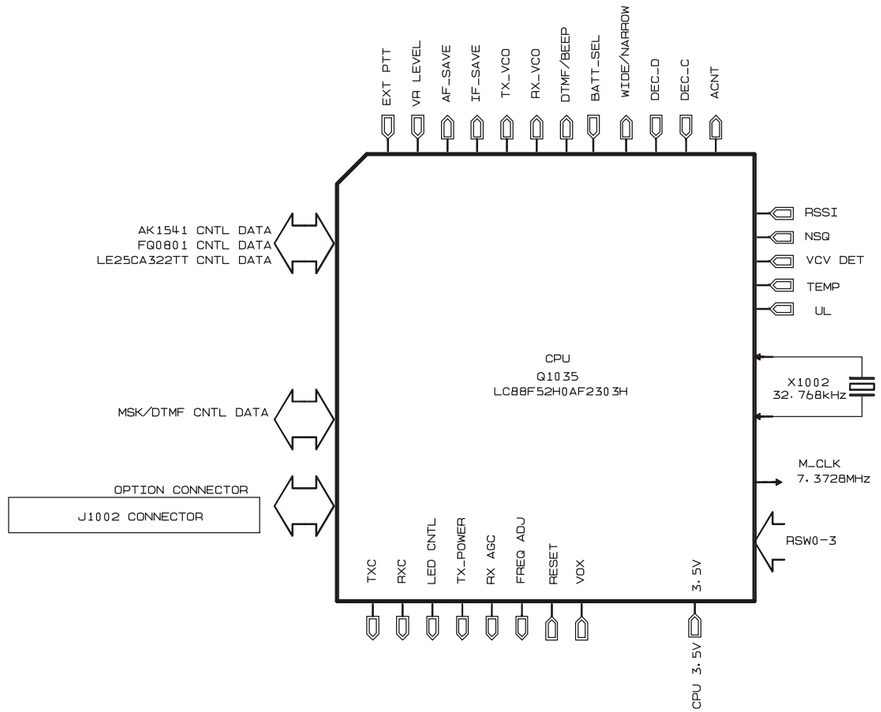
REGURATION SECTION

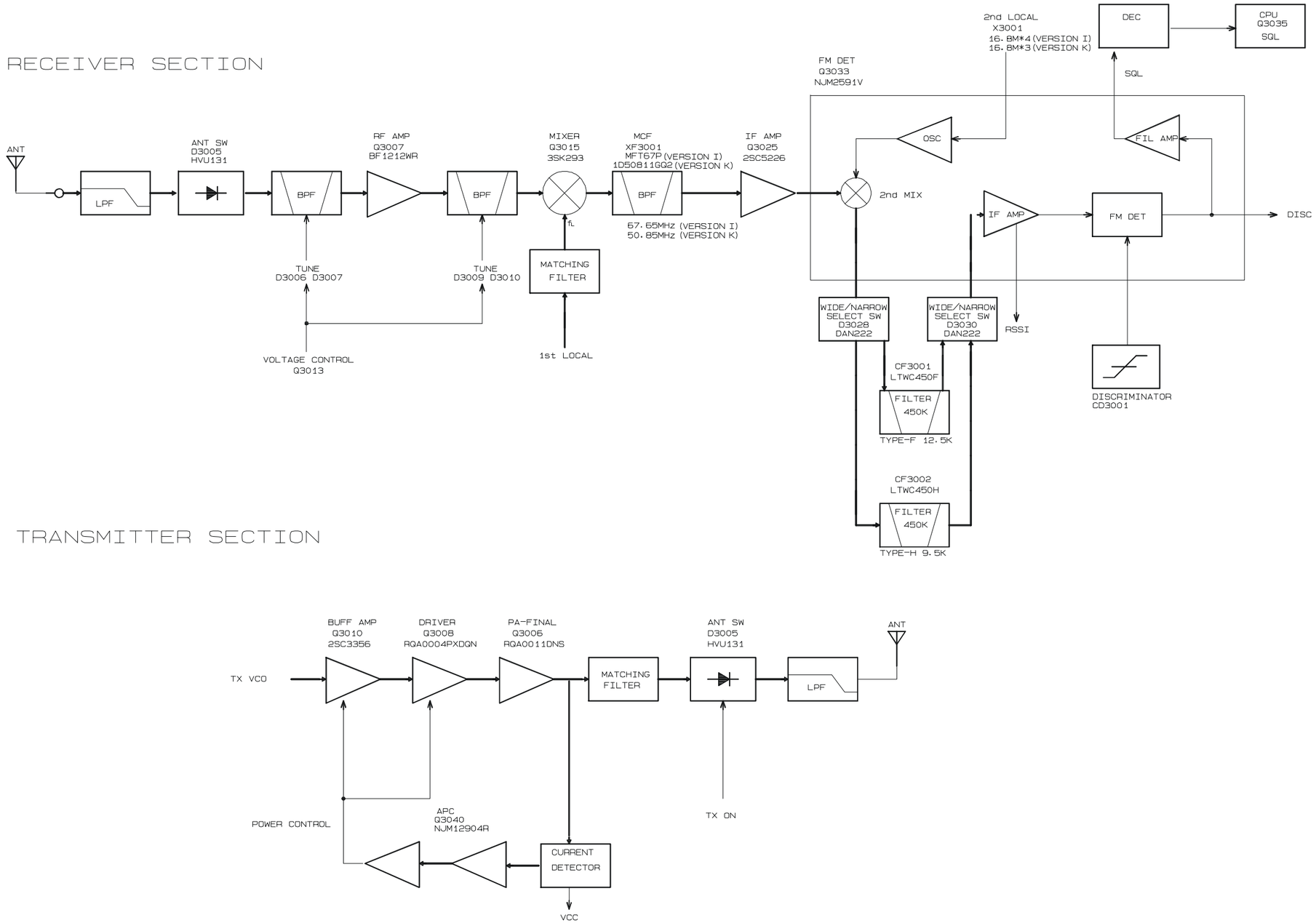


RECEIVER AF SECTION

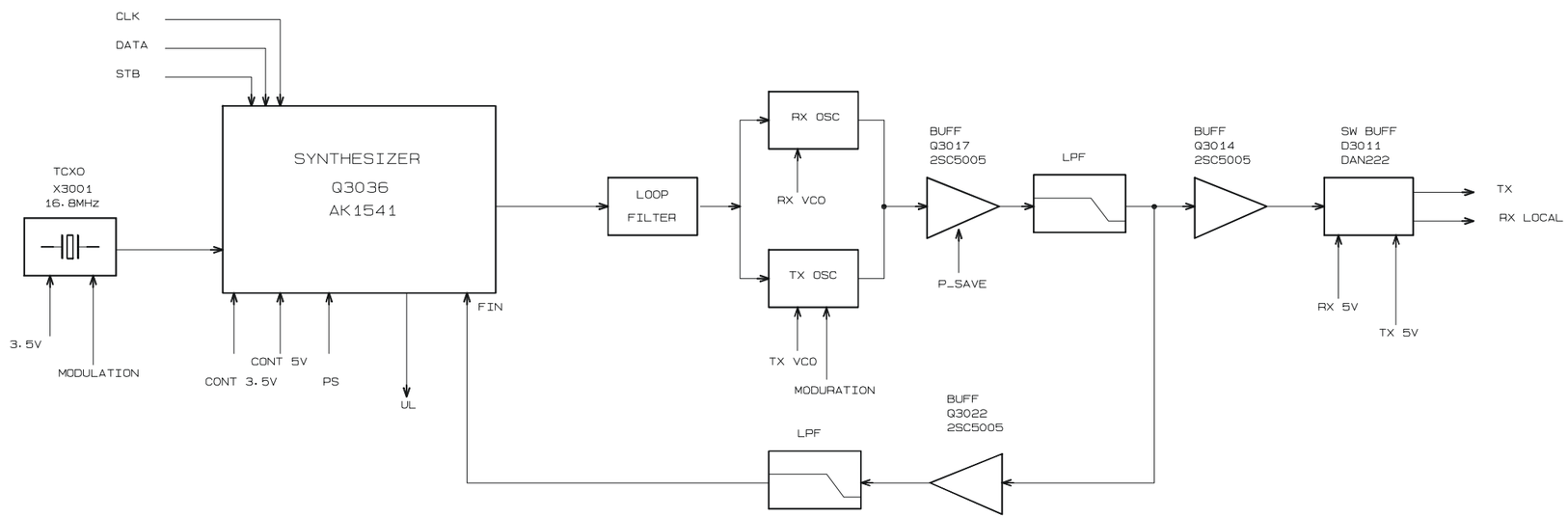


TRANSMITTER AF SECTION

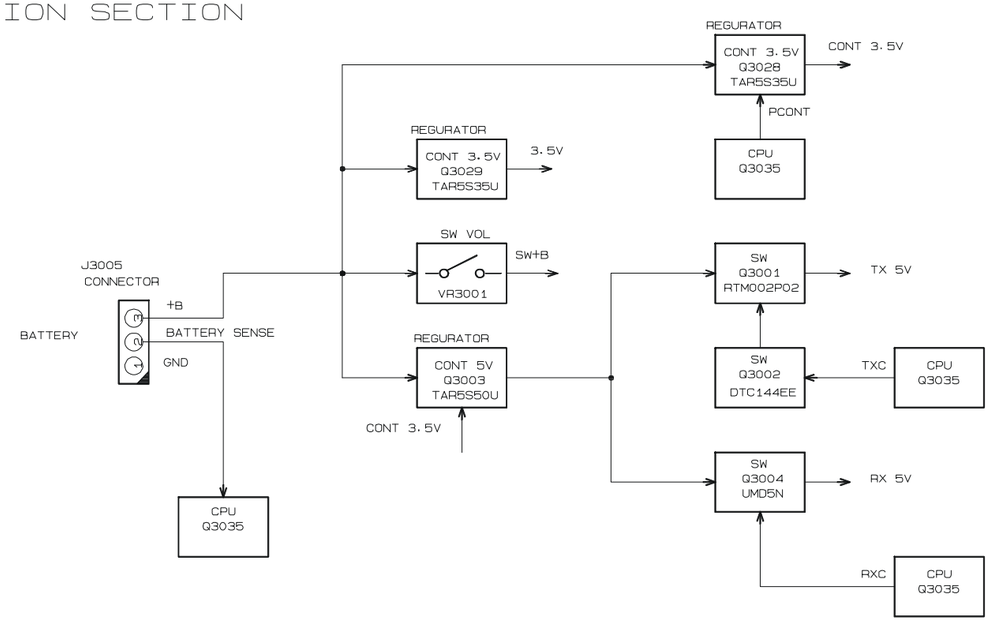

EXT PTT
VR LEVEL
AF_SAVE
IF_SAVE
TX_VCO
RX_VCO
DTMF/BEEP
BATT_SEL
WIDE/NARROW
DEC_D
DEC_C
ACNT
AK1541 CNTL DATA
FQ0801 CNTL DATA
LE25CA322TT CNTL DATA
MSK/DTMF CNTL DATA
OPTION CONNECTOR
J1002 CONNECTOR
CPU
Q1035
LC88F52H0AF2303H
RSSI
NSQ
VCV DET
TEMP
UL
X1002
32.768kHz
M_CLK
7.3728MHz
RSW0-3
TXC
RXC
LED CNTL
TX_POWER
RX AGC
FREQ ADJ
RESET
VOX
3.5V
CPU 3.5V


RECEIVER SECTION
ANT
LPF
ANT SW
D3005
HVU131
BPF
RF AMP
Q3007
BF1212WR
BPF
MIXER
Q3015
3SK293
fL
MCF
XF3001
MFT67P(VERSION I)
1D50811GQ2(VERSION K)
BPF
57.65MHz (VERSION I)
50.85MHz (VERSION K)
IF AMP
Q3025
2SC5226
FM DET
Q3033
NJM2591V
2nd LOCAL
X3001
16.8M*4(VERSION I)
16.8M*3(VERSION K)
DEC
CPU
Q3035
SQL
SQL
OSC
FIL AMP
2nd MIX
IF AMP
FM DET
DISC
TUNE
D3006 D3007
TUNE
D3009 D3010
MATCHING
FILTER
VOLTAGE CONTROL
Q3013
1st LOCAL
WIDE/NARROW
SELECT SW
D3028
DAN222
WIDE/NARROW
SELECT SW
D3030
DAN222
RSSI
CF3001
LTWC450F
FILTER
450K
TYPE-F 12.5K
DISCRIMINATOR
CD3001
CF3002
LTWC450H
FILTER
450K
TYPE-H 9.5K
TRANSMITTER SECTION
BUFF AMP
Q3010
2SC3356
DRIVER
Q3008
RQA0004PXDQN
PA-FINAL
Q3006
RQA0011DNS
ANT SW
D3005
HVU131
ANT
TX VCO
MATCHING
FILTER
LPF
POWER CONTROL
APC
Q3040
NJM12904R
CURRENT
DETECTOR
TX ON
VCC

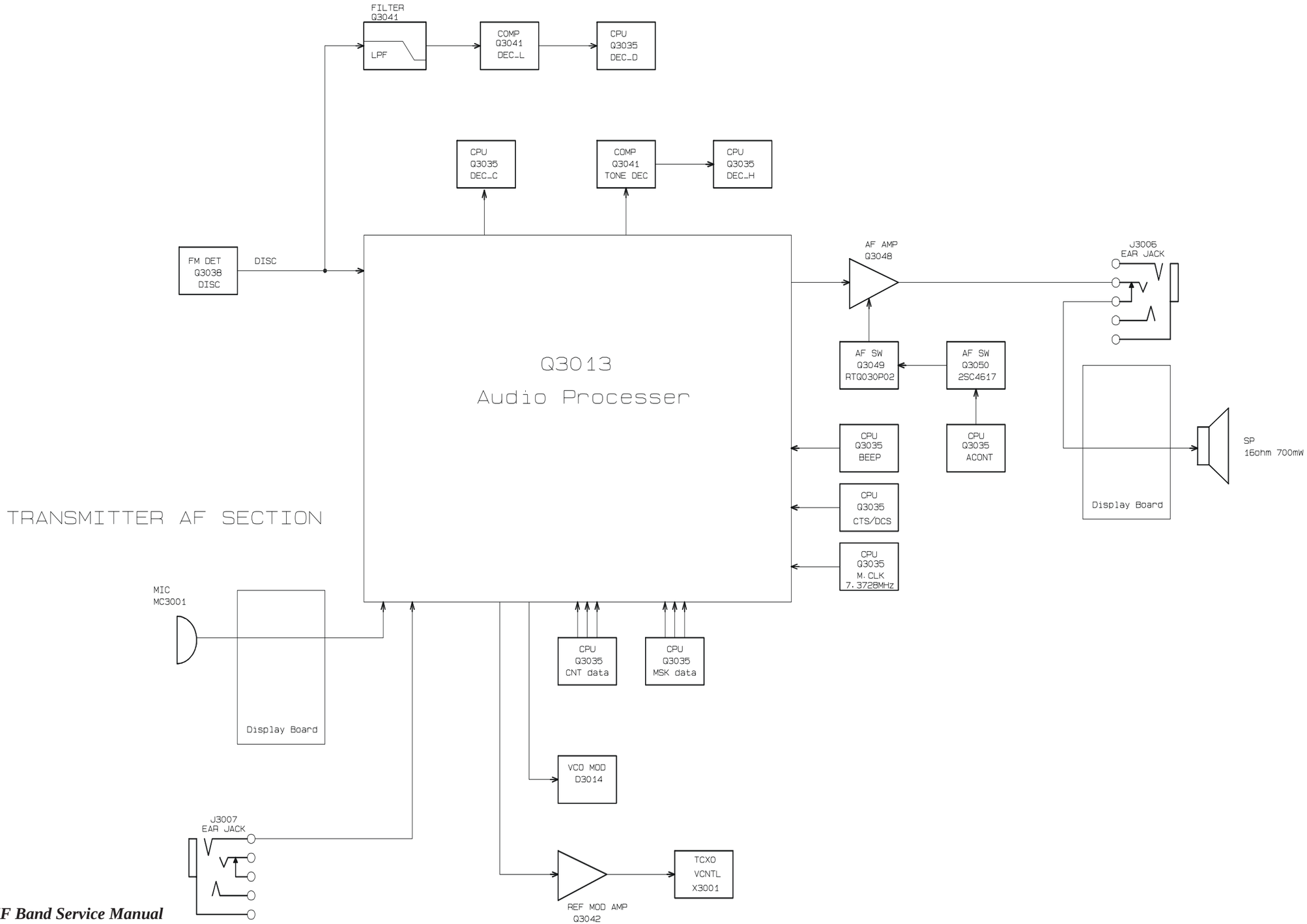
FREQUENCY GENERATION SECTION



REGURATION SECTION

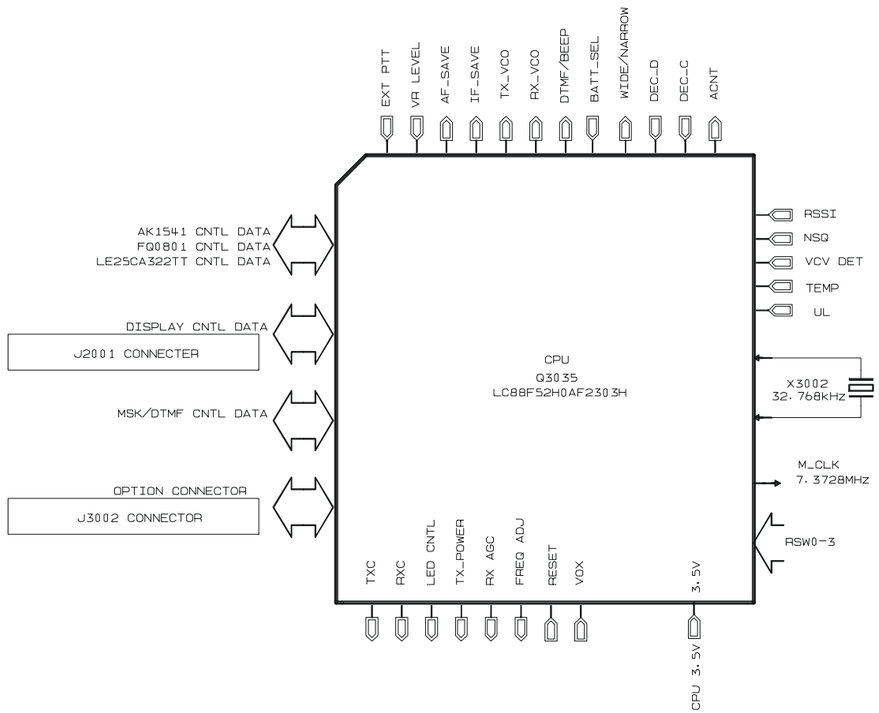


RECEIVER AF SECTION

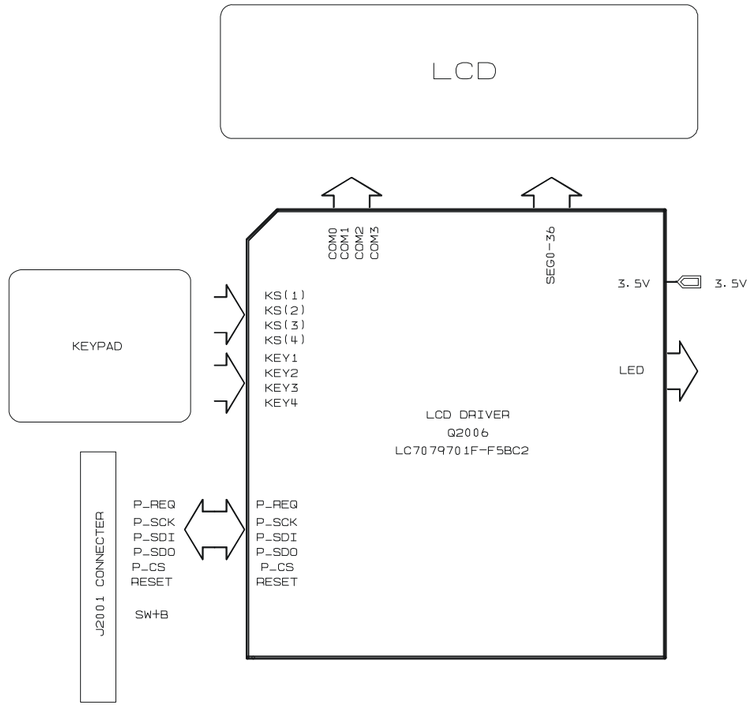


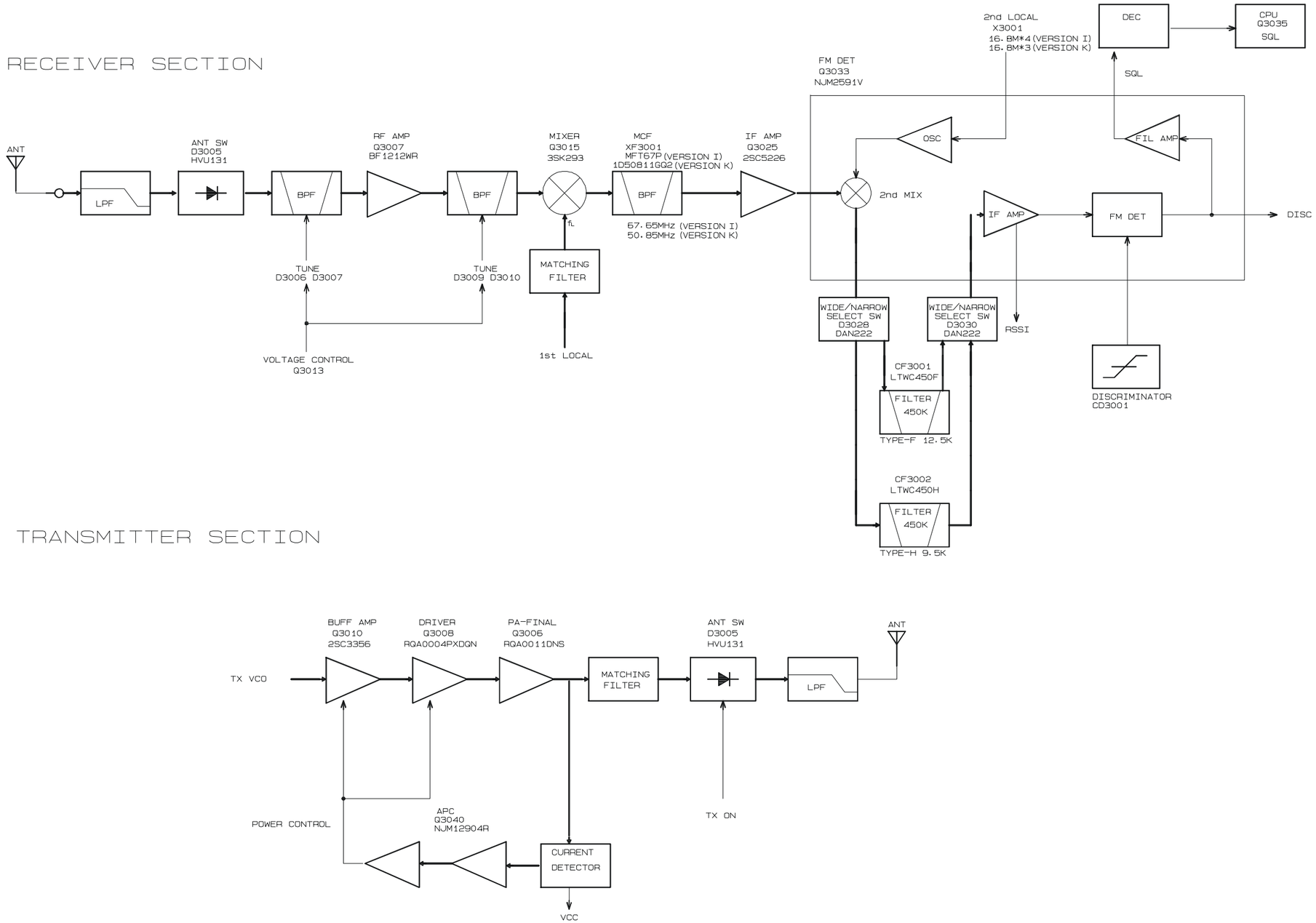
Block Diagram (Version I & K, 16 key & 4 key Type)

MAIN UNIT

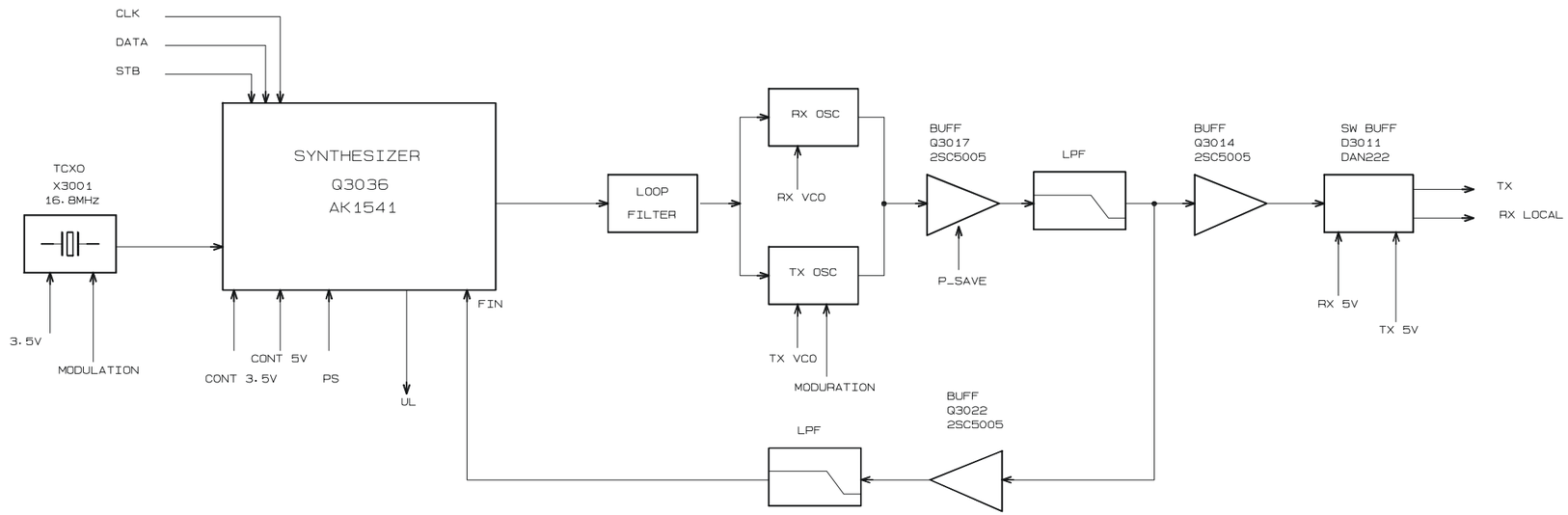


DISPLAY UNIT

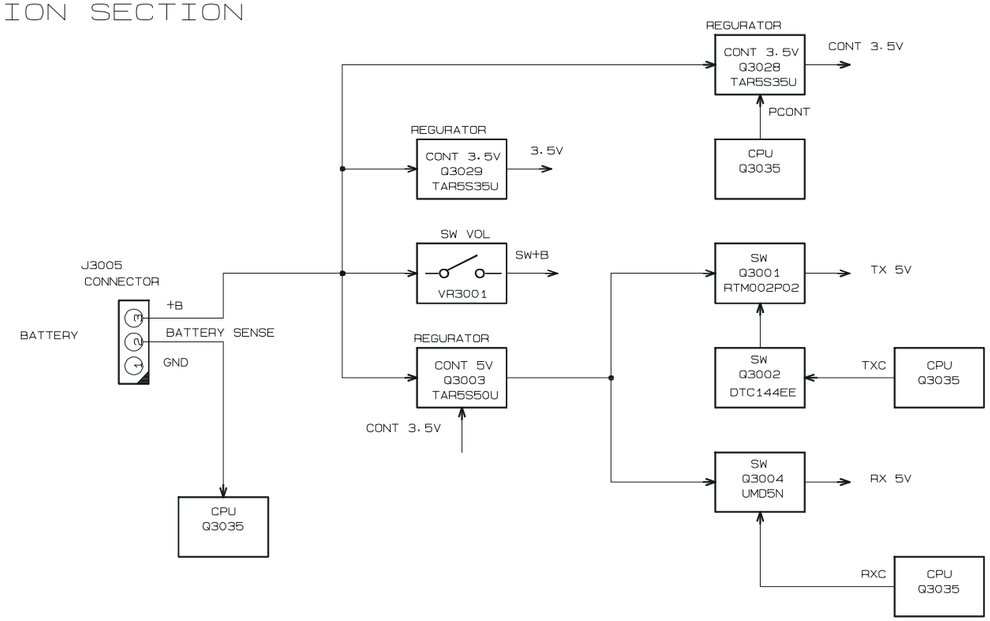


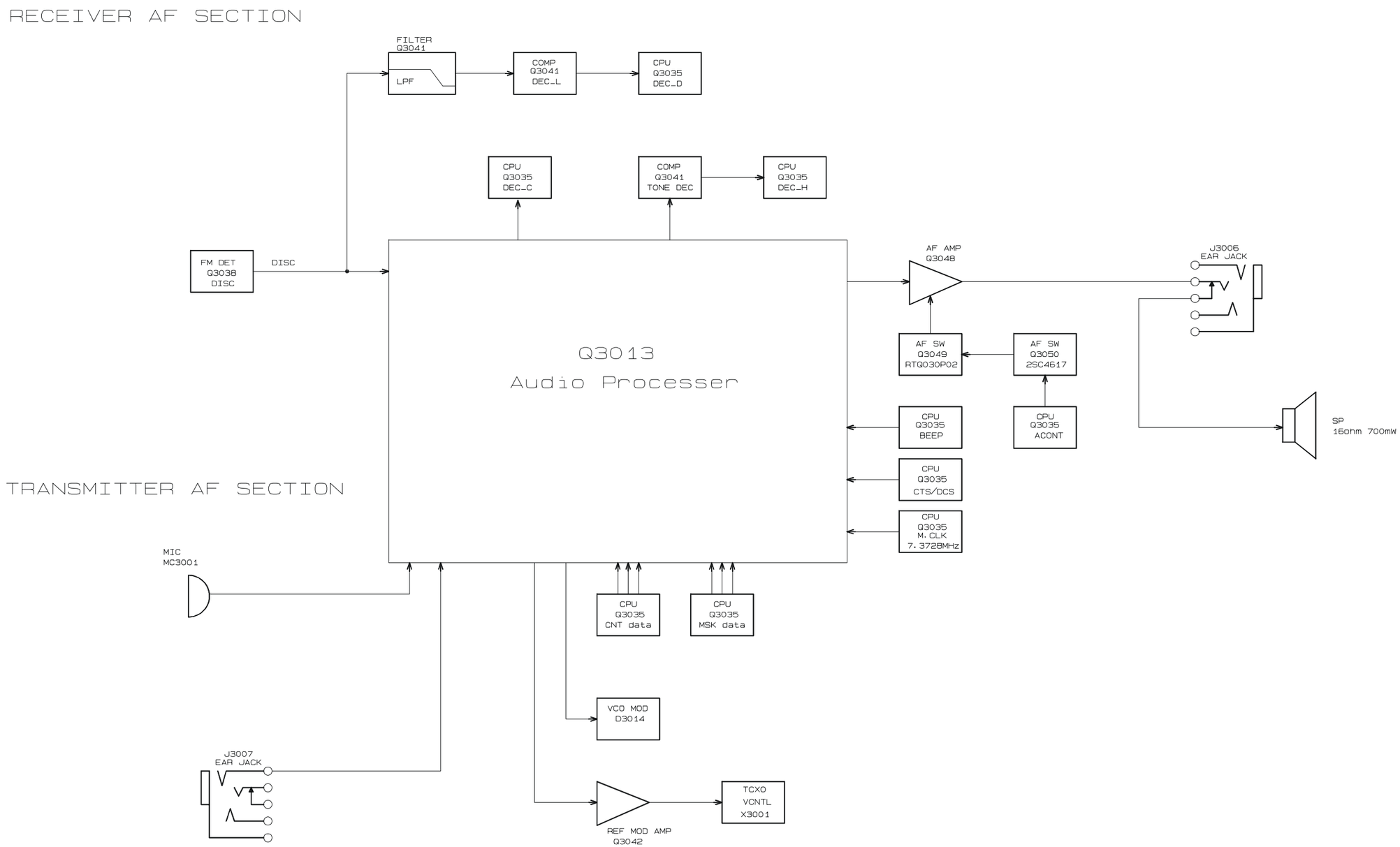

RECEIVER SECTION
ANT
LPF
ANT SW
D3005
HVU131
BPF
RF AMP
Q3007
BF1212WR
BPF
MIXER
Q3015
3SK293
fL
MCF
XF3001
MFT67P(VERSION I)
1D50811GQ2(VERSION K)
BPF
57.65MHz (VERSION I)
50.85MHz (VERSION K)
IF AMP
Q3025
2SC5226
TUNE
D3006 D3007
TUNE
D3009 D3010
MATCHING
FILTER
VOLTAGE CONTROL
Q3013
1st LOCAL
FM DET
Q3033
NJM2591V
2nd LOCAL
X3001
16.8M*4(VERSION I)
16.8M*3(VERSION K)
DEC
CPU
Q3035
SQL
SQL
OSC
FIL AMP
2nd MIX
IF AMP
FM DET
DISC
WIDE/NARROW
SELECT SW
D3028
DAN222
WIDE/NARROW
SELECT SW
D3030
DAN222
RSSI
CF3001
LTWC450F
FILTER
450K
TYPE-F 12.5K
DISCRIMINATOR
CD3001
CF3002
LTWC450H
FILTER
450K
TYPE-H 9.5K
TRANSMITTER SECTION
TX VCO
BUFF AMP
Q3010
2SC3356
DRIVER
Q3008
RQA0004PXDQN
PA-FINAL
Q3006
RQA0011DNS
MATCHING
FILTER
ANT SW
D3005
HVU131
LPF
ANT
TX ON
POWER CONTROL
APC
Q3040
NJM12904R
CURRENT
DETECTOR
VCC

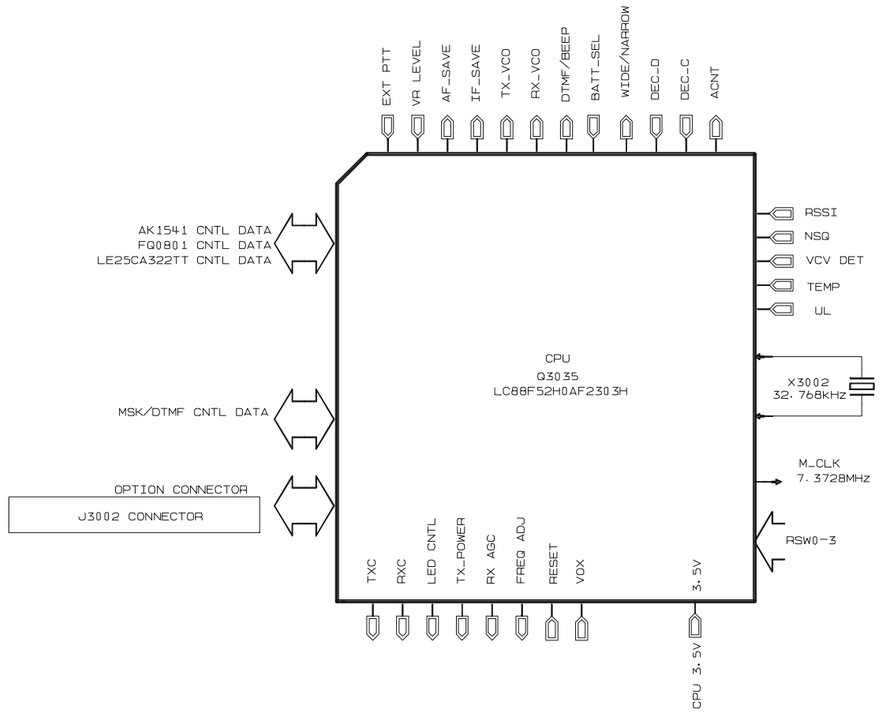
FREQUENCY GENERATION SECTION



REGURATION SECTION




RECEIVER AF SECTION
FILTER
Q3041
LPF
COMP
Q3041
DEC_L
CPU
Q3035
DEC_D
CPU
Q3035
DEC_C
COMP
Q3041
TONE DEC
CPU
Q3035
DEC_H
FM DET
Q3038
DISC
DISC
Q3013
Audio Processer
AF AMP
Q3048
J3006
EAR JACK
AF SW
Q3049
RTQ030P02
AF SW
Q3050
2SC4617
CPU
Q3035
BEEP
CPU
Q3035
ACONT
SP
16ohm 700mW
CPU
Q3035
CTS/DCS
CPU
Q3035
M.CLK
7.3728MHz
TRANSMITTER AF SECTION
MIC
MC3001
CPU
Q3035
CNT data
CPU
Q3035
MSK data
VCO MOD
D3014
J3007
EAR JACK
TCXO
VCNTL
X3001
REF MOD AMP
Q3042


EXT PTT
VR LEVEL
AF_SAVE
IF_SAVE
TX_VCO
RX_VCO
DTMF/BEEP
BATT_SEL
WIDE/NARROW
DEC_D
DEC_C
ACNT
AK1541 CNTL DATA
FQ0801 CNTL DATA
LE25CA322TT CNTL DATA
MSK/DTMF CNTL DATA
OPTION CONNECTOR
J3002 CONNECTOR
CPU
Q3035
LC88F52H0AF2303H
RSSI
NSQ
VCV DET
TEMP
UL
X3002
32.768kHz
M_CLK
7.3728MHz
RSW0-3
TXC
RXC
LED CNTL
TX_POWER
RX AGC
FREQ ADJ
RESET
VOX
3.5V
CPU 3.5V

Circuit Description (Version A & D)

1. Circuit Configuration by Frequency

The receiver is a Double-conversion Super-heterodyne with a first intermediate frequency (IF) of 67.65 MHz and a second IF of 450 kHz. Incoming signal from the antenna is mixed with the local signal from the VCO/PLL to produce the first IF of 67.65 MHz. This is then mixed with the 67.2 MHz second local oscillator output to produce the 450 kHz second IF. This is detected to give the demodulated signal.
The transmit signal frequency is generated by the PLL VCO, and modulated by the signal from the microphone. It is then amplified and sent to the antenna.

2. Receiver System

2-1. Front-end RF amplifier

Incoming RF signal from the antenna is delivered to the MAIN Unit and passes through Low-pass filer, antenna switching diode, high pass filter and removed undesired frequencies by varactor diode **D1006**, **D1007**, **D1009**, and **D1010** (tuned band-pass filer: all **1SV325**).
The passed signal is amplified in **Q1007** (**BF1212WR**) and moreover cuts an image frequency with the tuned band pass filter and comes into the 1st mixer.

2-2. First Mixer

The 1st mixer consists of the **Q1015** (**3SK293**). Buffered output from the VCO is amplified by **Q1014** (**2SC5005**) to provide a pure first local signal between 332.35 and 402.35 MHz (Version "A") or 382.35 and 452.35 MHz (Version "D") for injection to the first mixer.
The IF signal then passes through monolithic crystal filters **XF1001** (± 7.5 kHz BW) to strip away all but the desired signal.

2-3. IF Amplifier

The first IF signal is amplified by **Q1025** (**2SC5226**). The amplified first IF signal is applied to FM IF subsystem IC **Q1033** (**NJM2591V**) which contains the second mixer, second local oscillator, limiter amplifier, noise amplifier, and RSSI amplifier.
The signal from reference oscillator **X1001** becomes 4 times of frequencies in **Q1033**, it is mixed with the IF signal and becomes 450 kHz.
The second IF then passes through the ceramic filter **CF1001** or **CF1002** to strip away unwanted mixer products, and is applied to the limiter amplifier in **Q1033**, which removes amplitude variations in the 450 kHz IF, before detection of the speech by the ceramic discriminator **CD1001** (**ECDA450C24**).

2-4. Audio amplifier

Detected signal from **Q1033** (**NJM2591V**) is inputted to Audio Processor IC **Q1013**.
The signal which appeared from **Q1001** is in high pass filter **Q1041** (**NJM12902V**).
The signal which passed **Q1041** goes to AF volume (VR1001). And then the signal goes to audio amplifier **Q1048** (**TDA2822L-50B**).The output signal from **J1006** is in audio speaker.

2-5. Squelch Circuit

There are 16 levels of squelch setting from 0 to 15. The level 0 means open the squelch. The level 1 means the threshold setting level and level 14 means tight squelch. From 2 to 13 is established in the middle of threshold and tight.
The bigger figure is nearer the tight setting. The level 15 becomes setting of carrier squelch.

2-5-1. Noise Squelch

Noise squelch circuit is composed of the band path filter and noise detector of **Q1033**.
When a carrier isn't received, the noise ingredient which goes out of the demodulator **Q1033** is amplified in **Q1037** through the band path filter, is detected to DC voltage with **D1031** and is inputted to 15 pin (the A/D port) of the **Q1035** (CPU).
When a carrier is received, the DC voltage becomes low because the noise is compressed.
When the detected voltage to CPU is high, the CPU stops AF output with **Q1049** "OFF" by making the 90 pin (CPU) "L" level.
When the detection voltage is low, the CPU makes **Q1049** ON with making 90 pin "H" and the AF signal is output.

2-5-2. Carrier Squelch

The CPU (14 pin: A/D port) detect RSSI voltage output from **Q1033** 12 pin, and controls AF output.

The RSSI output voltage changes according to the signal strength of carrier. The stronger signal makes the RSSI voltage to be higher voltage.

The process of the AF signal control is same as Noise Squelch.

The shipping data is adjusted –1 dBu (EMF) higher than squelch tight sensitivity.

3. Transmitter System

3-1. MIC Amplifier

The AF signal from internal microphone **MC2001** or external microphone **J1004** in to Audio processor IC **Q1013**. (selected 34 pin or 35 pin) **Q1013** is which contains the microphone amplifier, compandor, Pre-emphasis, limiter and splatter filter, the processed signal to made FM modulation to transmit carrier by the modulator **D1014** (**HVC383B**) of VCO.

Q1013 is built-in DTMF Receiver, and Inversion Type Encryption.

3-2. Drive and Final Amplifier Stages

The modulated signal from the VCO **Q1023** (**2SC4227**) is buffered by **Q1017** (**2SC5005**) . Then the signal is buffered by **Q1010** (**2SC3356**) for the final amplifier driver **Q1015** (**RQA0004PXDQS**). The low-level transmit signal is then applied to **Q1006** (**RQA0011DNS**) for final amplification up to 5watts output power.

The transmit signal then passes through the antenna switch **D1005** (**HVU131**) and is low pass filtered to suppress away harmonic spurious radiation before delivery to the antenna.

3-3. Automatic Transmit Power Control

The current detector **Q1040-1**(**NJM12904V**) detects the current of **Q1006** and **Q1008**, and converts the current difference to the voltage difference.

The output from the current detector **Q1040-1** is compared with the reference voltage and amplified by the power control amplifier **Q1040-2**.

The output from **Q1040-2** controls the gate bias of the final amplifiers **Q1006** and the final amplifier driver **Q1008**.

The reference voltage changes into four values (Transmit Power High and Low) controlled by **Q1040** (**NJM12904V**).

4. PLL Frequency Synthesizer

The frequency synthesizer consists of PLL IC, **Q1036** (**AK1541**), VCO, TCXO (X1001).

The output frequency from TCXO is 16.8 MHz and the tolerance is ±2.5 ppm (in the temperature range –30 to +60 degrees).

4-1. VCO (Voltage-Controlled Oscillator)

While the radio is receiving, the RX oscillator **Q1019** (**2SK508**) in VCO generates a programmed frequency between 382.35 and 452.35 MHz (Version A: 332.35 and 402.35 MHz) as 1st local signal.

While the radio is transmitting, the TX oscillator **Q1023** (**2SC4227**) in VCO generates a frequency between 400 and 470 MHz (Version "A") or 450 and 512 MHz (Version "D").

The output from oscillator is amplified by buffer amplifier **Q1017** (**2SC5005**) and becomes output of VCO. The output from VCO is divided, one is amplified by **Q1022** and feed back to the PLL IC 17 pin. The other is amplified in **Q1014** and in case of the reception, it is put into the mixer as the 1st local signal through **D1011**, in transmission, it is buffered **Q1010**, and more amplified in **Q1008** and it is put into the final amplifier **Q1008**.

4-2. VCV (Varactor Control Voltage) Control

Tuning voltage of VCO is expanding the lock range of VCO by controlling the cathode of varactor diode at the voltage and the control voltage from PLL IC.

4-3. PLL

The PLL IC consists of reference divider, main divider, phase detector, charge pumps and pulse swallow operation. The reference frequency from TCXO is inputted to 10 pin of PLL IC and is divided by reference divider.

The other hand, inputted feed back signal to 17 pin of PLL IC from VCO is divided with the dividing ratio which becomes same frequency as the output of reference divider. These two signals are compared by phase detector, the phase difference pulse is generated.

Circuit Description (Version A & D)

The phase difference pulse and the pulse from through the charge pumps and LPF. It becomes the DC voltage to control the VCO.
The oscillation frequency of VCO is locked by the control of this DC voltage.
The PLL serial data from CPU is sent with three lines of SDO (40 pin), SCK (36 pin) and PSTB (30 pin).
The lock condition of PLL is output from the UL (18 pin) terminal and UL becomes “H” at the time of the lock condition and becomes “L” at the time of the unlocked condition. The CPU always watches over the UL condition, and when it becomes “L” unlocked condition, the CPU prohibits transmitting and receiving.

Circuit Description (Version I & K)

1. Circuit Configuration by Frequency

The receiver is a Double-conversion Super-heterodyne with a first intermediate frequency (IF) of 67.65 MHz (Version "I") or 50.85 MHz (Version "K") and a second IF of 450 kHz. Incoming signal from the antenna is mixed with the local signal from the VCO/PLL to produce the first IF of 67.65 MHz (Version "I") or 50.85 MHz (Version "K").
This is then mixed with the 67.2 MHz (Version "I") or 50.4 MHz (Version "K") second local oscillator output to produce the 450 kHz second IF. This is detected to give the demodulated signal.
The transmit signal frequency is generated by the PLL VCO, and modulated by the signal from the microphone. It is then amplified and sent to the antenna.

2. Receiver System

2-1. Front-end RF amplifier

Incoming RF signal from the antenna is delivered to the MAIN-2 Unit and passes through Low-pass filer, antenna switching diode, high pass filter and removed undesired frequencies by varactor diode **D3006**, **D3007**, **D3009**, and **D3010** (tuned band-pass filer: all **1SV325**).
The passed signal is amplified in **Q3007** (**BF1212WR**) and moreover cuts an image frequency with the tuned band pass filter and comes into the 1st mixer.

2-2. First Mixer

The 1st mixer consists of the **Q3015** (**3SK293**). Buffered output from the VCO is amplified by **Q3014** (**2SC5005**) to provide a pure first local signal between 282.35 and 322.35 MHz (Version "I") or 249.15 and 289.15 MHz (Version "K") for injection to the first mixer.
The IF signal then passes through monolithic crystal filters **XF3001** (± 7.5 kHz BW) to strip away all but the desired signal.

2-3. IF Amplifier

The first IF signal is amplified by **Q3025** (**2SC5226**). The amplified first IF signal is applied to FM IF subsystem IC **Q3033** (**NJM2591V**) which contains the second mixer, second local oscillator, limiter amplifier, noise amplifier, and RSSI amplifier.
The signal from reference oscillator **X3001** becomes 4 times of frequencies in **Q3033**, it is mixed with the IF signal and becomes 450 kHz.
The second IF then passes through the ceramic filter **CF3001** or **CF3002** to strip away unwanted mixer products, and is applied to the limiter amplifier in **Q3033**, which removes amplitude variations in the 450 kHz IF, before detection of the speech by the ceramic discriminator **CD3001** (**ECDA450C24**).

2-4. Audio amplifier

Detected signal from **Q3033** (**NJM2591V**) is inputted to Audio Processor IC **Q3013**.
The signal which appeared from **Q3001** is in high pass filter **Q3041** (**NJM12902V**).
The signal which passed **Q3041** goes to AF volume (VR3001). And then the signal goes to audio amplifier **Q3048** (**TDA2822L-50B**). In the 4 key & 16 key Type, the output signal from **Q3048** is fed through **J2002** on the DISPLAY Unit to the audio speaker. In the Non key Type, the output signal from **Q3048** is fed through **J3006** to the audio speaker.

2-5. Squelch Circuit

There are 16 levels of squelch setting from 0 to 15. The level 0 means open the squelch. The level 1 means the threshold setting level and level 14 means tight squelch. From 2 to 13 is established in the middle of threshold and tight.
The bigger figure is nearer the tight setting. The level 15 becomes setting of carrier squelch.

2-5-1. Noise Squelch

Noise squelch circuit is composed of the band path filter and noise detector of **Q3033**.
When a carrier isn't received, the noise ingredient which goes out of the demodulator **Q3033** is amplified in **Q3037** through the band path filter, is detected to DC voltage with **D3031** and is inputted to 15 pin (the A/D port) of the **Q3035** (CPU).
When a carrier is received, the DC voltage becomes low because the noise is compressed.
When the detected voltage to CPU is high, the CPU stops AF output with **Q3049** "OFF" by making the 90 pin (CPU) "L" level.

When the detection voltage is low, the CPU makes **Q3049** ON with making 90 pin "H" and the AF signal is output.

2-5-2. Carrier Squelch

The CPU (14 pin: A/D port) detect RSSI voltage output from **Q3033** 12 pin, and controls AF output.
The RSSI output voltage changes according to the signal strength of carrier. The stronger signal makes the RSSI voltage to be higher voltage.
The process of the AF signal control is same as Noise Squelch.
The shipping data is adjusted –1dBu (EMF) higher than squelch tight sensitivity.

3. Transmitter System

3-1. MIC Amplifier

The AF signal from internal microphone **MC2001** (Non key Type: **MC3001**) or external microphone **J3004** in to Audio processor IC **Q3013** (selected 33 pin or 34 pin). **Q3013** is which contains the microphone amplifier, compandor, Pre-emphasis, limiter and splatter filter, the processed signal to made FM modulation to transmit carrier by the modulator **D3014** (**HVC383B**) of VCO.
Q3013 is built-in DTMF Receiver, and Inversion Type Encryption.

3-2. Drive and Final Amplifier Stages

The modulated signal from the VCO **Q3023** (**2SC4227**) is buffered by **Q3017** (**2SC5005**). Then the signal is buffered by **Q3010** (**2SC3356**) for the final amplifier driver **Q3015** (**RQA0004PXDQS**). The low-level transmit signal is then applied to **Q3006** (**RQA0011DNS**) for final amplification up to 5 watts output power.
The transmit signal then passes through the antenna switch **D3005** (**HVU131**) and is low pass filtered to suppress away harmonic spurious radiation before delivery to the antenna.

3-3. Automatic Transmit Power Control

The current detector **Q3040-1** (**NJM12904V**) detects the current of **Q3006** and **Q3008**, and converts the current difference to the voltage difference.
The output from the current detector **Q3040-1** is compared with the reference voltage and amplified by the power control amplifier **Q3040-2**.
The output from **Q3040-2** controls the gate bias of the final amplifiers **Q3006** and the final amplifier driver **Q3008**.
The reference voltage changes into four values (Transmit Power High and Low) controlled by **Q3040** (**NJM12904V**).

4. PLL Frequency Synthesizer

The frequency synthesizer consists of PLL IC, **Q3036** (**AK1541**), VCO, TCXO (X3001).
The output frequency from TCXO is 16.8 MHz and the tolerance is ±2.5 ppm (in the temperature range –30 to +60 degrees).

4-1. VCO (Voltage-Controlled Oscillator)

While the radio is receiving, the RX oscillator **Q3019** (**2SK508**) in VCO generates a programmed frequency between 282.35 and 322.35 MHz (Version "I") or 249.15 and 289.15 MHz (Version "K") as 1st local signal.
While the radio is transmitting, the TX oscillator **Q3023** (**2SC4227**) in VCO generates a frequency between 350 and 390 MHz (Version "I") or 300 and 340 MHz (Version "K").
The output from oscillator is amplified by buffer amplifier **Q3017** (**2SC5005**) and becomes output of VCO. The output from VCO is divided, one is amplified by **Q3022** and feed back to the PLL IC 17 pin. The other is amplified in **Q3014** and in case of the reception, it is put into the mixer as the 1st local signal through **D3011**, in transmission, it is buffered **Q3010**, and more amplified in **Q3008** and it is put into the final amplifier **Q3006**.

4-2. VCV (Varactor Control Voltage) Control

Tuning voltage of VCO is expanding the lock range of VCO by controlling the cathode of varactor diode at the voltage and the control voltage from PLL IC.

4-3. PLL

The PLL IC consists of reference divider, main divider, phase detector, charge pumps and pulse swallow operation. The reference frequency from TCXO is inputted to 10 pin of PLL IC and is divided by reference divider.

The other hand, inputted feed back signal to 17 pin of PLL IC from VCO is divided with the dividing ratio which becomes same frequency as the output of reference divider. These two signals are compared by phase detector, the phase difference pulse is generated.

The phase difference pulse and the pulse from through the charge pumps and LPF. It becomes the DC voltage to control the VCO.

The oscillation frequency of VCO is locked by the control of this DC voltage.

The PLL serial data from CPU is sent with three lines of SDO (40 pin), SCK (36 pin) and PSTB (30 pin).

The lock condition of PLL is output from the UL (18 pin) terminal and UL becomes "H" at the time of the lock condition and becomes "L" at the time of the unlocked condition. The CPU always watches over the UL condition, and when it becomes "L" unlocked condition, the CPU prohibits transmitting and receiving.

Alignment

Introduction

The **VX-450** series is carefully aligned at the factory for the specified performance across the frequency range specified for each version. Realignment should therefore not be necessary except in the event of a component failure, or altering version type. All component replacement and service should be performed only by an authorized ***Motorola Solutions*** representative, or the warranty policy may be void.

The following procedures cover the sometimes critical and tedious adjustments that are not normally required once the transceiver has left the factory. However, if damage occurs and some parts subsequently are replaced, realignment may be required. If a sudden problem occurs during normal operation, it is likely due to component failure; realignment should not be done until after the faulty component has been replaced.

We recommend that servicing be performed only by authorized ***Motorola Solutions*** service technicians who are experienced with the circuitry and fully equipped for repair and alignment. Therefore, if a fault is suspected, contact the dealer from whom the transceiver was purchased for instructions regarding repair. Authorized ***Motorola Solutions*** service technicians realign all circuits and make complete performance checks to ensure compliance with factory specifications after replacing any faulty components.

Those who do undertake any of the following alignments are cautioned to proceed at their own risk. Problems caused by unauthorized attempts at realignment are not covered by the warranty policy. Also, ***Motorola Solutions*** reserves the right to change circuits and alignment procedures in the interest of improved performance, without notifying owners.

Under no circumstances should any alignment be attempted unless the normal function and operation of the transceiver are clearly understood, the cause of the malfunction has been clearly pinpointed and any faulty components replaced, and realignment determined to be absolutely necessary.

The following test equipment (and thorough familiarity with its correct use) is necessary for complete realignment. Correction of problems caused by misalignment resulting from use of improper test equipment is not covered under the warranty policy. While most steps do not require all of the equipment listed, the interactions of some adjustments may require that more complex adjustments be performed afterwards. Do not attempt to perform only a single step unless it is clearly isolated electrically from all other steps. Have all test equipment ready before beginning, and follow all of the steps in a section in the order presented.

Required Test Equipment

- ❒ RF Signal Generator with calibrated output level at 600 MHz
- ❒ Oscilloscope
- ❒ Deviation Meter (linear detector)
- ❒ In-line Wattmeter with 5 % accuracy at 600 MHz
- ❒ 50 Ohm RF Dummy Load with power rating 10 W at 600 MHz
- ❒ Regulated DC Power Supply (standard 7.5 V DC, 3 A)
- ❒ Frequency Counter with 0.2 ppm accuracy at 600 MHz
- ❒ Audio Signal Generator
- ❒ AC Voltmeter
- ❒ DC Voltmeter
- ❒ UHF Sampling Coupler
- ❒ IBM® PC/compatible Computer with Microsoft® Windows® 2000, XP, Vista or Windows7
- ❒ Motorola Solutions CE115 PC Programming Software
- ❒ Motorola Solutions FIF-12 USB Programming Interface and CT-104A, CT-106, or CT-171 PC Programming Cable.
- ❒ Motorola Solutions FRB-6 Tuning Interface Box and CT-160 Connection Cable.
- ❒ Motorola Solutions CN-2A (P/N: A08420002) Antenna Connector

Alignment

Alignment Preparation & Precautions

A 50-Ohm RF Dummy Load and in-line wattmeter must be connected to the main antenna jack in all procedures that call for transmission, except where specified otherwise. Correct alignment is not possible with an antenna.

Because of the BTL (**B**ridged **T**rans **L**ess) Amplifier circuit used in the **VX-450** series, do not connect earth side of the speaker leads to chassis "ground".

After completing one step, read the following step to determine whether the same test equipment will be required. If not, remove the test equipment (except dummy load and wattmeter, if connected) before proceeding.

Correct alignment requires that the ambient temperature be the same as that of the transceiver and test equipment, and that this temperature be held constant between 68 and 86 °F (20 ~ 30 °C). When the transceiver is brought into the shop from hot or cold air, it should be allowed time to come to room temperature before alignment.

Whenever possible, alignments should be made with oscillator shields and circuit boards firmly affixed in place. Also, the test equipment must be thoroughly warmed up before beginning.

Note: Signal levels in dB referred to in the alignment procedure are based on *0 dBμ EMF = 1 μV.*

Test Setup

Setup the test equipment as shown below for transceiver alignment, apply 7.5 V DC power to the transceiver.

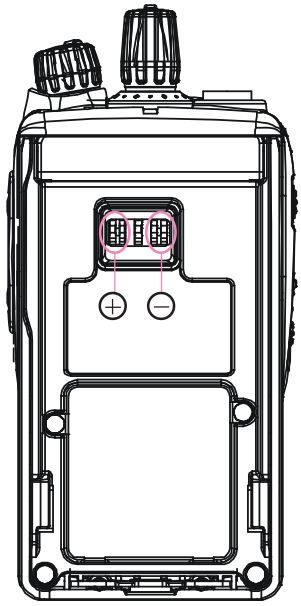
The Alignment Tool Outline

Installation of the alignment tool

- ❒ Install the CE115 (PC Programming Software) to your PC.
- ❒ "Alignment" function in the "Radio" menu tab of CE115.

Action of the switches

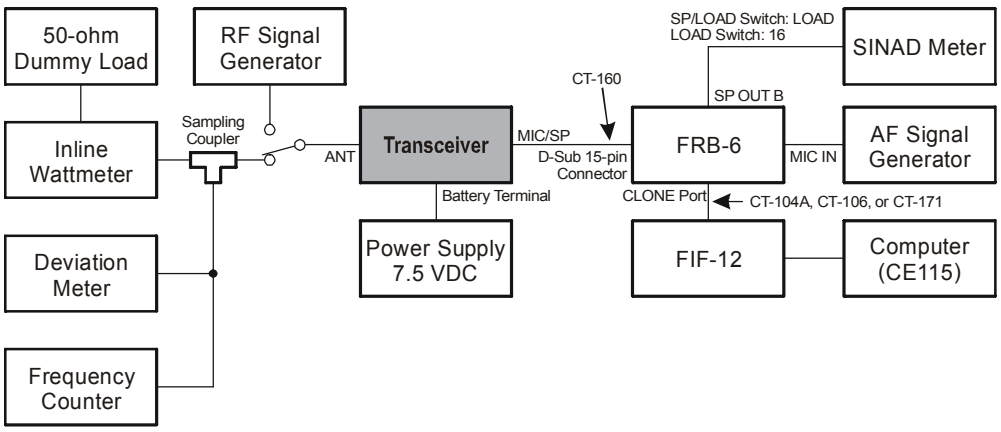
When the transceiver is in the "Alignment mode," the action of the PTT and all PF KEYS are ignored. All of the action is controlled by the PC.



BATTERY TERMINAL POLARITY

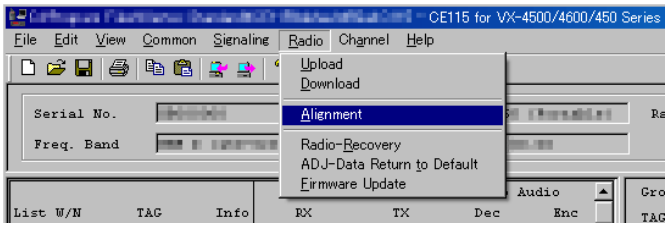
Caution!

Please never turn off the power supply during alignment. If the power supply is turned off during alignment, the alignment data will be corrupted.



Alignment Mode

The Alignment mode allows you to align the entire radio. The value of each parameter can be changed to the desired value by use of the "←" / "→" and up/down arrow keys, along with direct number input and dragging of the PC mouse.



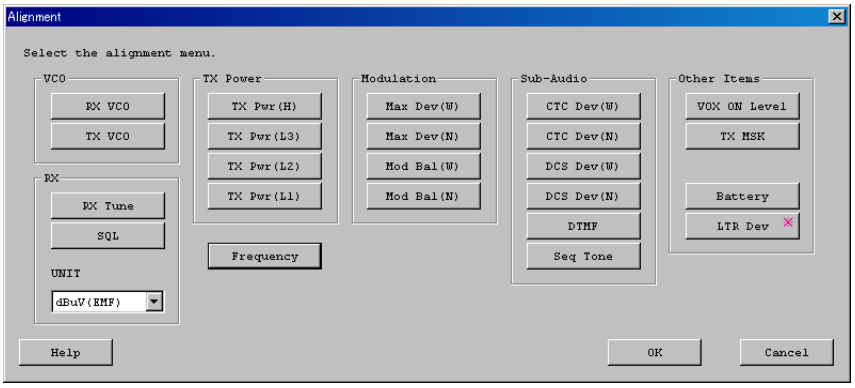
To enter the Alignment Mode, select "Alignment" in the main "Radio" menu. It will start to "Upload" the alignment data from the radio to the PC. Pressing the "OK" button will then "Download" the alignment data to the radio and exit the Alignment Mode.

Note: when all items are to be aligned, it is strongly recommended to align them according to the following sequence. Detailed information for each step may be found in the "Help" file within CE115 (PC Programming Software).

1. VCO (*Please do not adjust it*)
2. PLL Reference Frequency (Frequency)
3. RX Sensitivity (RX Tune)
4. Squelch (SQL/RSSI)
5. TX Power <High/Low3/Low2/Low1>
6. Maximum Deviation <Wide/Narrow>

Please adjust the following items when needed.

- ❍ Modulation Balance <Wide/Narrow>
- ❍ CTCSS Deviation <Wide/Narrow>
- ❍ DCS Deviation <Wide/Narrow>
- ❍ DTMF Alignment
- ❍ Seq Tone
- ❍ VOX ON Level
- ❍ TX MSK
- ❍ LTR Deviation※
- ❍ Battery

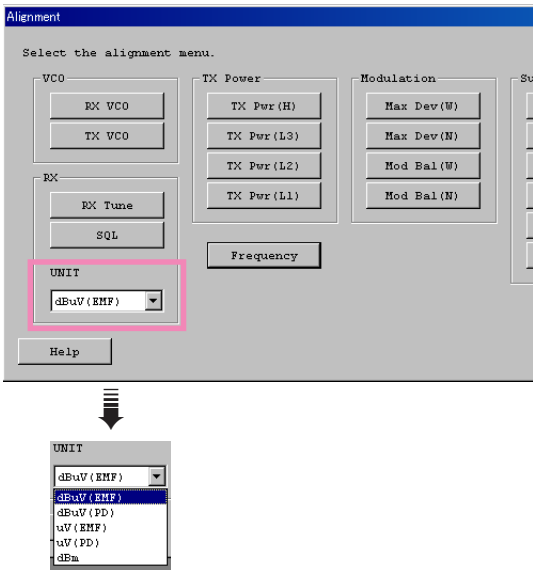


※ The "LTR Dev" parameter does not appear when adjusting the transceiver which is not installed the LTR feature.

Unit

During alignment, you may select the value among dBμV,μV (EMF or PD), or dBm.

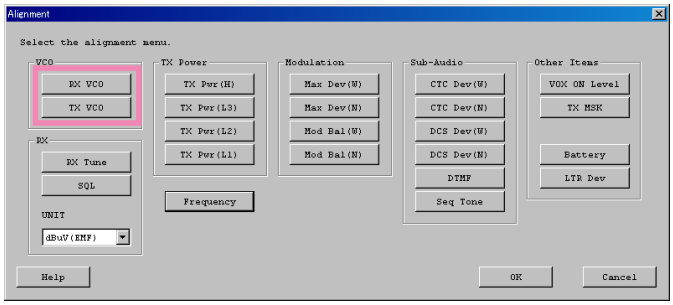
When performing the "RX Tune" and "SQL" alignment, the RF level shows this unit according to this setting.



Alignment

1. VCO (RX VCO/TX VCO) - Normally there is no need to adjust this parameter -

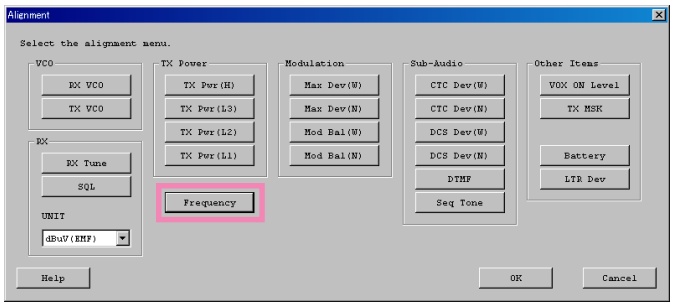
This parameter is to align the VCO Voltage adjustment.

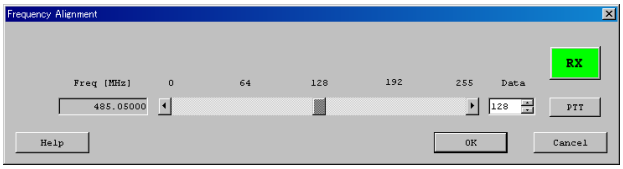


2. PLL Reference Frequency (Frequency)

This parameter is to align the reference frequency for PLL.

1. Press the “Frequency” button to start the alignment.
   The Frequency Alignment window will appear.
2. Click the “PTT” button or press the “SPACE” bar, and the radio will start to transmit on the center frequency channel.
3. Set the value to get the desired frequency by dragging the slide bar, clicking the up-down button, pressing the left or right arrow key, or entering the value in the entry box.
4. After getting the desired frequency click the “PTT” button or press the “SPACE” bar to stop transmitting.
5. Click the “OK” button to finish the frequency alignment and save the data.





3. RX SENSITIVITY (RX TUNE)

This parameter is to align the RX BPF (Band Pass Filter) for Receive (RX) sensitivity. The PLL Reference Frequency (Frequency) alignment must be done before this alignment is performed.

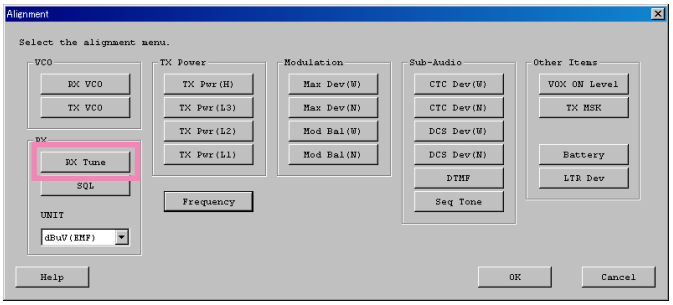
1. Press the "RX Tune" button to start the alignment. The RX Sensitivity Alignment window will appear.
2. Click the left mouse button on the slide bar or press Up / Down arrow key, to switch to the selected channel.
3. Set the Signal Generator according to the indication at the top of the screen (Setting Your SG as followings).
4. Drag the slide bar, click the up-down buttons, press the left or right arrow key, or enter the value in the entry box to get the best RX sensitivity (Highest RSSI value).
5. Click the "OK" button to finish the RX Sensitivity alignment and save the data.

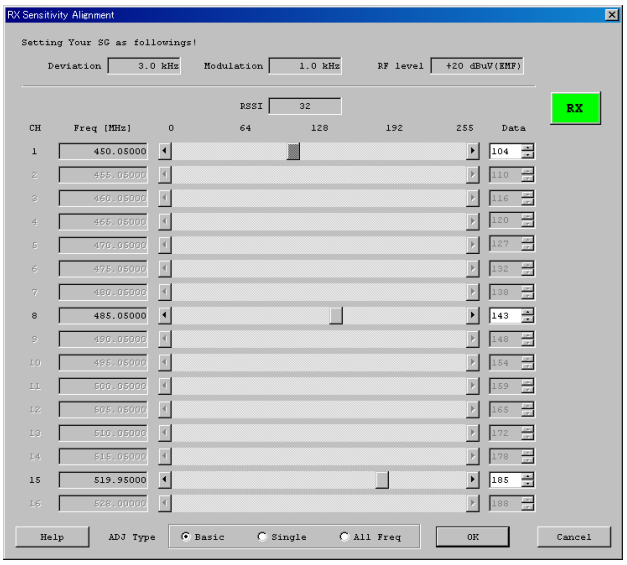
ADJ Type

Basic: "Low-edge / band center / high-edge" and select the channel for alignment (Default).

Single : Alignment value changes only on the selected channel.

All Freq : Alignment value changes on all channels.





4. SQUELCH (SQL)

This parameter is to align the SQL (Squelch) Sensitivity.

There are several alignments as follows in the Squelch Sensitivity.

Tight SQL Level (TI NSQ W/N)
The Alignment for the Noise SQL Tight level at Wide (5k/4k) or Narrow (2.5k).

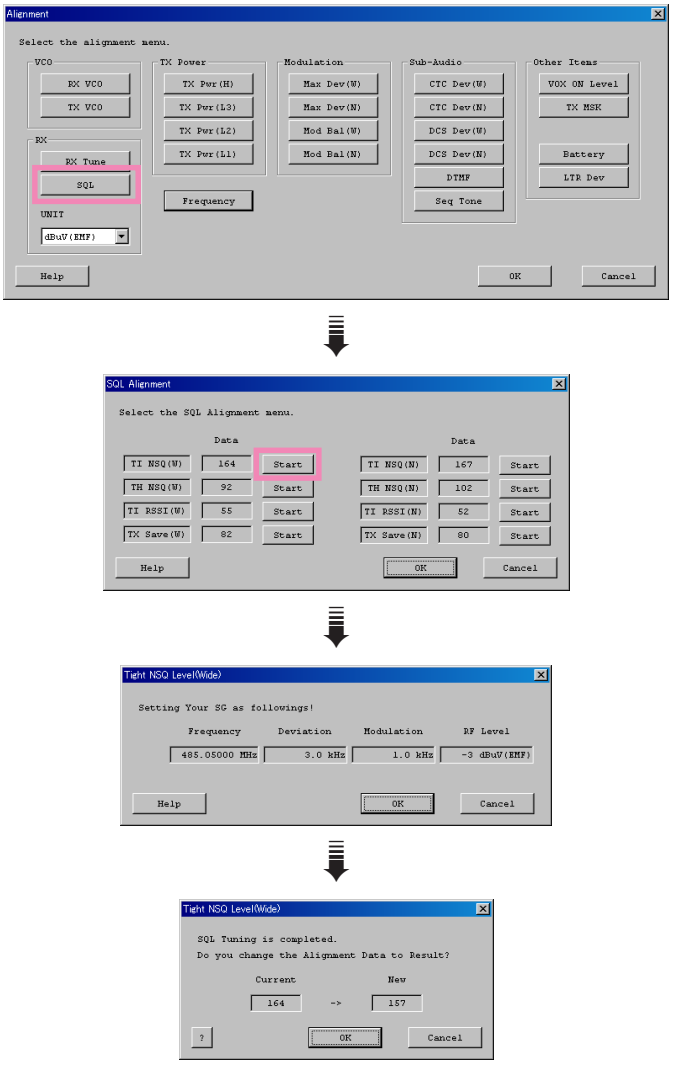
Threshold SQL Level (TH NSQ W/N)
The Alignment for the Noise SQL Threshold level at Wide (5k/4k) or Narrow (2.5k).

Tight SQL RSSI Level (TI RSSI W/N)
The Alignment for the "level 15" of the RSSI SQL level at Wide (5k/4k) or Narrow (2.5k).

TX Save RSSI Level (TX SAVE W/N)
The Alignment for the TX Save RSSI level at Wide (5k/4k) or Narrow (2.5k).

The procedure for all the alignments is as follows.

1. Click the "Start" button to open the alignment window in the SQL/RSSI Alignment menu.
2. The Alignment window will appear, Set the Signal Generator according to the indication, then click the "Start" button.
3. The automatic alignment will start to get the SQL or RSSI level.
4. It will show the alignment result in the "New" box.
5. Click the "OK" button, then the data will be saved and the alignment is finished.



5. TX Power

This parameter is to align the “Power High”, “Power Low3”, “Power Low2” or “Power Low1” for the selected channel.

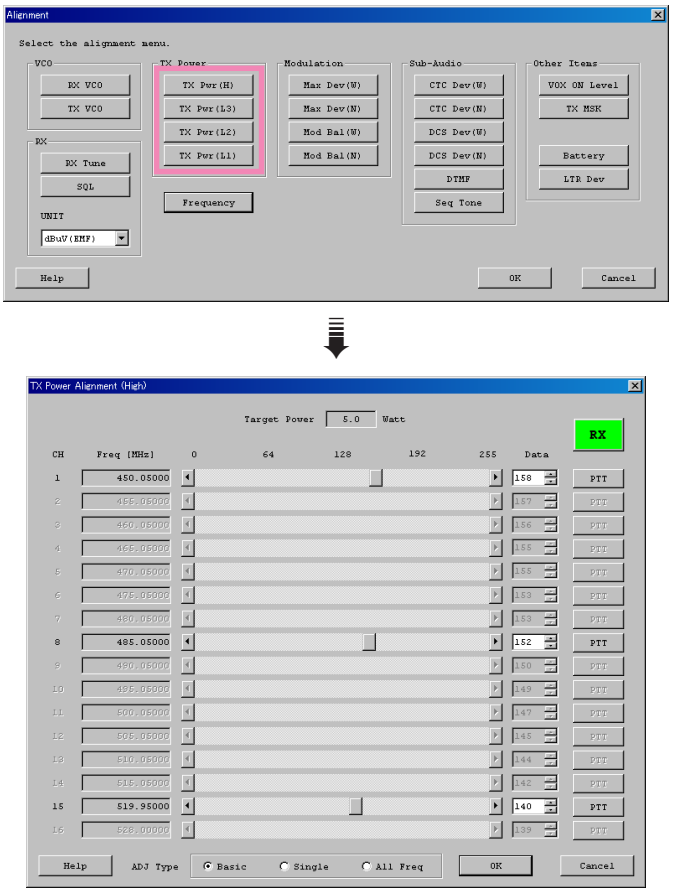
1. Press the “TX Pwr(H / L3 / L2 / L1)” button to start the alignment. The TX Power Alignment window will appear.
2. Click the left mouse button on the slide bar or press the Up / Down arrow key, to select the desired channel.
3. Click the “PTT” button or press the “SPACE” bar at the desired channel, then the radio starts to transmit on the selected channel.
4. Set the value to get desired output power (High: 5 W, Low3: 2.5 W, Low2: 1 W, Low1: 250 mW) on the Power Meter by dragging the slide bar, clicking the up-down button, pressing the left or right arrow key, or entering the value in the entry box on the selected channel.
5. After getting the desired output power click the “PTT” button or press the “SPACE” bar to stop transmitting.
6. Click the “OK” button to finish the TX Power alignment and save the data.

   ADJ Type

   Basic: “Low-edge / band center / high-edge“ and select the channel for alignment (Default).

   Single : Alignment value changes only on the selected channel.

   All Freq : Alignment value changes on all channels.



6. MAXIMUM DEVIATION <WIDE> / <NARROW>

This parameter is to align the "Maximum Deviation" (Wide/Narrow).
It requires the appropriate JIG (Tuning Interface BOX). Connect the JIG and Test Equipment to the radio before the alignment is started.

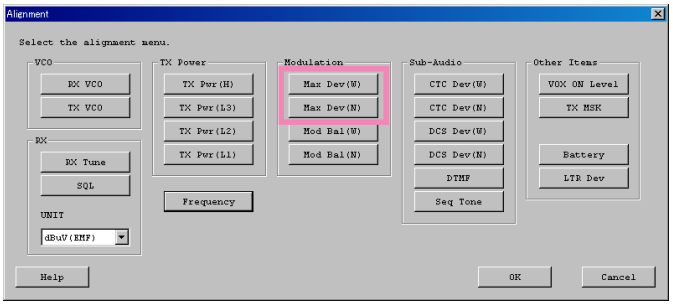
1. Press the "Max Dev (W /N)" button to start the alignment.
2. The Max Deviation alignment window will appear.
3. Connect the Generator, Inject a1 kHz tone / Sine Wave / -10 dBm to the MIC jack.
4. Click the left mouse button on the slide bar or press the Up / Down arrow key, to select the desired channel.
5. Click the "PTT" button or press the "SPACE" bar the radio starts to transmit on the selected channel.
6. Set the value to get desired deviation (Wide: 4.2kHz, Narrow: 2.1kHz) on the deviation meter by dragging the slide bar, clicking the up-down button, pressing the left or right arrow key, or entering the value in the entry box on the selected channel.
7. After getting the desired deviation click the "PTT" button or press the "SPACE" bar to stop transmitting.
8. Click the "OK" button to finish the Max Deviation alignment and save the data.

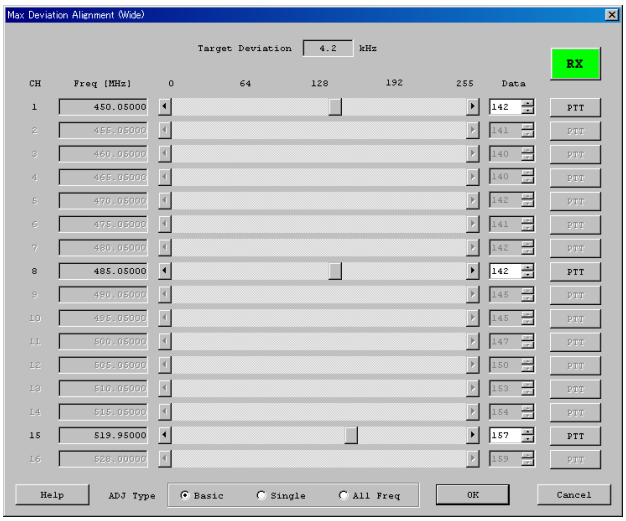
   ADJ Type

   Basic: "Low-edge / band center / high-edge" and select the channel for alignment (Default).

   Single : Alignment value changes only on the selected channel.

   All Freq : Alignment value changes on all channels.





Alignment

Please adjust the following items when needed.

MODULATION BALANCE <WIDE> / <NARROW> (THIS ALIGNMENT IS DIFFICULT.)

This parameter is to align the "Modulation Balance" (Wide/Narrow).
It needs the appropriate JIG (Tuning Interface BOX). Connect the JIG and Test Equipment to the radio before the alignment is started.

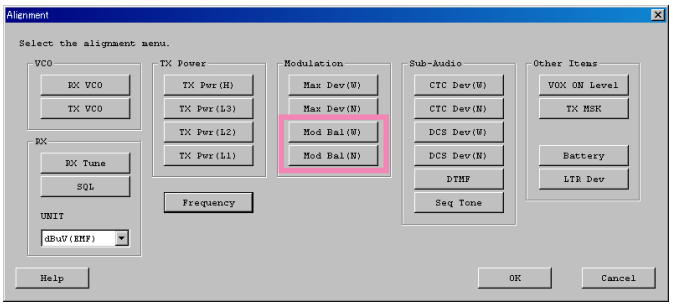
1. Press the "Mod Bal (W / N)" button to start the alignment.
2. The Modulation Balance Alignment window will appear.
3. Connect the Generator, Inject a 400Hz tone / Sine Wave / -10 dBm to the MIC jack.
4. Click the left mouse button on the slide bar or press the Up / Down arrow key, to select the desired channel.
5. Click the "PTT" button or press the "SPACE" bar the radio starts to transmit on the selected channel.
6. Set the value to get "the best square wave" on the Oscilloscope by dragging the slide bar, clicking the up-down button, pressing the left or right arrow key, or entering the value in the entry box on the selected channel.
7. After getting the "the best square wave" click the "PTT" button or press the "SPACE" bar to stop transmitting.
8. Click the "OK" button to finish the Modulation Balance alignment and save the data.

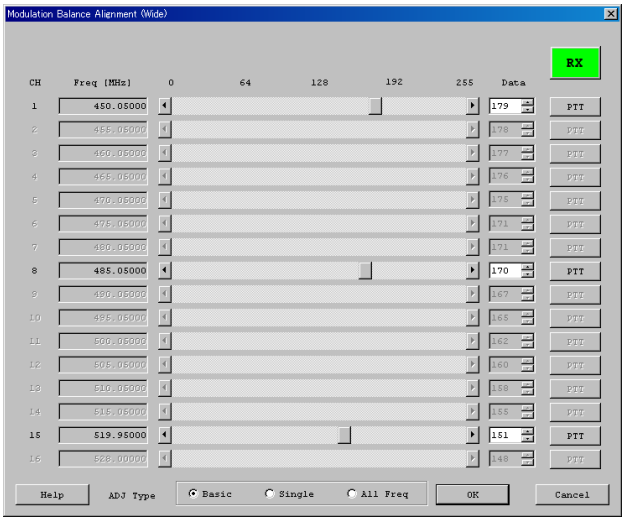
   ADJ Type

   Basic: "Low-edge / band center / high-edge" and select the channel for alignment (Default).

   Single : Alignment value changes only on the selected channel.

   All Freq : Alignment value changes on all channels.

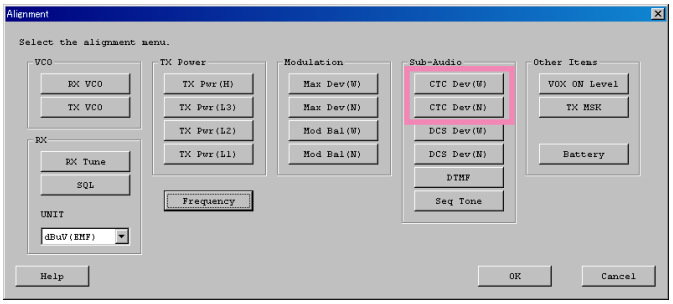


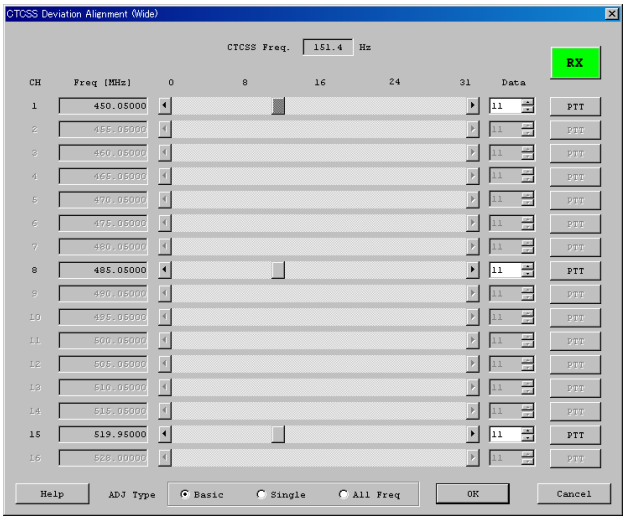


CTCSS DEVIATION <WIDE> / <NARROW>

This parameter is to align CTCSS Deviation of the selected channel.

1. Press the "CTC Dev (W / N)" button to start the alignment.
   The CTCSS Deviation Alignment window will appear.
2. Click the left mouse button on the slide bar or press the Up / Down arrow key, to select the desired channel.
3. Click the "PTT" button or press the "SPACE" bar the radio starts to transmit with CTCSS tone on the selected channel.
4. Set the value to get desired deviation on the deviation meter by dragging the slide bar, clicking the up-down button, pressing the left or right arrow key, or entering the value in the entry box on the selected channel..
5. After getting the desired deviation (Wide: 0.6 kHz, Narrow: 0.3 kHz) click the "PTT" button or press "SPACE" bar to stop transmitting.
6. Click the "OK" button to finish the CTCSS Deviation alignment and save the data.
   ADJ Type
   Basic: "Low-edge / band center / high-edge" and select the channel for alignment (Default).
   Single : Alignment value changes only on the selected channel.
   All Freq : Alignment value changes on all channels.

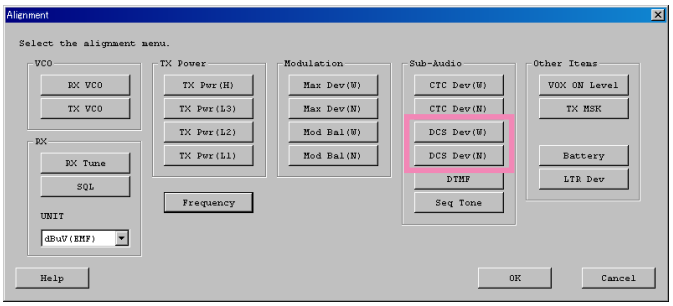


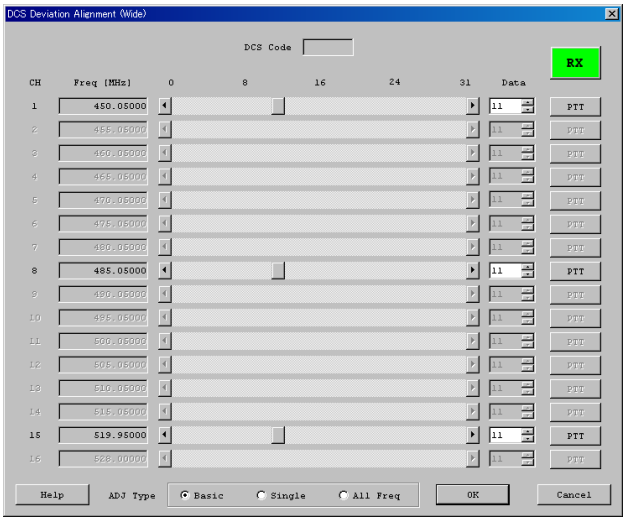


DCS DEVIATION <WIDE> / <NARROW>

This parameter is to align "DCS Deviation" of the selected channel.

1. Press the "DCS Dev (W / N)" button to start the alignment.
   The DCS Deviation Alignment window will appear.
2. Click the left mouse button on the slide bar or press the Up / Down arrow key, to select the desired channel.
3. Click the "PTT" button or press the "SPACE" bar the radio starts to transmit with DCS Code on the selected channel.
4. Set the value to get desired deviation (Wide: 0.6 kHz, Narrow: 0.3 kHz) on the deviation meter by dragging the slide bar, clicking the up-down button, pressing the left or right arrow key, or entering the value in the entry box on the selected channel.
5. After getting the desired deviation click "PTT" button or press "SPACE" bar to stop transmitting.
6. Click the "OK" button to finish the DCS Deviation alignment and save the data.
   ADJ Type
   Basic: "Low-edge / band center / high-edge" and select the channel for alignment (Default).
   Single : Alignment value changes only on the selected channel.
   All Freq : Alignment value changes on all channels.

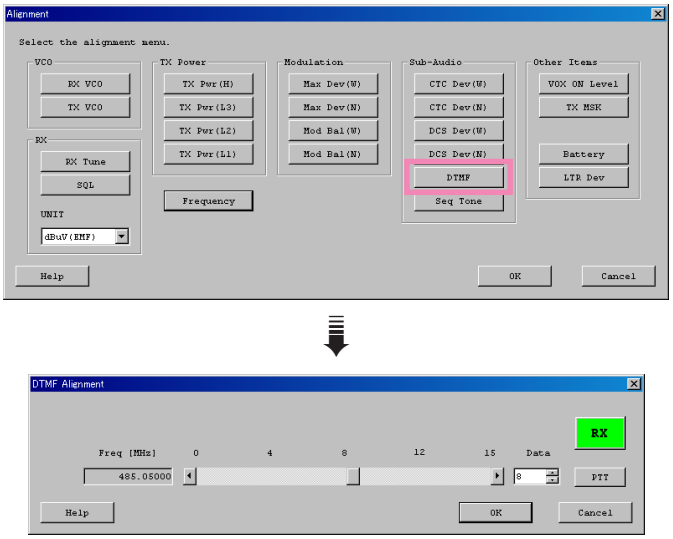




DTMF Deviation

This parameter is to align “DTMF Deviation”.

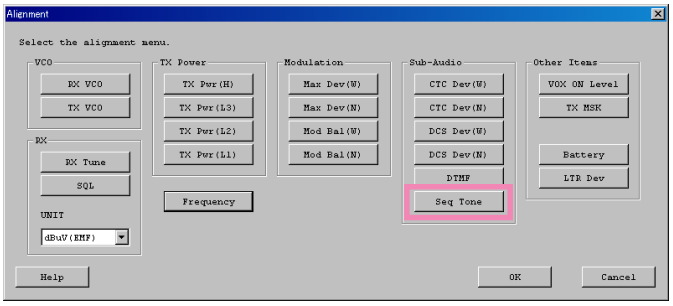
1. Press the “DTMF” button to start the alignment. The DTMF Alignment window will appear.
2. Click the “PTT” button or press the “SPACE” bar the radio starts to transmit on the Center frequency channel.
3. Set the value to get desired deviation (3.0 kHz) on the deviation meter by dragging the slide bar, clicking the up-down button, pressing the left or right arrow key, or entering the value in the entry box.
4. After getting the desired deviation click the “PTT” button or press the “SPACE” bar to stop transmitting..
5. Click the “OK” button to finish the DTMF Deviation alignment and save the data.

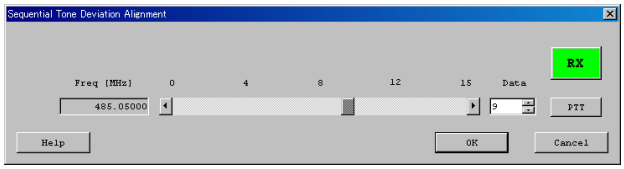


Sequential Tone Deviation

This parameter is to align “Sequential Tone Deviation”.

1. Press the “Seq Tone” button to start the alignment. The Sequential Tone Deviation Alignment window will appear.
2. Click the “PTT” button or press the “SPACE” bar the radio starts to transmit on the Center frequency channel.
3. Set the value to get desired deviation (3.0 kHz) on the deviation meter by dragging the slide bar, clicking the up-down button, pressing the left or right arrow key, or entering the value in the entry box.
4. After getting the desired deviation click the “PTT” button or press the “SPACE” bar to stop transmitting.
5. Click the “OK” button to finish the Sequential Tone Deviation alignment and save the data.

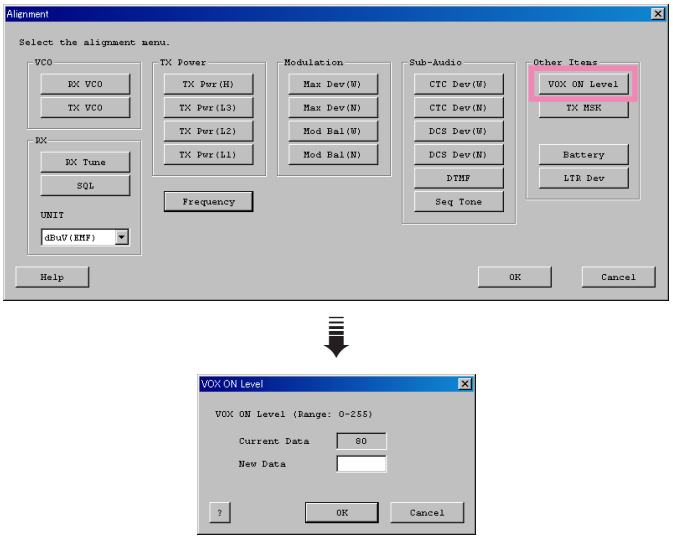




VOX On Level

This parameter is to align the “VOX On Level”.
Set the Sensitivity of the VOX circuitry's input audio detector.

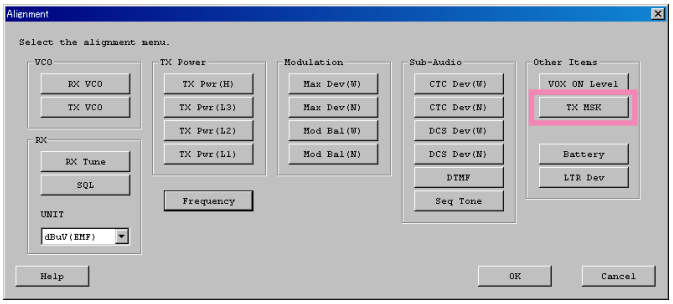
1. Press the “VOX ON Level” button to start the alignment.
   The VOX ON Level window will appear.
2. Then input the alignment value in the “New” box.
   Default: 80
   Input Range: 0 (Level Down) ~ 255 (Level Up)
3. Click the “OK” button, the data will be saved and the alignment is complete.

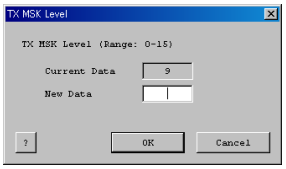


TX MSK Level

This parameter is to align the modulation level of the ANI function.

1. Press the “TX MSK” button to start the alignment.
   The TX MSK Level window will appear.
2. Then input the alignment value in the “New” box.
   Default: 9
   Input Range: 0 (Level Down) ~ 15 (Level Up)
3. Click the “OK” button, the data will be saved and the alignment is complete.

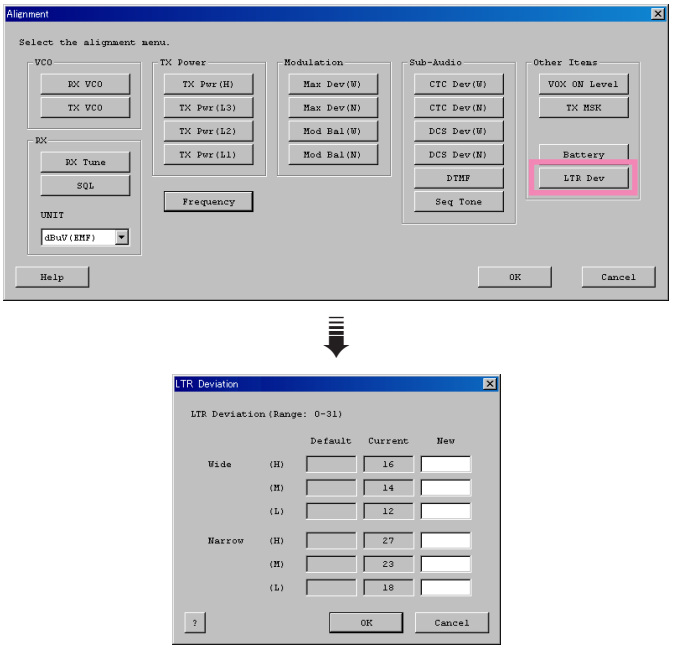




LTR Deviation

This parameter is to align the “LTR Deviation”.
This parameter does not appear when adjusting the transceiver which is not installed the LTR feature.

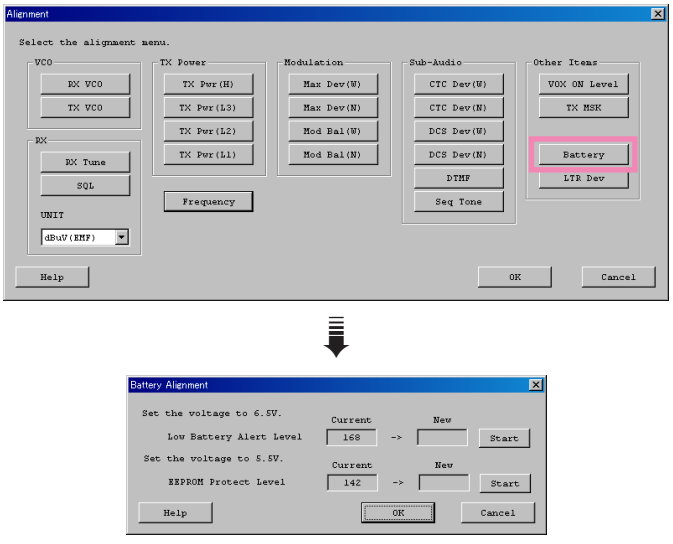
1. Press the “LTR Dev” button to start the alignment. The LTR Deviation window will appear.
2. Then input the alignment value in the “New” box. Input Range: 0 (Level Down) ~ 31 (Level Up)
   Important Note: You must input a value in the all boxes, even if you do not want to change all other values. When you click the “OK” button without entering any values, the current values becomes “0”. Inputs the current value to the box which you do not want to change.
3. Click the “OK”" button, the data will be saved and the alignment is complete.



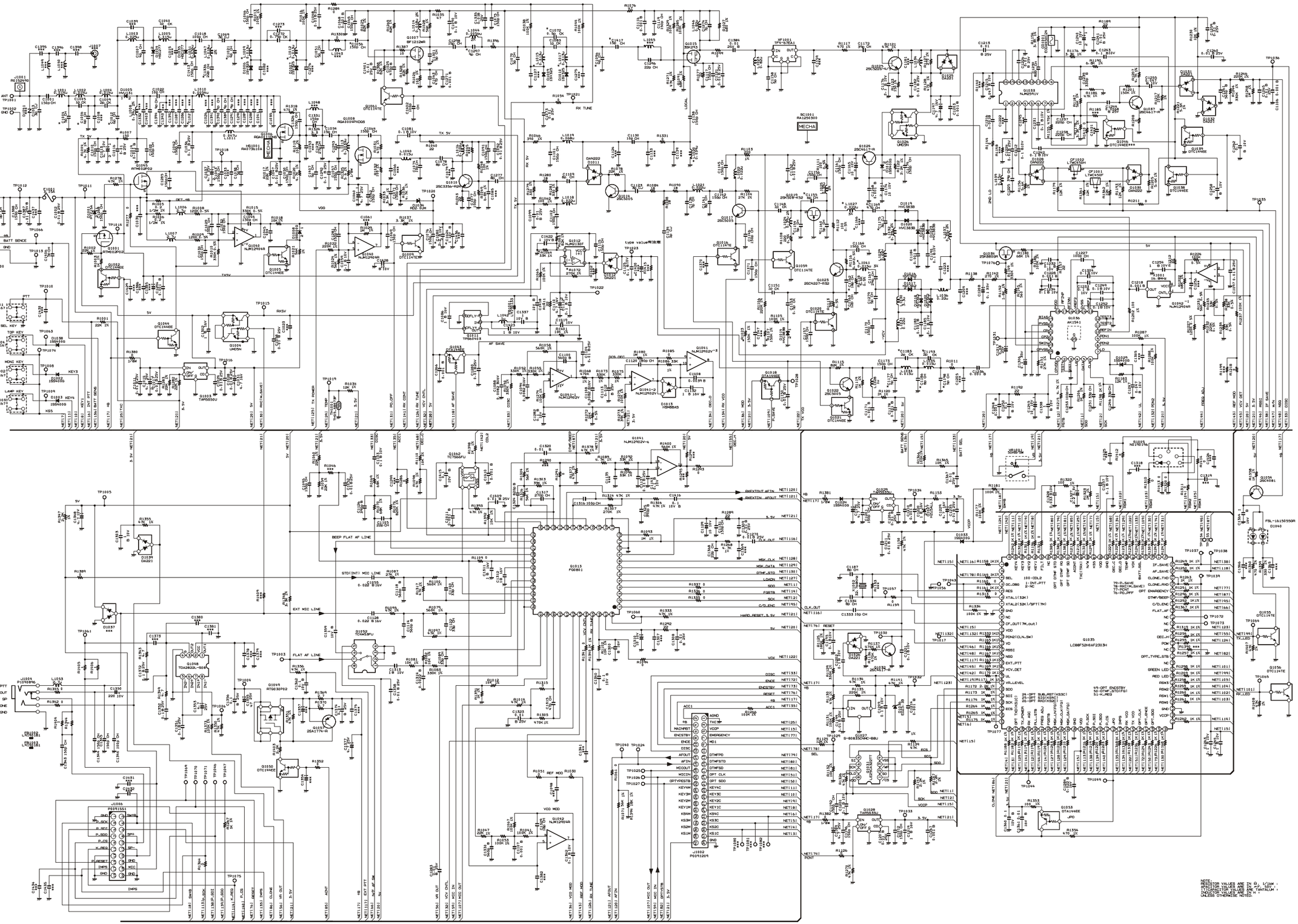
Battery

This parameter is to align the “Low Battery Alert Level” and “EEPROM Protect Level” voltage. When the DC power source voltage drops below the “EEPROM Protect Level” voltage, the radio will stop writing data to the EEPROM to prevent erroneous writing.

1. Set the value of the DC Power source to 6.5V (according to the indication) and click the “Start” button.
   The new alignment value will show in the “New” box.
2. Set the value of the DC Power source to 5.5V (according to the indication) and click the “Start” button.
   The new alignment value will show in the "New" box.
3. Click the “OK” button, the data will be saved and the alignment is complete.
4. Set the value of the DC Power source to 7.5V (according to the indication).



MAIN Unit Circuit Diagram (Version A & D, 16 key & 4 key Type)



	A-BAND 420~470	D-BAND 430~440
C1016	8p	5p
C1019	2p	1p
C1116	8p	6p
C1212	5p	6p
C1521	5p	4p
C1526	8p	***
C1527	3p	***
C1941	10p	***
C1956	22p	15p
C1964	100p	150p
C1984	1000p	150p
C1980	4.7u	2.2u
C1154	8p	5p
C1155	8p	6p
C1166	8p	5p
C1162	22p	18p
C1163	15p	12p
C1166	3p	***
C1167	33p	47p
C1175	***	3p
C1177	***	5p
C1183	3p	2p
C1186	9p	8p
C1193	3p	2p
C1198	6p	5p
C1277	22p	8p
C1278	22p	27p

	A-BAND 420~470	D-BAND 430~440
C1288	10p	***
C1291	***	9p
C1293	6p	***
C1296	10p	22p
C1297	12p	9p
C1311	6p	5p
C1326	***	150p
C1336	27p	22p
C1389	***	9p
C1390	8p	9p
C1391	8p	***
C1417	10p	15p
C1420	10u	***
C1424	***	1.5u

	A-BAND 420~470	D-BAND 430~440
R1025	120K	150K
R1031	15K	47K
R1043	4.7	22
R1065	***	82K
R1066	47K	33K
R1072	100K	270K
R1318	***	470
R1330	10	0
R1342	***	0
R1345	***	0

	A-BAND 420~470	D-BAND 430~440
L1004	18n	15n
L1012	18n	15n
L1015	18n	15n
L1016	15n	22n
L1017	18n	15n
L1020	47n	39n
L1027	27n	22n
L1048	18n	15n
L1061	18n	15n
FB1032	L1419018J	***
FB1033	L1419018J	***

MAIN Unit Circuit Diagram (Version A & D, Non key Type)

	A-BAND 420~470	D-BAND 430~520
C1288	10p	***
C1291	***	9p
C1293	6p	***
C1296	10p	22p
C1297	12p	9p
C1301	6p	5p
C1326	***	150p
C1336	27p	22p
C1389	***	9p
C1390	8p	9p
C1391	8p	***
C1417	10p	15p
C1420	10u	***
C1426	***	1.0u

	A-BAND 420~470	D-BAND 430~520
R1023	120K	150K
R1031	150	470
R1043	4.7	22
R1063	***	82K
R1064	47K	33K
R1072	100K	270K
R1318	***	470
R1330	10	0
R1362	***	0
R1365	***	0

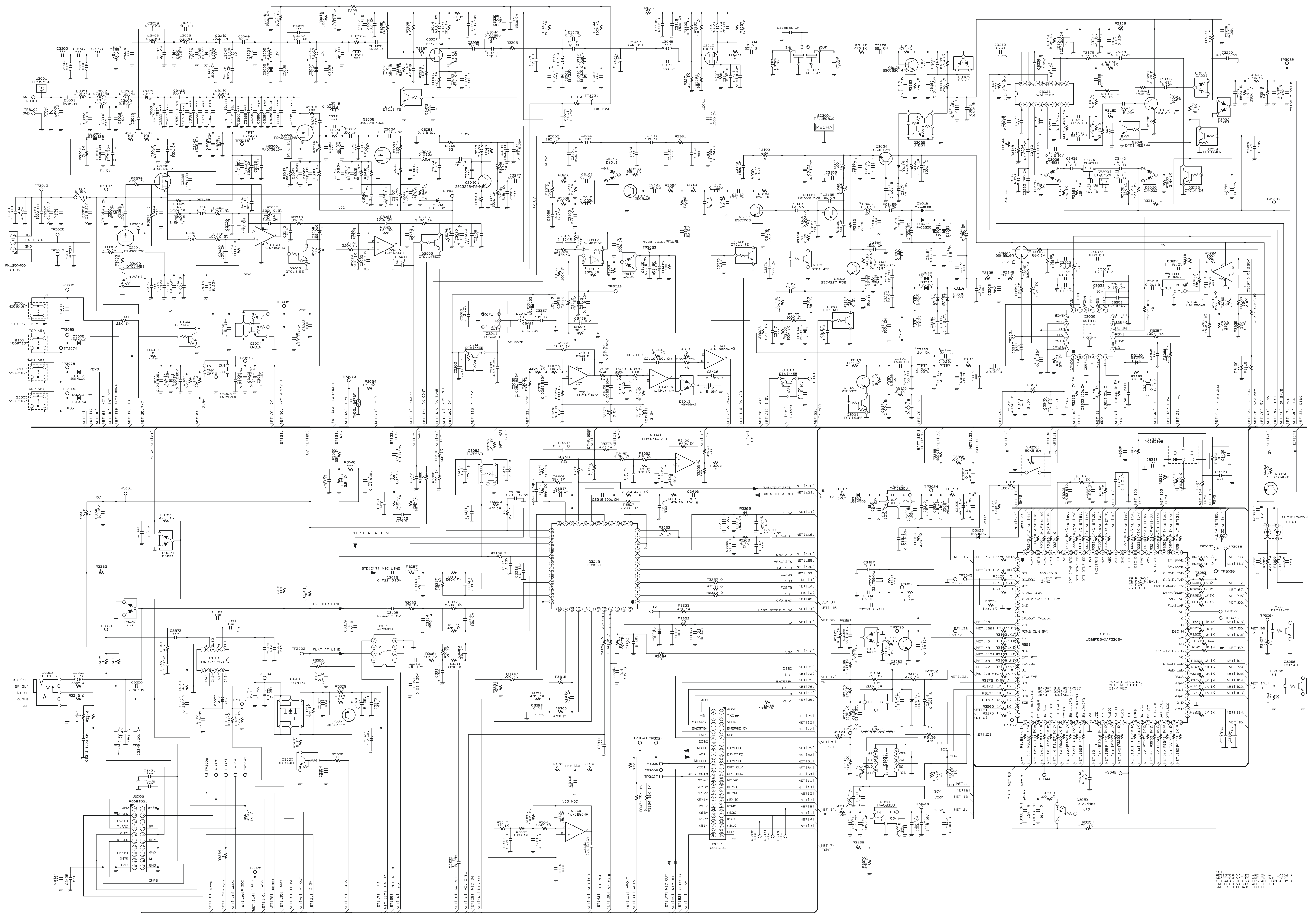
	A-BAND 420~470	D-BAND 430~520
L1009	18n	13n
L1012	18n	13n
L1015	18n	13n
L1016	15n	22n
L1017	18n	13n
L1020	47n	39n
L1027	27n	22n
L1040	18n	15n
L1041	18n	15n
FB1002	L14J901181	***
FB1003	L14J901181	***

NOTE:
RESISTOR VALUES ARE IN Ω, 1/16W ;
CAPACITOR VALUES ARE IN pF, 50V ;
ATTENTION:VALUES ARE IN TANTALUM ;
INDUCTOR VALUES ARE IN H ;
UNLESS OTHERWISE NOTED.

MAIN-2 Unit Circuit Diagram (Version I & K, 16 key & 4 key Type)

	K-BAND 300-340	I-BAND 350-390
C3003	5p	3p
C3004	15p	7p
C3005	1p	1.5p
C3007	7p	4p
C3008	15p	9p
C3009	1p	2.5p
C3012	***	7p
C3015	4p	3p
C3039	4p	2.5p
C3040	2p	4p
C3041	10p	***
C3061	1000p	100p
C3072	***	0.5p
C3154	8p	9p
C3158	7p	5p
C3162	27p	22p
C3163	18p	15p
C3167	33p	20p
C3169	47p	39p
C3172	0.01u	39p
C3183	3p	2p
C3193	4p	3p
C3198	9p	8p
C3225	68p	39p
C3272	0.75p	1p
C3274	12p	7p
C3288	5p	10p
C3296	47p	33p
C3301	10p	8p
C3336	33p	27p
C3394	15p	10p
C3417	7p	12p
C3443	9p	***

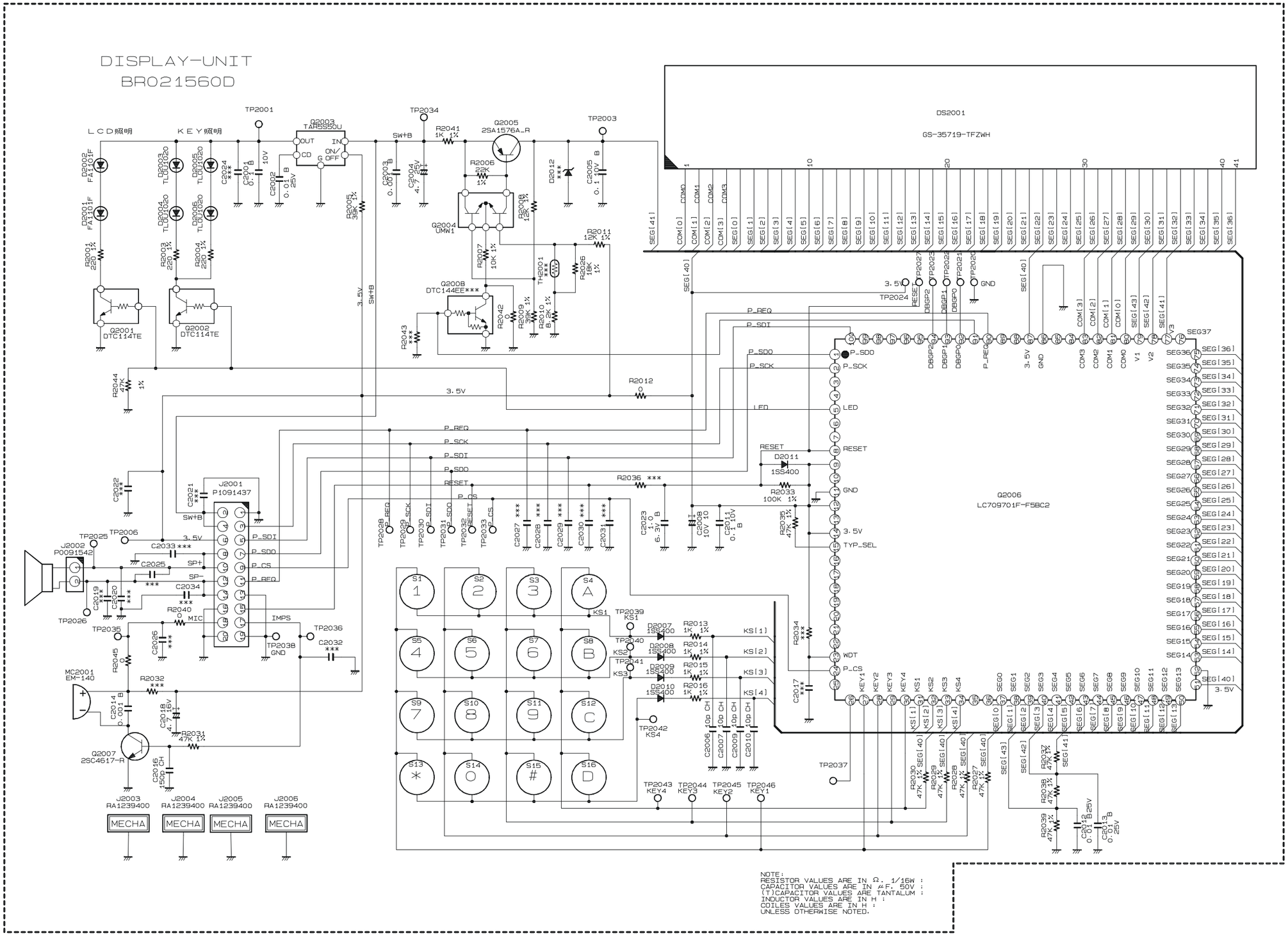
	K-BAND 300-340	I-BAND 350-390
R3023	47k	82k
R3031	470	330
R3032	100	47
R3033	3.3k	4.7k
R3043	47	22
R3048	15K	10k
R3062	390	100
R3178	3.3k	15k
R3185	4.7k	***
R3224	150k	100k
R3227	180k	150k
R3237	100k	82k
R3237	22	0
R3418	10	***
L3001	24.7n	17.4n
L3002	24.7n	17.4n
L3004	24.7n	17.4n
L3009	39n	27n
L3012	39n	27n
L3015	39n	26.7n
L3017	39n	26.7n
L3023	***	820n
L3027	48n	39n
L3040	***	15n
L3041	30n	27n
XF3001	H1102462	H1102471



MAIN-2 Unit Circuit Diagram (Version I & K, Non key Type)

	K-BAND 300~340	I-BAND 350~390
C3003	6p	3p
C3004	15p	7p
C3005	1p	1.5p
C3007	7p	4p
C3008	15p	9p
C3009	1p	2.5p
C3012	***	7p
C3015	4p	3p
C3039	4p	2.5p
C3040	2p	4p
C3041	10p	***
C3061	1000p	1000p
C3072	***	0.5p
C3154	8p	9p
C3158	7p	5p
C3162	27p	22p
C3163	18p	15p
C3167	33p	20p
C3169	47p	39p
C3172	0.01u	39p
C3183	3p	2p
C3193	4p	3p
C3198	9p	6p
C3225	68p	39p
C3272	0.75p	1p
C3274	12p	7p
C3288	5p	10p
C3296	47p	33p
C3301	10p	8p
C3336	33p	27p
C3394	15p	10p
C3417	7p	12p
C3443	9p	***

	L BAND 300~340	J BAND 350~390
C 3023	47k	82k
C 3031	470	330
C 3032	100	47
C 3033	3.3k	4.7k
C 3043	47	22
C 3048	15K	10k
C 3062	390	100
C 3178	3.3k	15k
C 3185	4.7k	***
C 3224	150k	100k
C 3227	180k	150k
C 3237	100k	82k
C 3237	22	0
C 3418	10	***
L3001	24.7n	17.4n
L3002	24.7n	17.4n
L3004	24.7n	17.4n
L3009	39n	27n
L3012	39n	27n
L3015	39n	26.7n
L3017	39n	26.7n
L3023	***	820n
L3027	48n	39n
L3040	***	15n
L3041	30n	27n
XF3001	H1102462	H1102471


DISPLAY-UNIT
BR021560D
LCD照明
KEY照明
TP2001
TP2034
TP2003
Q2003
TAR5S50U
SW+B
R2041
1K 1%
Q2005
2SA1576A-R
R2006
10K
1%
D2012
***
C2005
0.1 10V B
Q2004
UMW1
R2008
12K 1%
R2011
12K 1%
R2007
10K 1%
TH2001
***
R2026
18K
1%
Q2008
DTC144EE***
R2042
0
R2009
3K 1%
R2010
8.2K 1%
R2043
***
D2001
FA1101F
D2002
FA1101F
R2001
220 1%
R2003
220 1%
R2004
220 1%
Q2001
DTC114TE
Q2002
DTC114TE
R2005
39K 1%
C2001
0.1 B 10V
C2002
0.01 B 25V
C2003
0.001 B
C2004
4.7 25V
R2044
27K 1%
3.5V
R2012
0
DS2001
GS-35719-TFZWH
TP2024
RESET
DBGP2
DBGP1
DBGP0
GND
P_REQ
P_SDI
P_SDO
P_SCK
LED
RESET
GND
3.5V
TYP_SEL
WDT
P_CS
KEY1
KEY2
KEY3
KEY4
KS1
KS2
KS3
KS4
Q2006
LC709701F-F5BC2
SEG37
SEG36
SEG35
SEG34
SEG33
SEG32
SEG31
SEG30
SEG29
SEG28
SEG27
SEG26
SEG25
SEG24
SEG23
SEG22
SEG21
SEG20
SEG19
SEG18
SEG17
SEG16
SEG15
SEG14
SEG13
J2001
P1091437
SW+B
P_SDI
P_SDO
P_CS
P_REQ
J2002
P0091542
SP+
SP-
TP2025
TP2006
TP2026
TP2035
TP2036
TP2038
GND
IMPS
MIC
R2040
0
C2033 ***
C2034 ***
C2025 ***
C2026 ***
C2032 ***
R2045
R2032 ***
MC2001
EM-140
C2014
0.001 B
C2018
47 16V
R2031
47K 1%
Q2007
2SC4617-R
C2016
150P CH
J2003
RA1239400
J2004
RA1239400
J2005
RA1239400
J2006
RA1239400
MECHA
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
S14
S15
S16
TP2039
KS1
TP2040
KS2
TP2041
KS3
TP2042
KS4
D2007
1SS400
D2008
1SS400
D2009
1SS400
D2010
1SS400
R2013
1K 1%
R2014
1K 1%
R2015
1K 1%
R2016
1K 1%
KS[1]
KS[2]
KS[3]
KS[4]
C2006
10P CH
C2007
10P CH
C2009
10P CH
C2010
10P CH
TP2043
KEY4
TP2044
KEY3
TP2045
KEY2
TP2046
KEY1
TP2037
R2036 ***
D2011
1SS400
R2033
100K 1%
R2035
47K 1%
R2034
***
C2017
***
C2023
1.0 6.3V B
C2008
10V 10
C2011
0.1 10V B
C2027 ***
C2028 ***
C2029 ***
C2030 ***
C2031 ***
TP2028
P_REQ
TP2029
P_SCK
TP2030
P_SDI
TP2031
P_SDO
TP2032
RESET
TP2033
P_CS
R2039
47K 1%
R2038
47K 1%
R2037
47K 1%
R2027
47K 1%
R2028
47K 1%
R2029
47K 1%
R2030
47K 1%
C2012
0.1 25V B
C2013
0.01 B 25V
NOTE:
RESISTOR VALUES ARE IN Ω. 1/16W :
CAPACITOR VALUES ARE IN μF. 50V :
(T)CAPACITOR VALUES ARE TANTALUM :
INDUCTOR VALUES ARE IN H :
COILES VALUES ARE IN H :
UNLESS OTHERWISE NOTED.