Vertex Standard

VHF Digital/Analog Transceiver

EVX-531

Service Manual

Vertex Standard LMR, Inc.

EC113N90I

Introduction

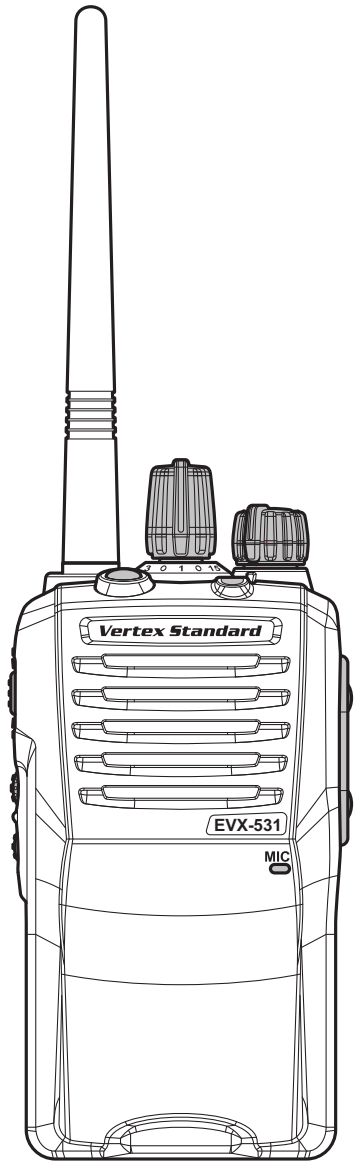
This manual provides technical information necessary for servicing the **EVX-531** VHF Hand-Held Digital/Analog Transceiver.

Servicing this equipment requires expertise in handling 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 circuit board in the transceiver. Each side of is referred to by the type of the majority of components installed on that side ("leaded" or "chip-only"). In most cases one side has only chip components, and the other has either a mixture of both chip and leaded components (trimmers, coils, electrolytic capacitors, ICs, etc.), or leaded components only.

While we believe the technical information in this manual to be correct, Vertex Standard 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.

CAUTION

Risk of explosion if battery is replaced by an incorrect type.
Dispose of used batteries according to the instructions.

Contents

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

General

Frequency Range:	136-174 MHz
Channel / Group:	32 Channel / 2 Group
Emission Type:	16K0F3E / 11K0F3E (Analog)
	7K60F1E / 7K60FXE (Digital: 12.5 kHz Voice)
	7K60F1D / 7K60FXD (Digital: 12.5 kHz Data)
	7K60F1W (Digital: Combination of 12.5 kHz Voice & Data)
Power Supply Voltage:	7.4 V DC ±10 %
Current Consumption:	1.8 A (5 W TX)
Channel Separation:	12.5 / 25 kHz (Analog) (USA Model: 12.5 kHz)
	12.5 kHz (Digital)
Operating Temperature Range:	–22 °F to +140 °F (–30 °C to +60 °C)
Frequency Stability:	±1.5 ppm
Antenna Impedance:	50 ohm (unbalanced)
Dimension (W x H x D):	2.3” x 4.4” x 1.2” (58.4 x 112.5 x 30.5 mm) w/FNB-V133LI-UNI
	2.3” x 4.4” x 1.5” (58.4 x 112.5 x 38 mm) w/FNB-V134LI-UNI
Weight (Approx.):	9.4 oz (276 g) w/FNB-V133LI-UNI, Antenna, Belt Clip
	11.1 oz (315 g) w/FNB-V134LI-UNI, Antenna, Belt Clip

Receiver: Measured by TIA603/603D

Circuit Type:	Double Conversion Super-heterodyne
IF	50.85 MHz / 101.7 MHz
Sensitivity:	0.25 µV (Analog, 12 dB SINAD)
	0.28 µV (Digital 1 % BER)
Conducted Spurious:	–57 dBm
Adjacent Channel Selectivity:	70 dB (25 kHz Step, TIA-603)
	60 dB (12.5 kHz Step, TIA-603)
	70 dB (25 kHz Step, TIA-603D)
	45 dB (12.5 kHz Step, TIA-603D)
Intermodulation:	65 dB (25 kHz Step)
	60 dB (12.5 kHz Step)
Spurious & Image Rejection:	70 dB
Hum and Noise:	–45 dB (25 kHz Step)
	–40 dB (12.5 kHz Step)
Audio output:	700 mW (internal @ 16 ohm 5% THD)
	500 mW (external @ 4 ohm 5% THD)

Transmitter: Measured by TIA603/603D

Output Power:	5.0 / 2.5 / 1.0 / 0.25 W
Modulation Type:	Sigma Delta Modulation
Maximum Frequency Deviation:	±5.0 kHz (25 kHz Step, Analog)
	±2.5 kHz (12.5 kHz Step, Analog)
	1745 Hz - 2138 Hz (12.5 kHz Step, Symbol Deviation)
Conducted Spurious Emissions:	70 dB Below Carrier
FM Hum & Noise:	–45 dB (25 kHz Step)
	–40 dB (12.5 kHz Step)
Audio Distortion:	3 % @1 kHz

Specifications subject to change without notice or obligation.

General

Frequency Range:	136-174 MHz
Channel / Group:	32 Channel / 2 Group
Emission Type:	16K0F3E / 14K0F3E / 11K0F3E (Analog)
	7K60F1E / 7K60FXE (Digital: 12.5 kHz Voice)
	7K60F1D / 7K60FXD (Digital: 12.5 kHz Data)
	7K60F1W (Digital: Combination of 12.5 kHz Voice & Data)
Power Supply Voltage:	7.4 V DC ±10 %
Current Consumption:	1.8 A (5 W TX)
Channel Separation:	12.5 / 20 / 25 kHz (Analog)
	12.5 kHz (Digital)
Operating Temperature Range:	–30 °C to +60 °C
Frequency Stability:	±1.5 ppm
Antenna Impedance:	50 ohm (unbalanced)
Dimension (W x H x D):	58.4 x 112.5 x 30.5 mm w/FNB-V133LI-UNI
	58.4 x 112.5 x 38 mm w/FNB-V134LI-UNI
Weight (Approx.):	276 g w/FNB-V133LI-UNI, Antenna, Belt Clip
	315 g w/FNB-V134LI-UNI, Antenna, Belt Clip

Receiver: Measured by ETS 300 086

Circuit Type:	Double Conversion Super-heterodyne
IF	50.85 MHz / 101.7 MHz
Sensitivity:	0.4 µV (Analog, 20 dB SINAD)
	0.28 µV (Digital 1 % BER)
Conducted Spurious:	–57 dBm @≦ 1 GHz, –47 dBm @>1 GHz
Adjacent Channel Selectivity:	70 dB (25 kHz Step)
	60 dB (12.5 kHz Step)
Intermodulation:	65 dB
Spurious & Image Rejection:	70 dB
Hum and Noise:	–45 dB (25 kHz Step)
	–40 dB (12.5 kHz Step)
Audio output:	700 mW (internal @ 16 ohm 5% THD)
	500 mW (external @ 4 ohm 5% THD)

Transmitter: Measured by ETS 300 086

Output Power:	5.0 / 2.5 / 1.0 / 0.25 W
Modulation Type:	Sigma Delta Modulation
Maximum Frequency Deviation:	±5.0 kHz (25 kHz Step, Analog)
	±4.0 kHz (20 kHz Step, Analog)
	±2.5 kHz (12.5 kHz Step, Analog)
	1745 Hz - 2138 Hz (12.5 kHz Step, Symbol Deviation)
Conducted Spurious Emissions:	–36 dBm @≦ 1 GHz, –30 dBm @>1 GHz
FM Hum & Noise:	–45 dB (25 kHz Step)
	–40 dB (12.5 kHz Step)
Audio Distortion:	3 % @1 kHz

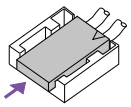
Specifications subject to change without notice or obligation.

Exploded View & Miscellaneous Parts (w/o Option Connector)

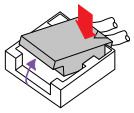
Disconnect the Speaker Connector from the MAIN Unit when remove the Front Case of the transceiver.

To Disconnecting the Speaker Connector:

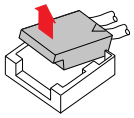
1. Hook the lever.



2. Pull up and friction lock is released.

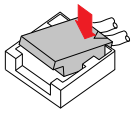


3. Positive lock is released and removal completes.

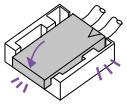


To Connecting the Speaker Connector:

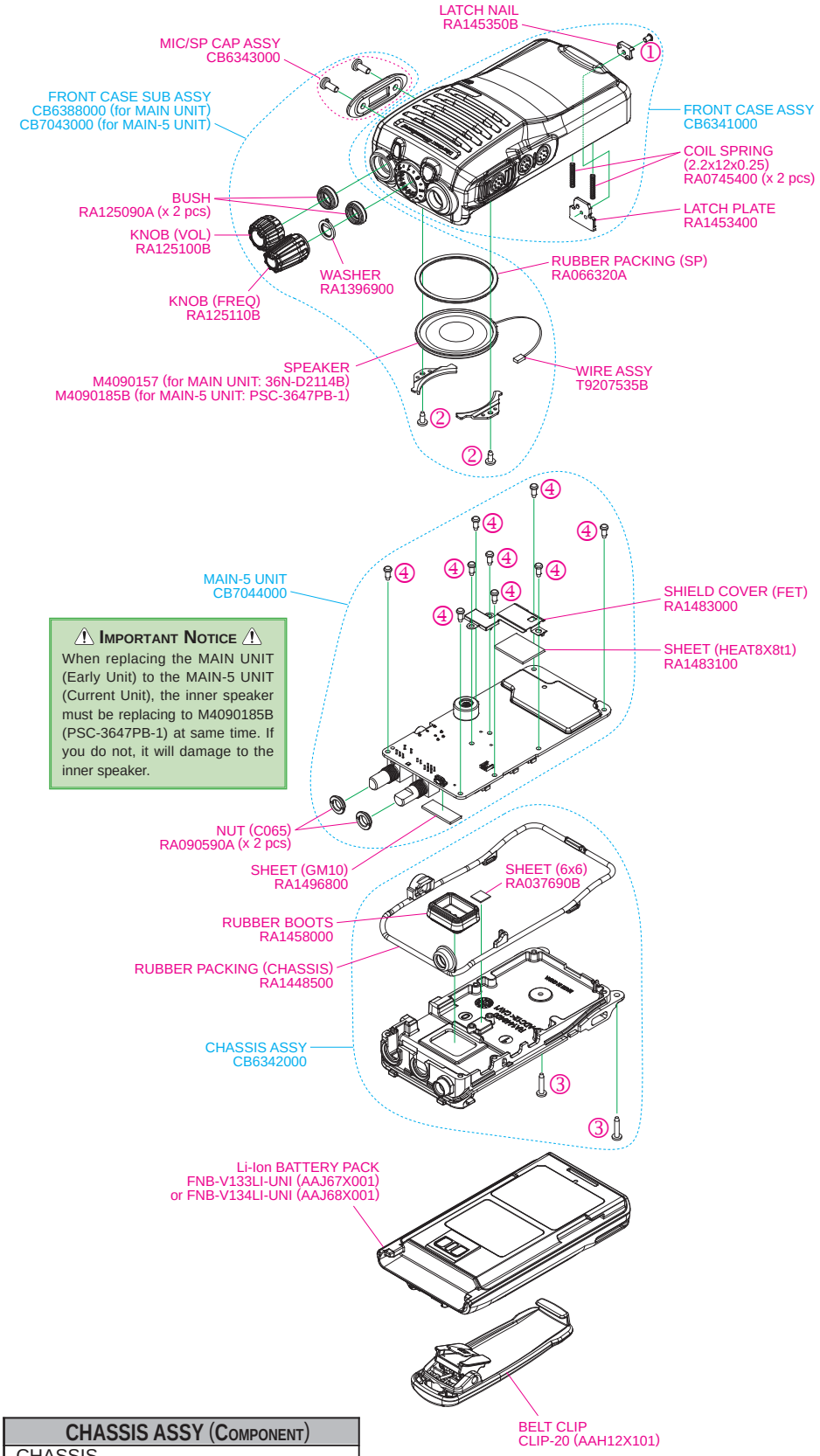
1. Insert the cable side first.



2. Press down at the lever side.



Note: Horizontal mating could damage the connector.



⚠ Important Notice ⚠

When replacing the MAIN UNIT (Early Unit) to the MAIN-5 UNIT (Current Unit), the inner speaker must be replacing to M4090185B (PSC-3647PB-1) at same time. If you do not, it will damage to the inner speaker.

FRONT CASE ASSY (Component)

FRONT CASE
MODEL LABEL
NAME PLATE
ESCUTCHEON (16CH)
DOUBLE FACE TAPE (ECS)
PLATE (FREQ)
RUBBER (TOP SEL)
SUPPORT (TOP SEL)
LIGHT GUIDE
SP NET
RUBBER (PTT)
FRAME (PTT)
SHEET (PTT)
RUBBER (SIDE)
LATCH NAIL
LATCH PLATE
COIL SPRING (2.2x12x0.25) (2 pcs)
SPONGE RUBBER (LED)
SHEET (M-TEX 9x4.5)
O RING (3.0x0.9)
PAN HEAD SCREW (M2X3BSUS#2)
BIND HEAD TAPTITE-B (M2X5) (2 pcs)

FRONT CASE SUB ASSY (Component)

KNOB (VOL)
KNOB (FREQ)
WASHER
BUSH (2 pcs)
CAP (MIC/SP)
SPEAKER
WIRE ASSY
SPEAKER HOLDER (2 pcs)
RUBBER PACKING (SP)
O RING (CAP)
O RING (0.8x2.2) (2 pcs)
BINDING HEAD SCREW (M2.6X6B) (2 pcs)

CHASSIS ASSY (Component)

CHASSIS
CONNECTOR (SMAP-BT4WP)
RUBBER PACKING (CHASSIS)
RUBBER BOOTS
SHEET (6x6)
BIND HEAD TAPTITE-B (2X10) (2 pcs)

MAIN-5 UNIT (Component)

Printed Circuit Board with Components
HOLDER RUBBER (MIC)
SHIELD COVER (FET)
SHEET (HEAT8X8t1)
NUT (C065) (2 pcs)
PAN HEAD TAPTITE-B (M2X5) (9 pcs)

REF.	VXSTD P/N	DESCRIPTION	QTY.
①	U07230227	PAN HEAD SCREW M2X3BSUS #2	1
②	U24105001	BIND HEAD TAPTITE-B M2X5	2
③	U24110001	BIND HEAD TAPTITE-B 2X10	2
④	U44105001	PAN HEAD TAPTITE-B M2X5	9

DESCRIPTION	VXSTD P/N
Battery Pack **FNB-V133LI-UNI**	AAJ67X001
Desktop Charger **CD-58**	AAJ72X001
AC Adapter **PA-55C** or **PA-55U**	PA-55C: AAJ71X003 PA-55U: AAJ71X004
Belt Clip **CLIP-20**	AAH12X101

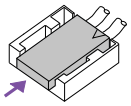
Non-designated parts are available only as part of a designated assembly.

Exploded View & Miscellaneous Parts (w/ Option Connector)

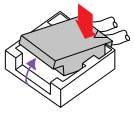
Disconnect the Speaker Connector from the MAIN Unit when remove the Front Case of the transceiver.

To Disconnecting the Speaker Connector:

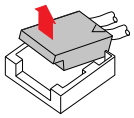
1. Hook the lever.



2. Pull up and friction lock is released.

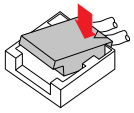


3. Positive lock is released and removal completes.

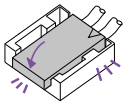


To Connecting the Speaker Connector:

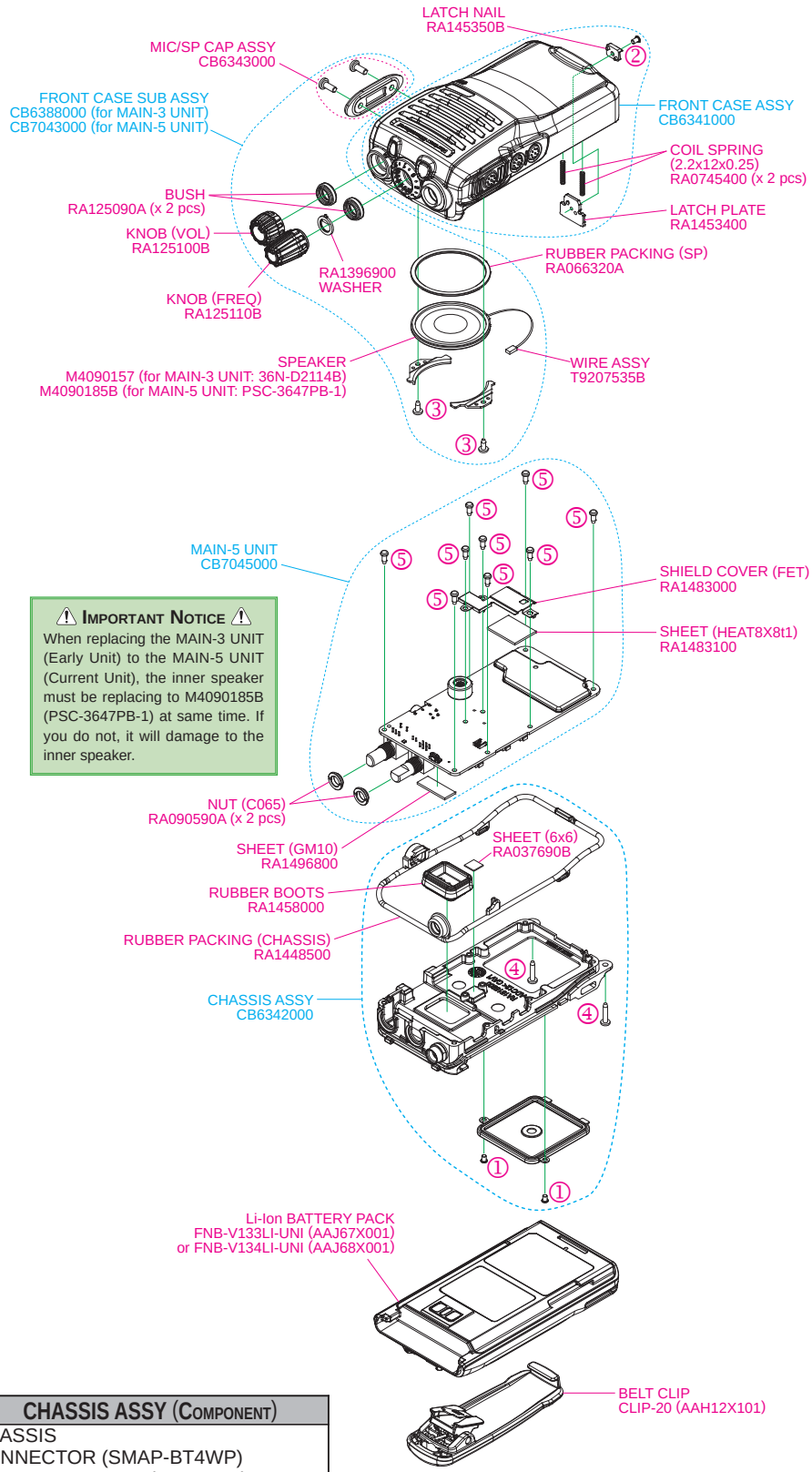
1. Insert the cable side first.



2. Press down at the lever side.



Note: Horizontal mating could damage the connector.



⚠ Important Notice ⚠
When replacing the MAIN-3 UNIT (Early Unit) to the MAIN-5 UNIT (Current Unit), the inner speaker must be replacing to M4090185B (PSC-3647PB-1) at same time. If you do not, it will damage to the inner speaker.

FRONT CASE ASSY (Component)

- FRONT CASE
- MODEL LABEL
- NAME PLATE
- ESCUTCHEON (16CH)
- DOUBLE FACE TAPE (ECS)
- PLATE (FREQ)
- RUBBER (TOP SEL)
- SUPPORT (TOP SEL)
- LIGHT GUIDE
- SP NET
- RUBBER (PTT)
- FRAME (PTT)
- SHEET (PTT)
- RUBBER (SIDE)
- LATCH NAIL
- LATCH PLATE
- COIL SPRING (2.2x12x0.25) (2 pcs)
- SPONGE RUBBER (LED)
- SHEET (M-TEX 9x4.5)
- O RING (3.0x0.9)
- PAN HEAD SCREW (M2X3BSUS#2)
- BIND HEAD TAPTITE-B (M2X5) (2 pcs)

FRONT CASE SUB ASSY (Component)

- KNOB (VOL)
- KNOB (FREQ)
- WASHER
- BUSH (2 pcs)
- CAP (MIC/SP)
- SPEAKER
- WIRE ASSY
- SPEAKER HOLDER (2 pcs)
- RUBBER PACKING (SP)
- O RING (CAP)
- O RING (0.8x2.2) (2 pcs)
- BINDING HEAD SCREW (M2.6X6B) (2 pcs)

CHASSIS ASSY (Component)

- CHASSIS
- CONNECTOR (SMAP-BT4WP)
- RUBBER PACKING (CHASSIS)
- RUBBER BOOTS
- SHEET (6x6)
- LID (OPTION)
- PACKING PAD (OPTION)
- SHEET (MICROTEX C010)
- PAN HEAD SCREW (M2X2.5(3KA)) (2 pcs)
- BIND HEAD TAPTITE-B (2X10) (2 pcs)

MAIN-5 UNIT (Component)

- Printed Circuit Board with Components
- HOLDER RUBBER (MIC)
- SHIELD COVER (FET)
- SHEET (HEAT8X8t1)
- NUT (C065) (2 pcs)
- PAN HEAD TAPTITE-B (M2X5) (9 pcs)

REF.	VXSTD P/N	DESCRIPTION	QTY.
①	U07225001	PAN HEAD SCREW M2X2.5 (3KA)	2
②	U07230227	PAN HEAD SCREW M2X3BSUS #2	1
③	U24105001	BIND HEAD TAPTITE-B M2X5	2
④	U24110001	BIND HEAD TAPTITE-B 2X10	2
⑤	U44105001	PAN HEAD TAPTITE-B M2X5	9

DESCRIPTION	VXSTD P/N
Battery Pack **FNB-V133LI-UNI**	AAJ67X001
Desktop Charger **CD-58**	AAJ72X001
AC Adapter **PA-55C** or **PA-55U**	PA-55C: AAJ71X003 PA-55U: AAJ71X004
Belt Clip **CLIP-20**	AAH12X101

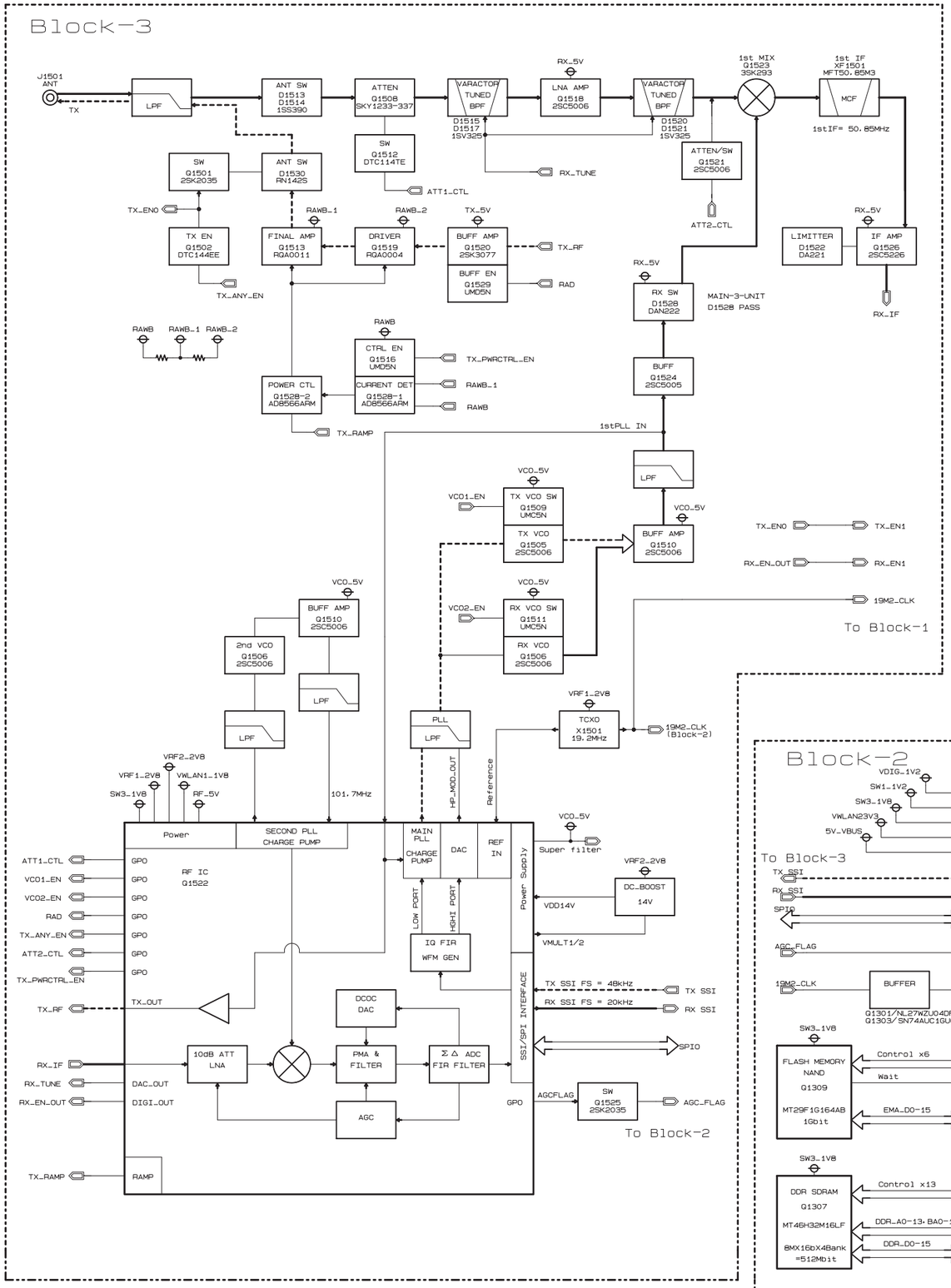
Non-designated parts are available only as part of a designated assembly.

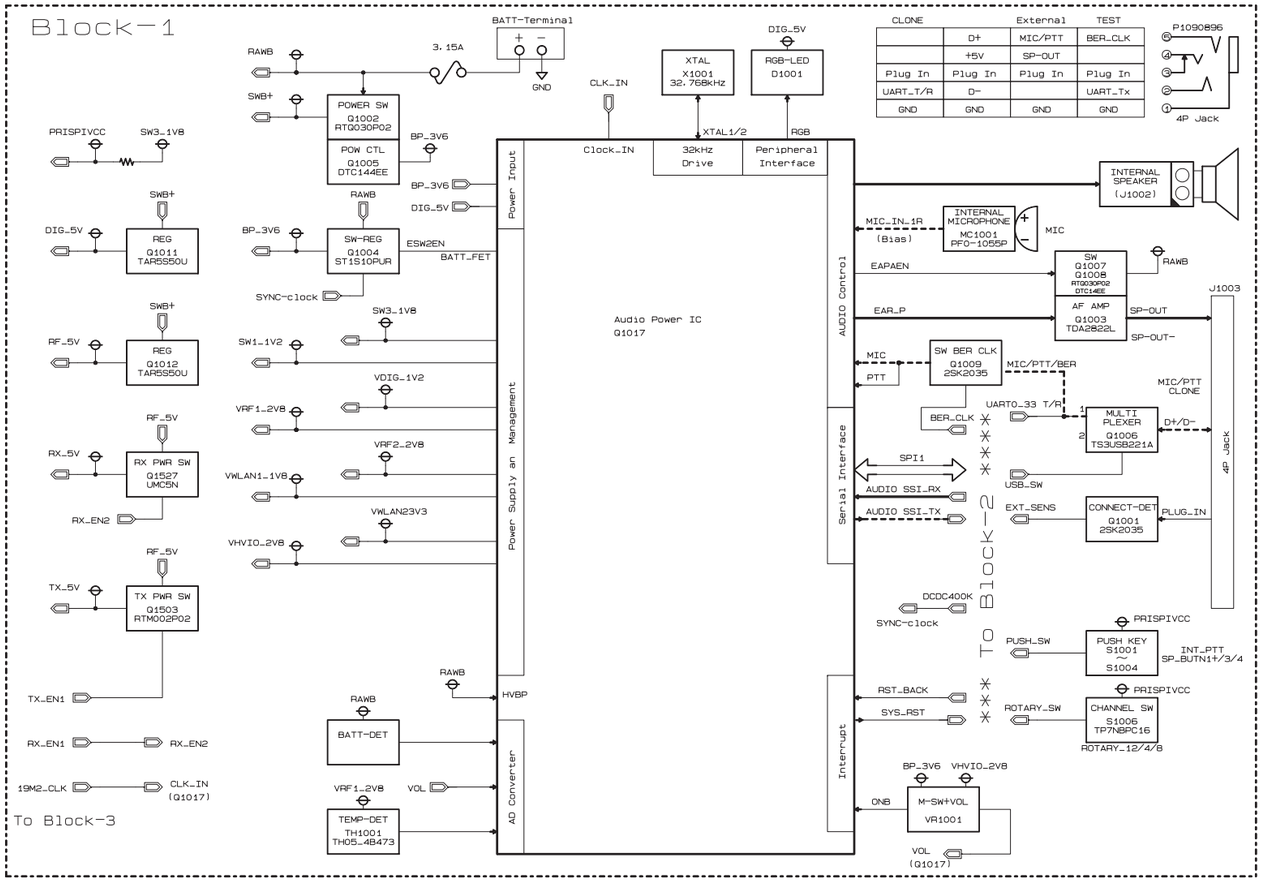
REF.	DESCRIPTION	VALUE	MFR's DESIG	VXSTD P/N
	FRONT CASE ASSY			CB6341000
	LATCH PLATE			RA1453400
	LATCH NAIL			RA145350B
	COIL SPRING	2 pcs	(2.2x12x0.25)	RA0745400
	PAN HEAD SCREW		M2X3BSUS #2	U07230227
	FRONT CASE SUB ASSY			CB7043000
	KNOB (VOL)			RA125100B
	KNOB (CH)			RA125110B
	WASHER			RA1396900
	BUSH	2 pcs		RA125090A
	RUBBER PACKING		(SP)	RA066320A
	SP HOLDER	2 pcs		RA1458300
	SPEAKER	16-ohm	PSC-3647PB-1	M4090185B
	WIRE ASSY			T9207535B
	MIC/SP CAP ASSY			CB6343000
	BIND HEAD TAPTITE-B	2 pcs	M2X5	U24105001
	CHASSIS ASSY (AC113N001)			CB6613000
	RUBBER PACKING		(CHASSIS)	RA1448500
	RUBBER BOOTS			RA1458000
	SHEET		(6x6)	RA037690B
	BIND HEAD TAPTITE-B	2 pcs	2X10	U24110001
	CHASSIS ASSY (AC113N003)			CB6614000
	RUBBER PACKING		(CHASSIS)	RA1448500
	RUBBER BOOTS			RA1458000
	SHEET		(6x6)	RA037690B
	PAN HEAD SCREW	2 pcs	M2X2.5 (3KA)	U07225001
	BIND HEAD TAPTITE-B	2 pcs	2X10	U24110001
	SPEAKER	4-ohm	36N-D2114B	M4090157 (for Early Model)
	MAIN UNIT (Early Model, w/o Option Connector)			
F 1001	CHIP FUSE ⚠	3.15A, 36V	FHC16 322ADTP	Q0000118
MC1001	MIC. ELEMENT		PF0-1055P	M3290045
Q 1513	FET		RQA0011DNS#G0	G3070507
S 1001	TACT SWITCH		EVQPUB02K	N5090167
S 1002	TACT SWITCH		EVQP8403M	N5090173
S 1003	TACT SWITCH		EVQPUB02K	N5090167
S 1004	TACT SWITCH		EVQPUB02K	N5090167
S 1006	ROTARY SWITCH		TP7NBPC16 14.7F RY-10115	N0190198
TH1001	THERMISTOR		TH05 4B473FR	G9090150
VR1001	POT.		TP76N975N13.5FB503RY10034	J60800314
X 1001	XTAL	32.768kHz	4809995L18 32.768KHZ	H0103407
X 1501	TCXO	19.2MHz	TTS27NSC-A7 - 4875185M04	H9501525
XF1501	XTAL FILTER		1D50807GQ8 50.85	H1102493
	SHIELD COVER		(FET)	RA1483000
	SHEET		(HEAT8X8t1)	RA1483100
	NUT	2 pcs	(C065)	RA090590A
	PAN HEAD TAPTITE-B	9 pcs	M2X5	U44105001

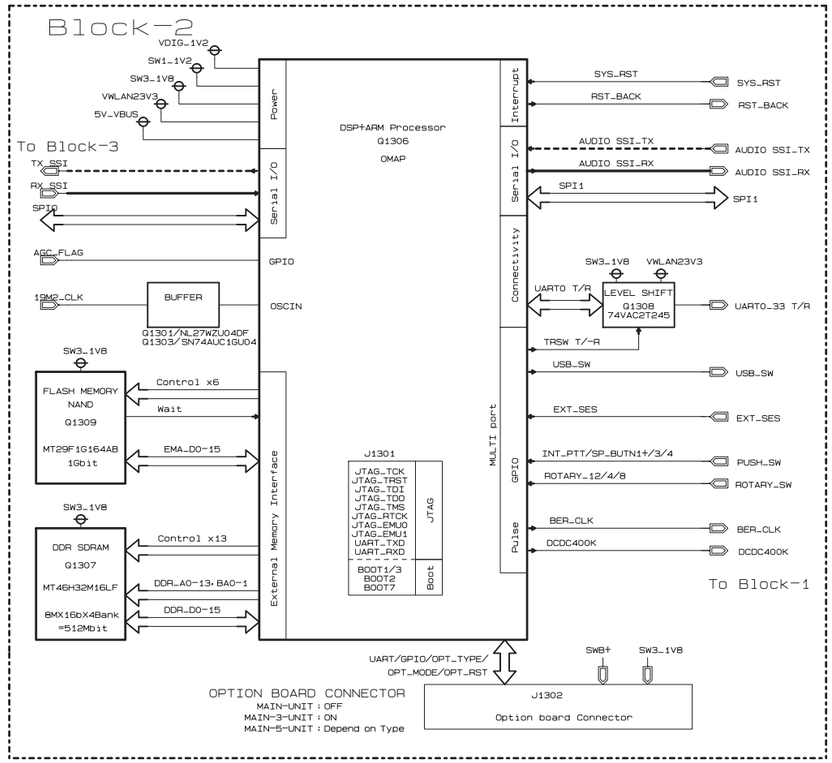
⚠ When replace a chip fuse, use the part of the same type and value.

REF.	DESCRIPTION	VALUE	MFR's DESIG	VXSTD P/N
	MAIN-3 UNIT (Early Model, w/ Option Connector)			
F 3001	CHIP FUSE ⚠	3.15A, 36V	FHC16 322ADTP	Q0000118
F 3301	CHIP FUSE ⚠	1.25A, 36V	FHC16 132ABTP	Q0000109
MC3001	MIC. ELEMENT		PF0-1055P	M3290045
Q 3513	FET		RQA0011DNS#G0	G3070507
S 3001	TACT SWITCH		EVQPUB02K	N5090167
S 3002	TACT SWITCH		EVQP8403M	N5090173
S 3003	TACT SWITCH		EVQPUB02K	N5090167
S 3004	TACT SWITCH		EVQPUB02K	N5090167
S 3006	ROTARY SWITCH		TP7NBPC16 14.7F RY-10115	N0190198
TH3001	THERMISTOR		TH05 4B473FR	G9090150
VR3001	POT.		TP76N975N13.5FB503RY10034	J60800314
X 3001	XTAL	32.768kHz	4809995L18 32.768KHZ	H0103407
X 3501	TCXO	19.2MHz	TTS27NSC-A7 - 4875185M04	H9501525
XF3501	XTAL FILTER		1D50807GQ8 50.85	H1102493
	SHIELD COVER		(FET)	RA1483000
	SHEET		(HEAT8X8t1)	RA1483100
	NUT	2 pcs	(C065)	RA090590A
	PAN HEAD TAPTITE-B	9 pcs	M2X5	U44105001
	MAIN-5 UNIT (w/o Option Connector) (w/ Option Connector)			CB7044000 CB7045000
F 5001	CHIP FUSE ⚠	3.15A, 36V	FHC16 322ADTP	Q0000118
F 5301	CHIP FUSE ⚠	1.25A, 36V	FHC16 132ABTP	Q0000109
MC5001	MIC. ELEMENT		PF0-1055P	M3290045
Q 5513	FET		RQA0011DNS#G0	G3070507
S 5001	TACT SWITCH		EVQPUB02K	N5090167
S 5002	TACT SWITCH		EVQP8403M	N5090173
S 5003	TACT SWITCH		EVQPUB02K	N5090167
S 5004	TACT SWITCH		EVQPUB02K	N5090167
S 5006	ROTARY SWITCH		TP7NBPC16 14.7F RY-10115	N0190198
TH5001	THERMISTOR		TH05 4B473FR	G9090150
VR5001	POT.		TP76N975N13.5FB503RY10034	J60800314
X 5001	XTAL	32.768kHz	4809995L18 32.768KHZ	H0103407
X 5501	TCXO	19.2MHz	TTS27NSC-A7 - 4875185M04	H9501525
XF5501	XTAL FILTER		1D50807GQ8 50.85	H1102493
	SHIELD COVER		(FET)	RA1483000
	SHEET		(HEAT8X8t1)	RA1483100
	NUT	2 pcs	(C065)	RA090590A
	PAN HEAD TAPTITE-B	9 pcs	M2X5	U44105001

⚠ When replace a chip fuse, use the part of the same type and value.







RX
TX
ETC

PARTS REFERENCE NUMBER

MAIN-UNIT : 1001 - 1999
MAIN-3-UNIT : 3001 - 3999
MAIN-5-UNIT : 5001 - 5999

1. Receiver System

1-1. Front-end RF Amplifier

Incoming RF signal from the antenna passes through the Low-pass filter, antenna switching diode Dx513, Dx514 (both 1SS390), and the RF attenuator Qx508 (SKY12338), and then removed undesired frequencies by the varactor tuned band-pass filter Dx515 and Dx516 (both 1SV325).

The filtered RF signal is amplified by Qx518 (2SC5006) and then passes through another varactor tuned band-pass filter Dx520 and Dx521 (both 1SV325) to remove the undesired frequencies, and then applied to the 1st mixer Qx523 (3SK293).

1-2. First Mixer

The RF signal is mixed with the 1st local signal between 186.85 and 224.85 MHz in the 1st mixer Qx523 (3SK293), to produce 50.85 MHz 1st IF signal.

The 1st local signal is generated by the VCO, which consists of Qx506 (2SC5006), varactor diodes Dx502 (1SV279), Dx504 (xSV282), Dx507 (1SV279), and Dx508 (1SV282). The 1st local signal is supplied to the 1st mixer Qx523 (3SK293) through the buffer amplifier Qx510 (2SC5005) and amplifier Qx524 (2SC5006).

1-3. IF Amplifier & Demodulator

The 1st IF signal is applied to the monolithic crystal filter XFx501 to strip away all but the desired signal, and then supplied to the custom IC Qx522 (RODINIA) through the buffer amplifier Qx526 (2SC5226). The custom IC Qx522 (RODINIA) converts the 1st IF signal into the Base Band signal.

The Base Band signal from the custom IC Qx522 (RODINIA) is applied to another custom IC Qx306 (OMAP), which is demodulated by the Digital Signal Processor.

1-4. Audio Amplifier

The demodulated signal from the custom IC Qx306 (OMAP) is applied to another custom IC Qx017 (CPCAP). The custom IC Qx017 (CPCAP) adjusts the audio volume level, and then amplifies the audio signal up to 700 mW. The output signal from the custom IC Qx017 (CPCAP) is applied to the audio speaker.

2. Transmitter System

2-1. MIC Amplifier & Modulator

The speech signal from internal microphone MCx001 or external microphone Jx003 is supplied to the custom IC Qx017 (CPCAP), which is amplified the speech signal.

The amplified speech signal from the custom IC Qx017 (CPCAP) is supplied to another custom IC Qx306 (OMAP), which process the speech signal by the Digital Signal Processor.

The processed speech signal from the custom IC Qx306 (OMAP) is supplied to the modulator section of the custom IC Qx522 (RODINIA), which modulates the speech signal into the FM or digital signal.

2-2. Drive & Final Amplifier Stages

The modulated signal from the custom IC Qx522 (RODINIA) is buffered by Qx520 (2SK3077) and amplified by the driver amplifier Qx519 (RQA0004PXDQS), and then is applied to the final amplifier Qx513 (RQA0011DNS), which is amplified up to 5 watts output power.

The transmit signal then passes through the antenna switch Dx512 (RN124S) and is low pass filtered to suppress away harmonic spurious radiation before delivery to the antenna.

2-3. Automatic Transmit Power Control

The current detector Qx528-1 (AD8566ARM) detects the current of the final amplifier Qx513 (RQA0011DNS) and the driver amplifier Qx519 (RQA0004PXDQS), and converts the current difference to the voltage difference.

The output from the current detector Qx528-1 (AD8566ARM) is compared with the reference voltage and amplified by the power control amplifier Qx528-2 (AD8566ARM).

The output from the power control amplifier Qx528-2 (AD8566ARM) controls the gate bias of the driver amplifier Qx519 (RQA0004PXDQS) and the final amplifier Qx513 (RQA0011DNS).

The reference voltage changes into four values (Transmit Power High and Low) controlled by custom IC Qx522 (RODINIA).

Parts reference number is as follows

MAIN Unit (w/o Option Connector): 1000 - 1999
MAIN-3 Unit (w/ Option Connector): 3000 - 3999
MAIN-5 Unit: 5000 - 5999

3. PLL Frequency Synthesizer

The frequency synthesizer consists of VCO, TCXO (Xx501), and the custom IC Qx522 (RODINIA).

The output frequency from TCXO is 19.2 MHz and the tolerance is ±1.5 ppm in the temperature range –22 °F to +140 °F (–30 °C to +60 °C).

3-1. VCO (Voltage Controlled Oscillator)

While the radio is receiving, the RX oscillator Qx506 (2SC5006) generates a programmed frequency between 186.85 and 224.85 MHz as 1st local signal.

While the radio is transmitting, the TX oscillator Qx505 (2SC5006) generates a frequency between 136.00 and 174.00 MHz.

The output from oscillator is amplified by buffer amplifier Qx510 (2SC5006) and then is divided, one is fed back to the PLL Circuit in the custom IC Qx522 (RODINIA). The other one is supplied to the 1st mixer Qx523 (3SK293) through the buffer amplifier Qx524 (2SC5005) in case of the reception. In the transmission, the output is modulated to the FM (or digital) in the custom IC Qx522 (RODINIA), and then supplied to the transmitter section described previously.

3-2. VCV (Varactor Control Voltage) Control

The tuning voltage (VCV) of the VCO establishes the lock range of VCO by controlling the cathode of varactor diode (Dx502 (1SV279), Dx504 (1SV282), Dx507 (1SV279), Dx508 (1SV282) for receiving, and Dx501 (1SV279), Dx503 (1SV282), Dx505 (1SV279), Dx506 (1SV282) for transmitting) from the custom IC Qx522 (RODINIA).

3-3. PLL

The main constitution product of the PLL is equipped all with in the custom IC Qx522 (RODINIA), so that all processing regarding the frequency control is performed in the custom IC Qx522 (RODINIA).

Parts reference number is as follows

MAIN Unit (w/o Option Connector): 1000 - 1999
MAIN-3 Unit (w/ Option Connector): 3000 - 3999
MAIN-5 Unit: 5000 - 5999

Introduction

The **EVX-531** series has been aligned at the factory for the specified performance across the entire frequency range specified. Realignment should therefore not be necessary except in the event of a component failure. All component replacement and service should be performed only by an authorized Vertex Standard representative, or the warranty policy may be voided.

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 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 Vertex Standard 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 Vertex Standard 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, Vertex Standard must reserve 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 the need for 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

- ❒ Radio Tester with calibrated output level at 500 MHz
- ❒ In-line Wattmeter with 5% accuracy at 500 MHz
- ❒ 50-ohm, 10-W RF Dummy Load
- ❒ Regulated DC Power Supply (standard 7.5 VDC, 3 A)
- ❒ Frequency Counter: ±0.2 ppm accuracy at 500 MHz
- ❒ AF Signal Generator
- ❒ AC Voltmeter
- ❒ DC Voltmeter
- ❒ VHF Sampling Coupler
- ❒ IBM PC/Compatible Computer with Microsoft® Windows® 2000, XP, Vista, or 7
- ❒ Vertex Standard CE142 PC Programming Software
- ❒ Vertex Standard FIF-12 USB Programming Interface and CT-106 PC Programming Cable
- ❒ Vertex Standard FRB-6 Tuning Interface Box and CT-160 Connection Cable

Alignment Preparation & Precautions

A 50- 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.

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.

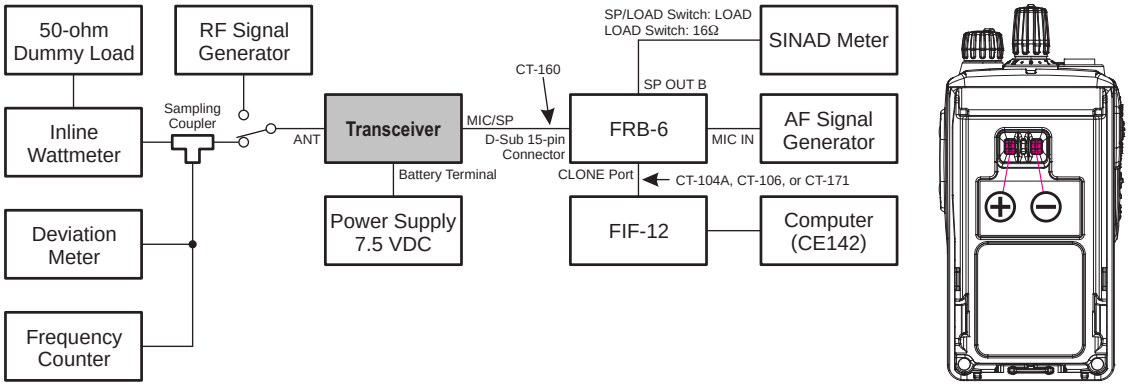
Correct alignment requires that the ambient temperature be the same as that of the transceiver and test equipment, and that this temperature be held constant between 20 °C and 30 °C. When the transceiver is brought into the shop from hot or cold air, it should be allowed time to come to room temperature 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 this procedure are based on 0 dBµ EMF = 1.0 µV.

Test Setup

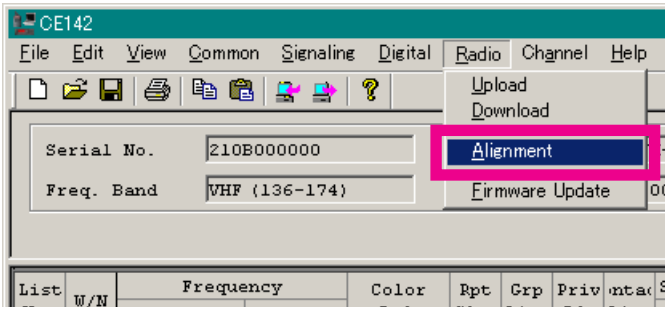
Setup the test equipment as shown below for transceiver alignment, then apply 7.5 V DC power to the transceiver.

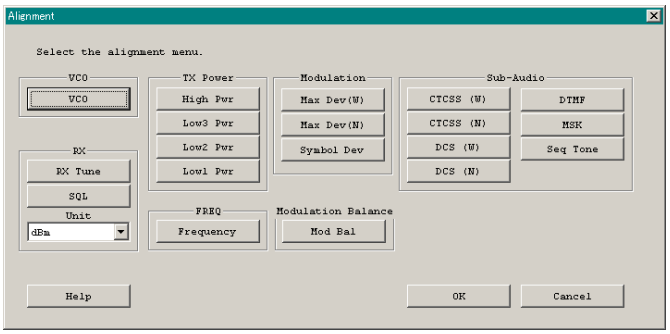


The Alignment Tool Outline

Installation the tool

- ❒ Install the CE142 PC Programming Software to your PC.
- ❒ Execute the “Alignment” function in the “Radio” menu of CE142.





Action of the switches

When the transceiver is in “Alignment Mode”, the action of PTT and KEY is ignored. All of the action is remote controlled by Computer.

Alignment Mode

In the “Alignment Mode”, the aligned data written in the radio will be able to re-align its alignment data. The value of each parameter can be changed to desired position by “←”/“→” arrow key for data up/down, “↑”/“↓” arrow key for channel up/down, direct number input, and drag the mouse.

Note: when all items are aligned, it is strongly recommended to align according to following order. The detail information is written in the help document of CE142 PC Programming Software.

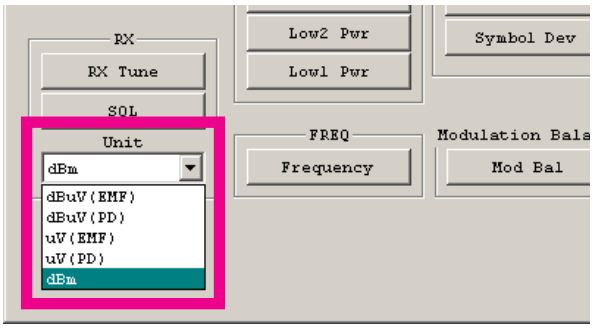
1. VCO (confirmation only)
2. PLL Reference Frequency (Frequency)
3. RX Sensitivity (RX Tune)
4. Squelch (SQL/RSSI)
5. TX Power <High/Low3/Low2/Low1>
6. Maximum Deviation <Wide/Narrow>

Adjust the following items when needed.

- ❍ Symbol Deviation
- ❍ Modulation Balance
- ❍ CTCSS Deviation <Wide/Narrow>
- ❍ DCS Deviation <Wide/Narrow>
- ❍ DTMF Deviation
- ❍ MSK Deviation
- ❍ Sequential Tone Deviation

Unit

During alignment, you may select the value among dBμV, μV (EMF or PD), or dBm by the “UNIT” box.

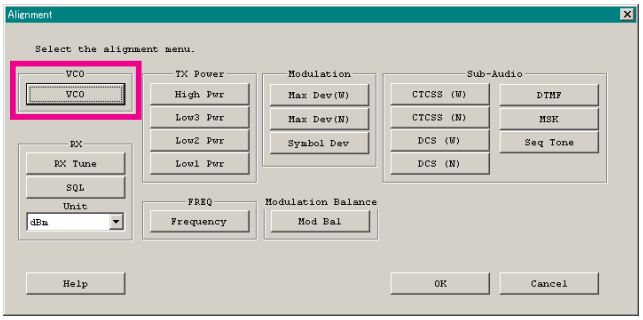


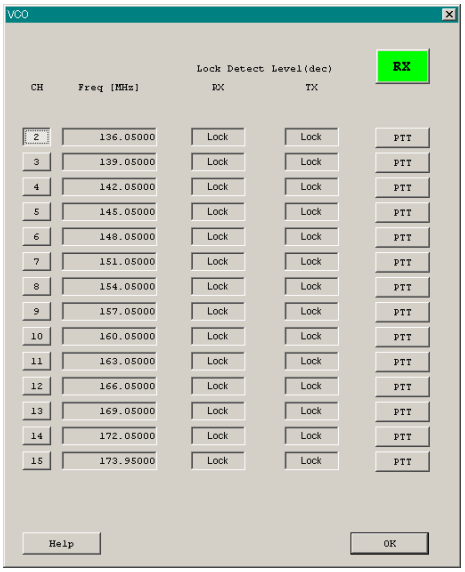
When perform the RX Tune and SQL alignment, the RF level shows this unit according to this setting.

1. VCO (RX VCO/TX VCO) - *This parameter is for confirmation only and cannot align* -

This parameter is to confirm whether the VCO status shall be “Lock” or “Unlock”.

1. Click the “VCO” button to open the “VCO” window.
2. Click the “CH” button on the desired channel. The RX VCO status (“Lock” or “Unlock”) will appear in the “RX” box.
3. Click the “PTT” button. The radio starts to transmit on the selected channel, and the TX VCO status (“Lock” or “Unlock”) will appear in the “TX” box.
4. Click the “PTT” button again to stop transmitting.
5. Click the “OK” button to finish the confirmation of the VCO status.

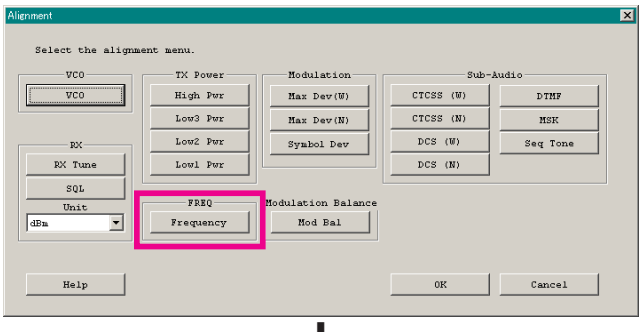


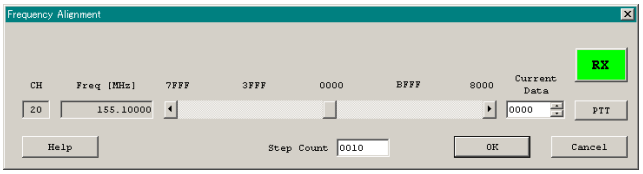


2. PLL Reference Frequency (Frequency)

This parameter is to align the reference frequency for PLL.

1. Click the “Frequency” button to open the “Frequency Alignment” window.
2. Click the “PTT” button or press the “SPACE” bar of the computer’s keyboard, the radio will start to transmit on the center frequency channel.
3. Set the value to get the desired frequency according to the following ways:
   - Dragging the slide bar
   - Clicking the arrow buttons
   - Pressing the left/right arrow key of the computer’s keyboard
   - Entering the value (“0000” - “FFFF”) in the “Current Data” box from the computer’s keyboard
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.



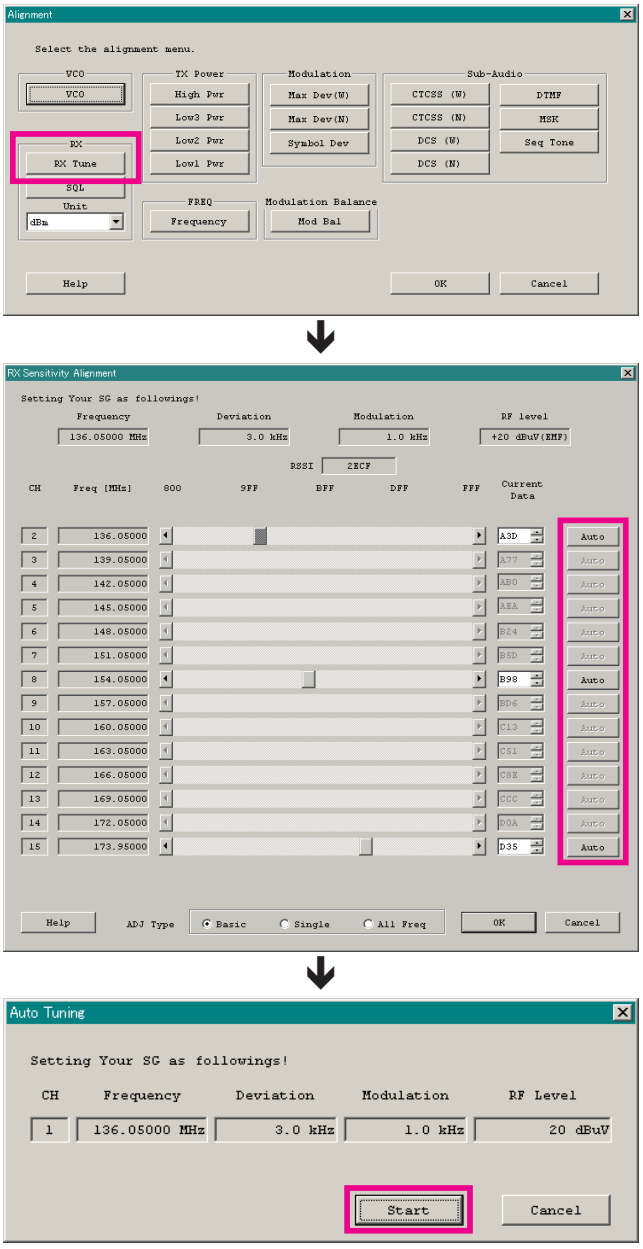


3. RX Sensitivity (RX Tune)

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. Click the “RX Tune” button to open the “RX Sensitivity Alignment” window.
2. Click the “Auto” button on the desired channel. The “Auto Tuning” window will appear.
3. Set the RF Signal Generator output according to the indication of the screen.
4. Click the “Start” button to start the automatic alignment to get the best RX sensitivity (Highest RSSI value).
5. Click the “OK” button to finish the RX Sensitivity alignment and save the data.

1) You may adjust the RX sensitivity manually by the following method:
   - Dragging the slide bar
   - Clicking the arrow buttons
   - Pressing the left/right arrow key of the computer’s keyboard
   - Entering the value (“800”- “FFF”) in the “Current Data” box from the computer’s keyboard
2) You may select the alignment type from the “Radio” button (**ADJ Type**) located at the bottom of the screen, as needed.
   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 alignment items as follows in the Squelch Sensitivity.

Threshold SQL Level (Wide/Narrow)

The alignment for the Noise SQL Threshold level at Wide (5k/4k) or Narrow (2.5k).

Normal RSSI Level (Wide/Narrow)

The alignment for the RSSI Normal level at Wide (5k/4k) or Narrow (2.5k).

Tight RSSI Level (Wide/Narrow)

The alignment for the RSSI Tight level at Wide (5k/4k) or Narrow (2.5k).

SQL Close Level (Wide/Narrow)

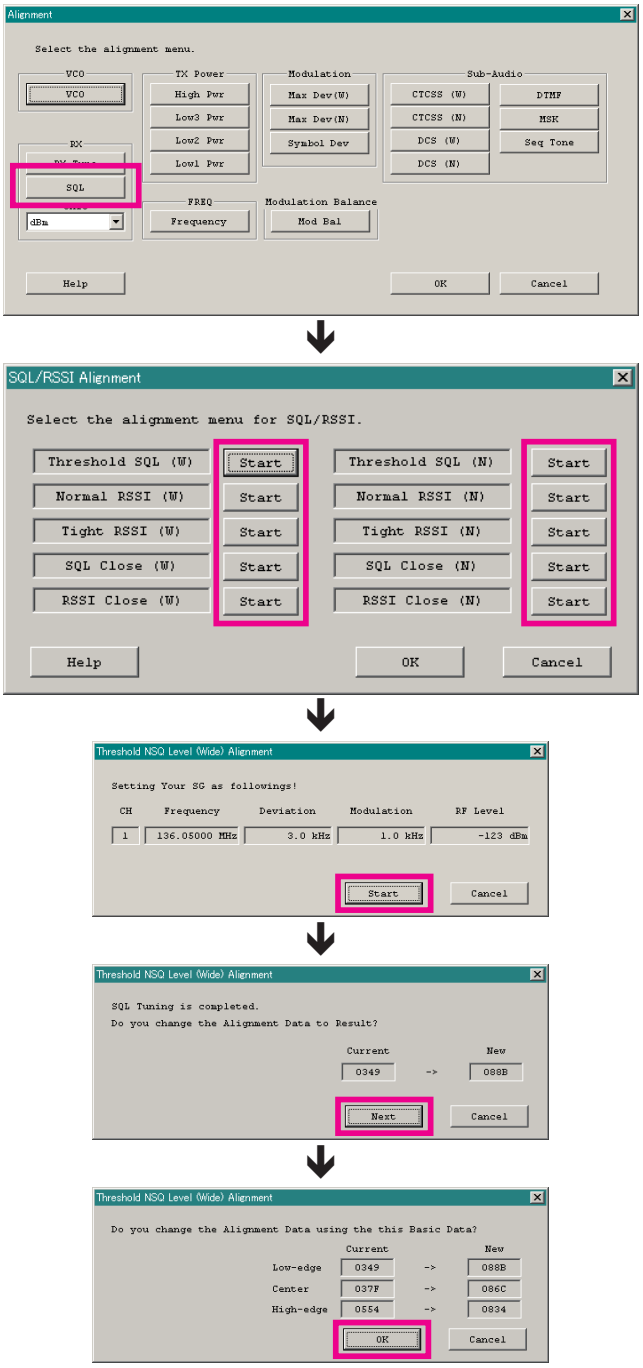
The alignment for the Noise SQL Close level at Wide (5k/4k) or Narrow (2.5k).

RSSI Close Level (Wide/Narrow)

The alignment for the RSSI Close level at Wide (5k/4k) or Narrow (2.5k).

The procedure for all the alignments is as follows.

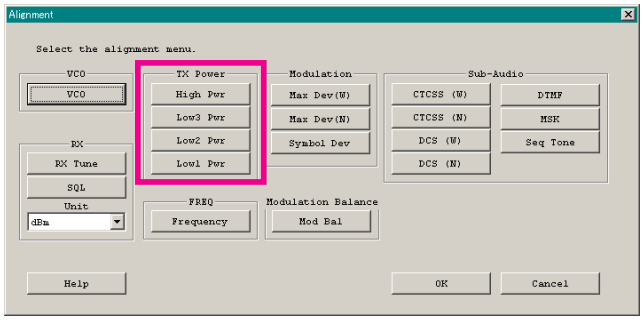
1. Click the “Start” button you wish to align to open the “SQL/RSSI Alignment” window.
2. Click the “Start” button on the desired alignment item to open other window.
3. Set the RF Signal Generator according to the indication of the window, then click the “Start” button.
4. The automatic alignment will start to get the optimum level.
5. The alignment result will appear in the “New” box.
   On the following alignment items, click the “Next” button and then repeat step 2-5 several times according to the indication of the window.
   Threshold SQL Level (Wide/Narrow)
   Normal RSSI Level (Wide/Narrow)
   Tight RSSI Level (Wide/Narrow)
   Other alignment items has not extra step; only one step procedure.
6. Click the “OK” button, then the data will be saved and the alignment is finished.

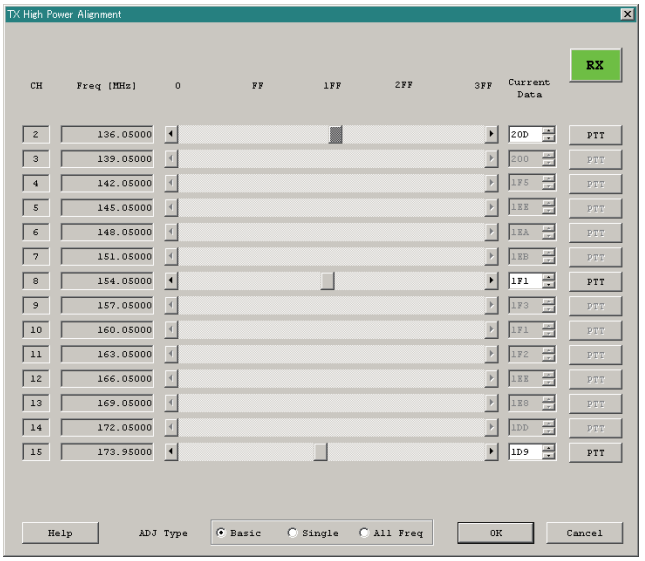


5. TX Power

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

1. Click the “TX Power (High Pwr / Low3 Pwr / Low2 Pwr / Low1 Pwr)” button to open the “TX Power Alignment” window.
2. Click the “PTT” button on the desired channel. The radio starts to transmit on the selected channel.
3. 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 according to the following ways:
   - Dragging the slide bar
   - Clicking the arrow buttons
   - Pressing the left/right arrow key of the computer’s keyboard
   - Entering the value in the entry box from the computer’s keyboard
4. After getting the desired output power, click the “PTT” button or press the “SPACE” bar to stop transmitting.
5. Click the “OK” button to finish the TX Power alignment and save the data.





You may select the adjusting type from the “Radio” button (**ADJ Type**) located at the bottom of the screen, as needed.

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

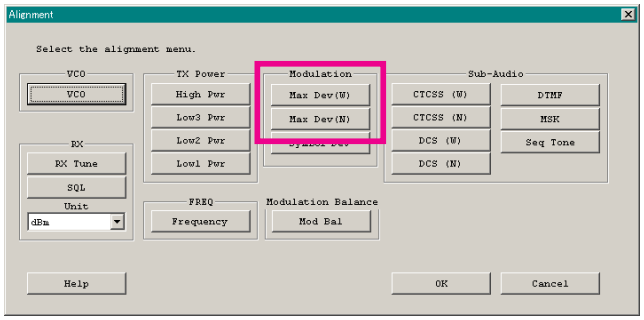
Single: Alignment value changes only on the selected channel.

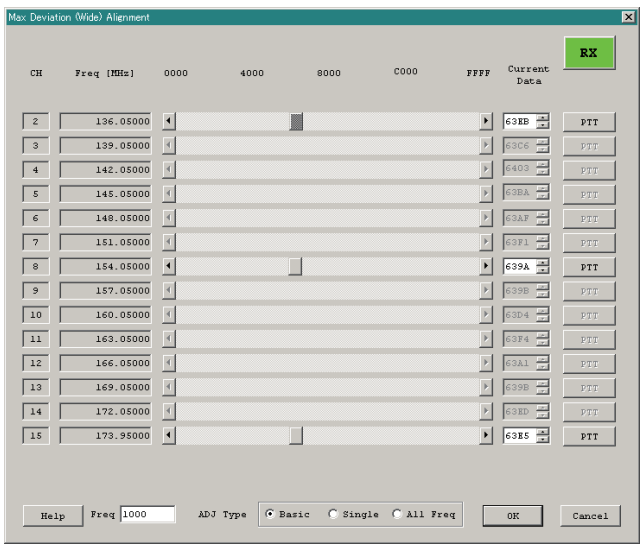
All Freq: Alignment value changes on all channels.

6. Maximum Deviation <Wide> / <Narrow>

This parameter is to align the “Maximum Deviation” (Wide/Narrow).

1. Press the “Max Dev (W/N)” button to open the “Max Deviation Alignment” window.
2. Click the “PTT” button on the desired channel. The radio starts to transmit on the selected channel.
3. Set the value to get desired deviation (Wide: 4.2 kHz, Narrow: 2.1 kHz) on the deviation meter according to the following ways:
   - Dragging the slide bar
   - Clicking the arrow buttons
   - Pressing the up-down key of the computer’s keyboard
   - Entering the value in the entry box from the computer’s keyboard
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 Max Deviation alignment and save the data.





1) You may align the deviation level by any modulation frequency by changing the value of the “Freq” box located at the bottom left of the screen, if needed.
2) You may select the alignment type from the “Radio” button (**ADJ Type**) located at the bottom of the screen, as needed.

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.

Perform the following alignments as needed.

SYMBOL DEVIATION

This parameter is to align the deviation of the digital mode artificially.

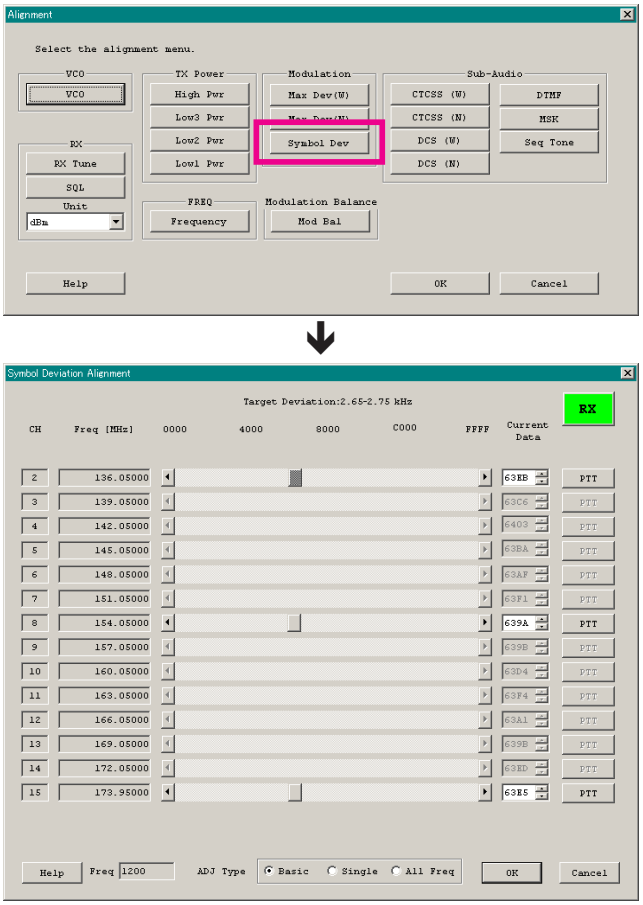
1. Press the “Symbol Dev” button to open the “Symbol Deviation Alignment” window.
2. Click the “PTT” button on the desired channel. The radio starts to transmit on the selected channel.
3. Set the value to get Target Deviation (which is indicated on the screen) on the deviation meter according to the following ways:
   - Dragging the slide bar
   - Clicking the arrow buttons
   - Pressing the up-down key of the computer’s keyboard
   - Entering the value in the entry box from the computer’s keyboard
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 Symbol Deviation alignment and save the data.

You may select the alignment type from the “Radio” button (**ADJ Type**) located at the bottom of the screen, as needed.

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.

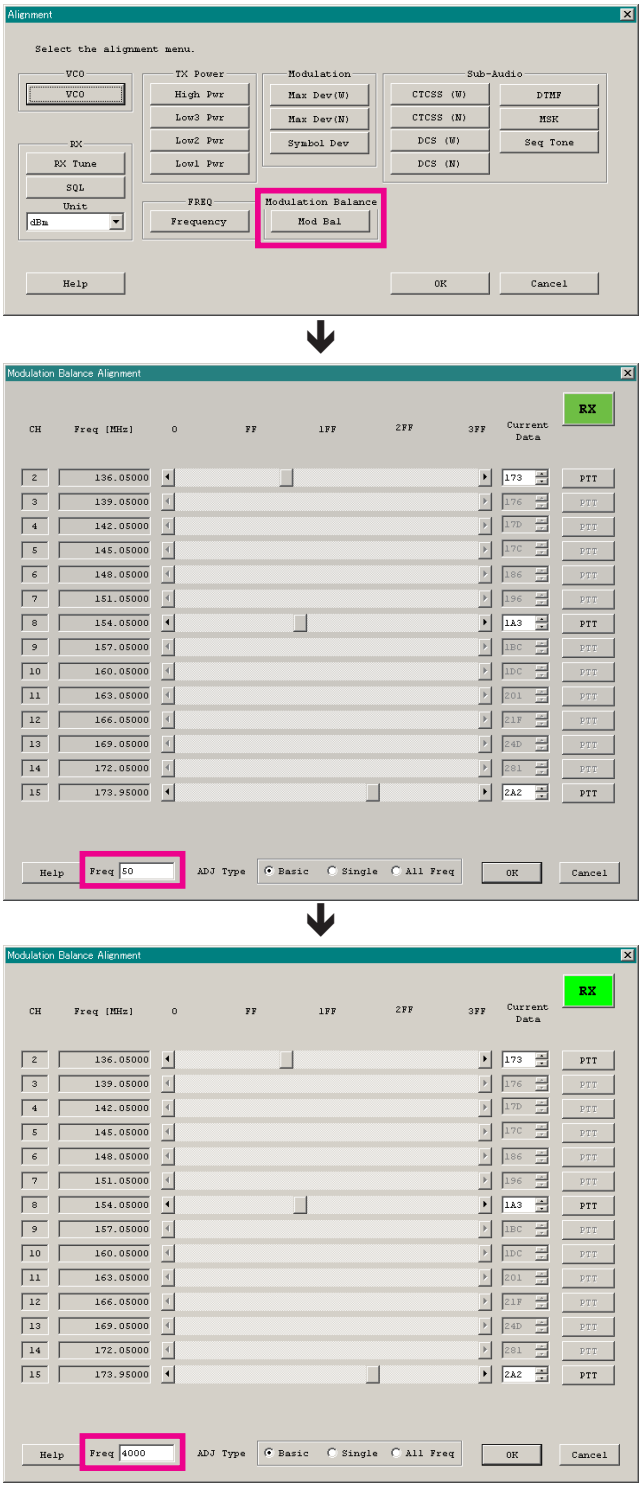


MODULATION BALANCE <WIDE> / <NARROW> (THIS ALIGNMENT IS DIFFICULT.)

This parameter is to align the "Modulation Balance" (Wide/Narrow).

1. Press the "Mod Bal" button to open the "Modulation Balance Alignment" window.
2. Confirm the modulation frequency which is indicated in the "Freq" box located at the bottom left of the screen is "50 (Hz)". If not, enter the value (50) in the "Freq" box from the computer's keyboard.
3. Click the "PTT" button on the desired channel. The radio starts to transmit on the selected channel.
4. Write down a deviation level, then enter the "4000 (Hz)" of the modulation frequency to the "Freq" box.
5. Set the value to get the same deviation level that wrote down according to the following ways:
   - Dragging the slide bar
   - Clicking the arrow buttons
   - Pressing the left/right arrow key of the computer's keyboard
   - Entering the value ("0" - "3FF") in the "Current Data" box from the computer's keyboard
6. Click the "PTT" button or press the "SPACE" bar to stop transmitting.
7. Click the "OK" button to finish the Modulation Balance alignment and save the data.

1) You may align the modulation balance by any frequency pair by changing the value of the "Freq" box located at the bottom left of the screen, if needed.
2) You may select the alignment type from the "Radio" button (**ADJ Type**) located at the bottom of the screen, as needed.
   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.

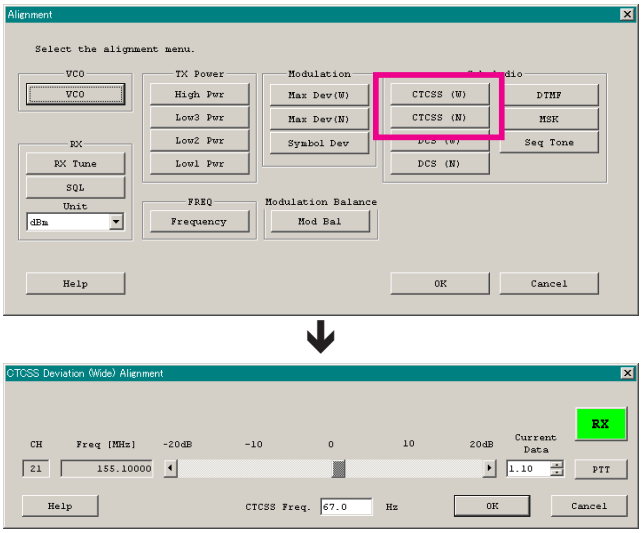


CTCSS Deviation <Wide> / <Narrow>

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

1. Press the “CTCSS (W/N)” button to open the “CTCSS Deviation Alignment” window.
2. Click the “PTT” button or press the “SPACE” bar of the computer’s keyboard to transmit the radio.
3. Set the value to get desired deviation (Nominal: Wide: 0.6 kHz, Narrow: 0.35 kHz) on the deviation meter according to the following ways:
   - Dragging the slide bar
   - Clicking the arrow buttons
   - Pressing the left/right arrow key of the computer’s keyboard
   - Entering the value (“–20.00” - “20.00”) in the “Currend Data” box from the computer’s keyboard
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 CTCSS Deviation alignment and save the data.

You may align the deviation level by any CTCSS tone frequency (default: 67.0 Hz) by changing the value of the “CTCSS Freq” box located at the bottom of the screen, if needed.

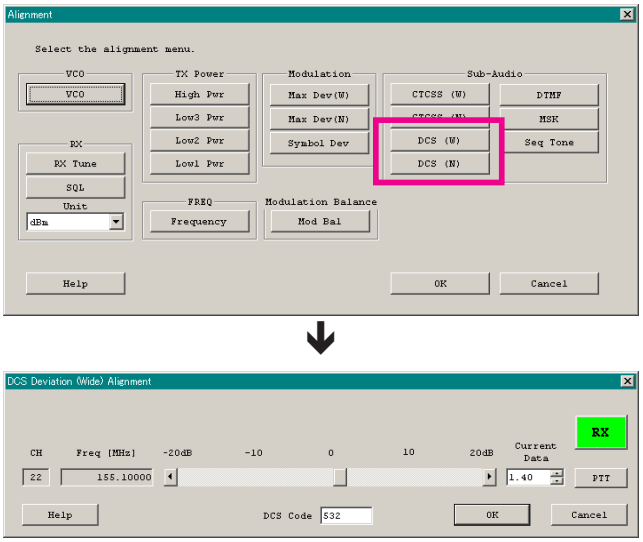


DCS Deviation <Wide> / <Narrow>

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

1. Press the “DCS (W/N)” button to open the “DCS Deviation Alignment” window.
2. Click the “PTT” button or press the “SPACE” bar of the computer’s keyboard to transmit the radio.
3. Set the value to get desired deviation (Nominal: Wide: 0.65 kHz, Narrow: 0.4 kHz) on the deviation meter according to the following ways:
   - Dragging the slide bar
   - Clicking the arrow buttons
   - Pressing the left/right arrow key of the computer’s keyboard
   - Entering the value (“–20.00” - “20.00”) in the “Currend Data” box from the computer’s keyboard
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 DCS Deviation alignment and save the data.

You may align the deviation level by any DCS code (default: 532) by changing the value of the “DCS Code” box located at the bottom of the screen, if needed.

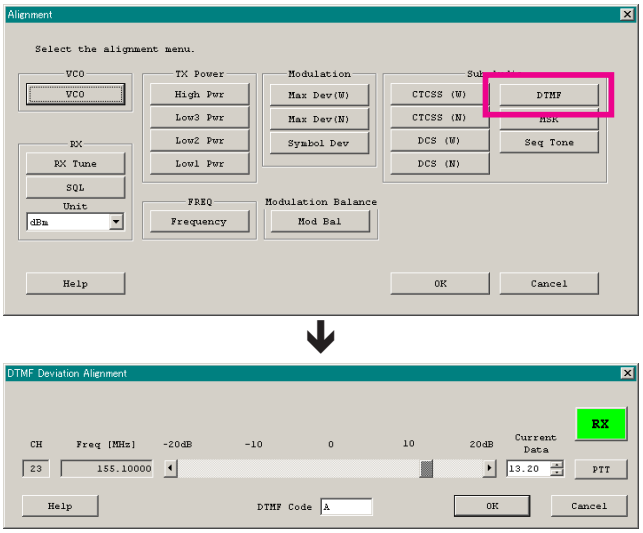


DTMF Deviation

This parameter is to align “DTMF Deviation”.

1. Press the “DTMF” button to open the “DTMF Deviation Alignment” window.
2. Click the “PTT” button or press the “SPACE” bar of the computer’s keyboard to transmit the radio.
3. Set the value to get desired deviation (Nominal: 3.0 kHz) on the deviation meter according to the following ways:
   - Dragging the slide bar
   - Clicking the arrow buttons
   - Pressing the left/right arrow key of the computer’s keyboard
   - Entering the value (“–20.00” - “20.00”) in the “Currend Data” box from the computer’s keyboard
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.

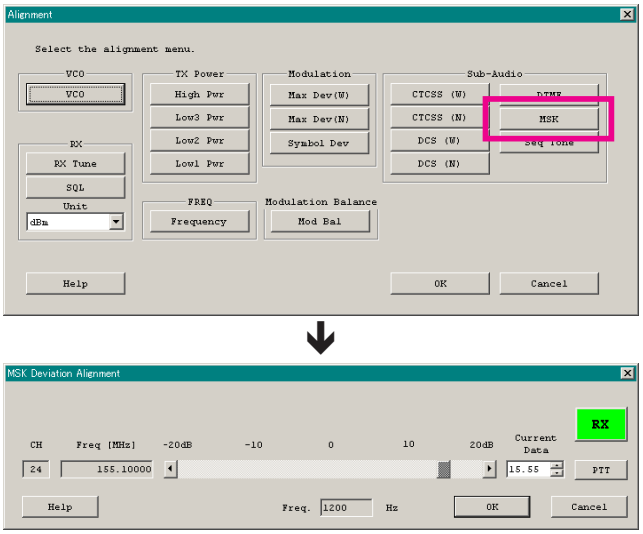
You may align the deviation level by any DTMF tone (default: “A”, available selection: “0” - “9”, “A” - “D”, “E(*)”, and “F(#)”) by changing the value of the “DTMF Code” box located at the bottom of the screen, if needed.



MSK Deviation

This parameter is to align “MSK Deviation” which use for the ANI operation of the MDC1200 System.

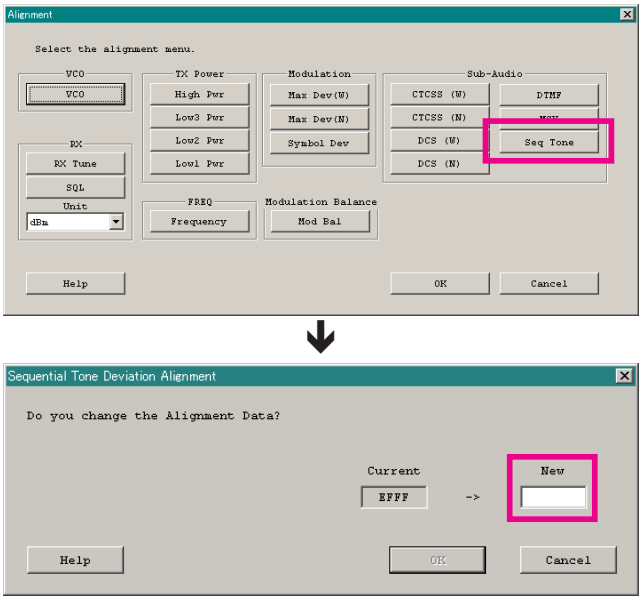
1. Press the “MSK” button to open the “MSK Deviation Alignment” window.
2. Click the “PTT” button or press the “SPACE” bar of the computer’s keyboard to transmit the radio.
3. Set the value to get desired deviation (Nominal: 3.0 kHz) on the deviation meter according to the following ways:
   - Dragging the slide bar
   - Clicking the arrow buttons
   - Pressing the left/right arrow key of the computer’s keyboard
   - Entering the value (“–20.00” - “20.00”) in the “Currend Data” box from the computer’s keyboard
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 MSK Deviation alignment and save the data.



Sequential Tone Deviation

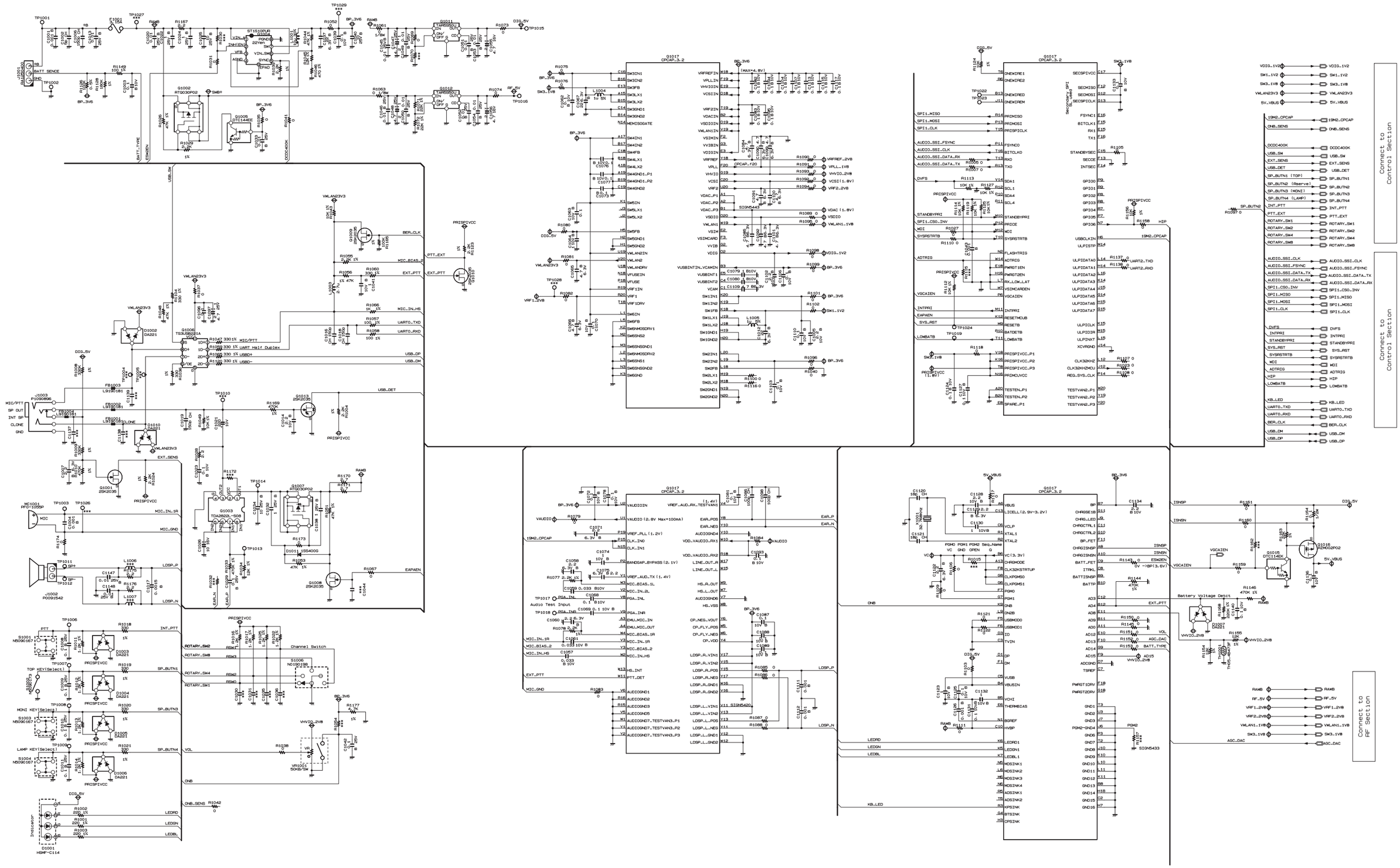
This parameter is to fine-tune of the “Sequential Tone Deviation” for the 2-Tone and 5-Tone Encoder.

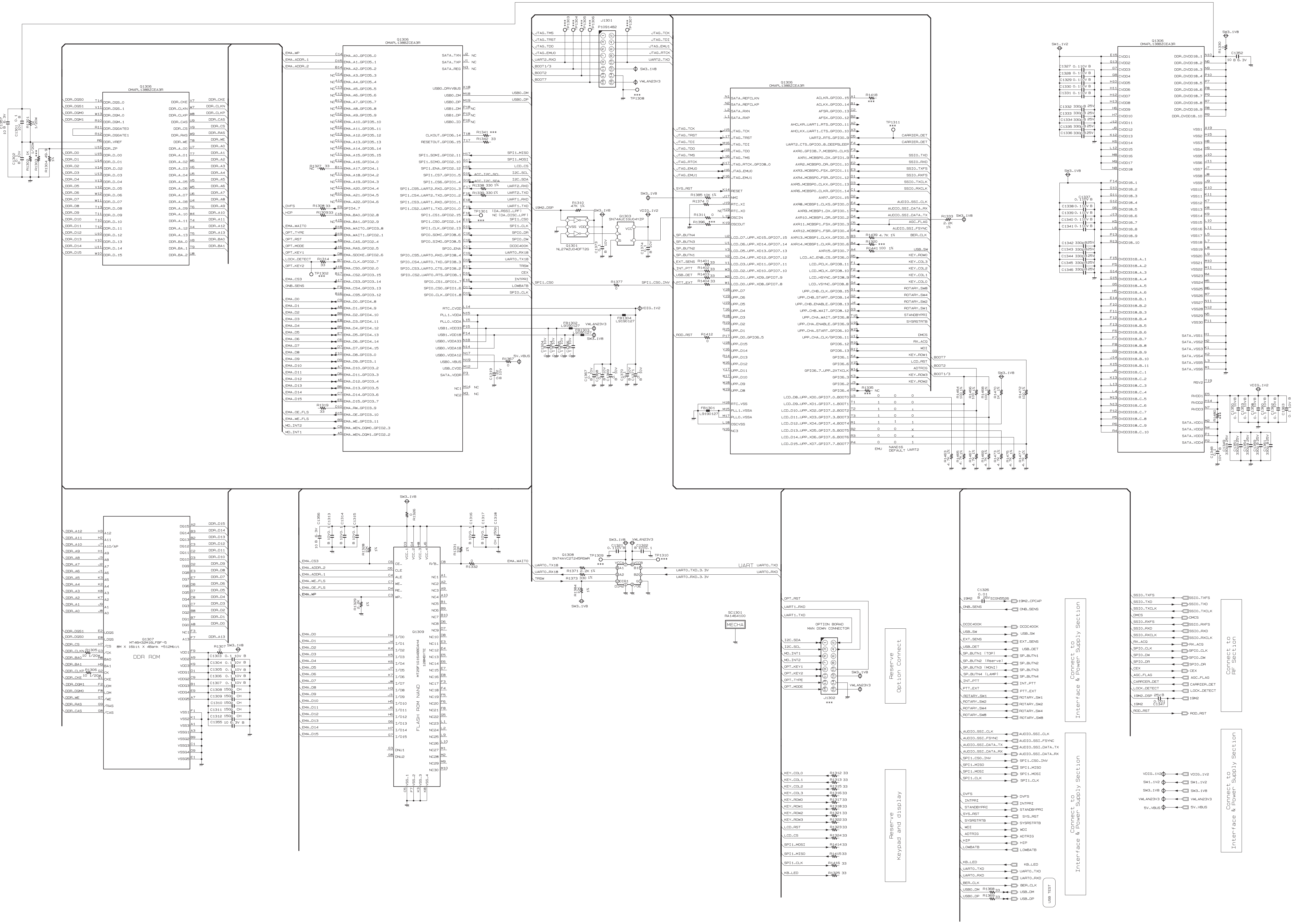
1. Press the “Seq Tone” button to open the “Sequential Tone Deviation Alignment” window.
2. Entering the desired value in the “New” box from the computer’s keyboard.
3. Click the “OK” button to finish the Sequential Tone Deviation alignment and save the data.



MAIN Unit (w/o Option Connector: Replaced by MAIN-5 Unit)

Circuit Diagram (FR024510C: Interface & Power Supply Sections)

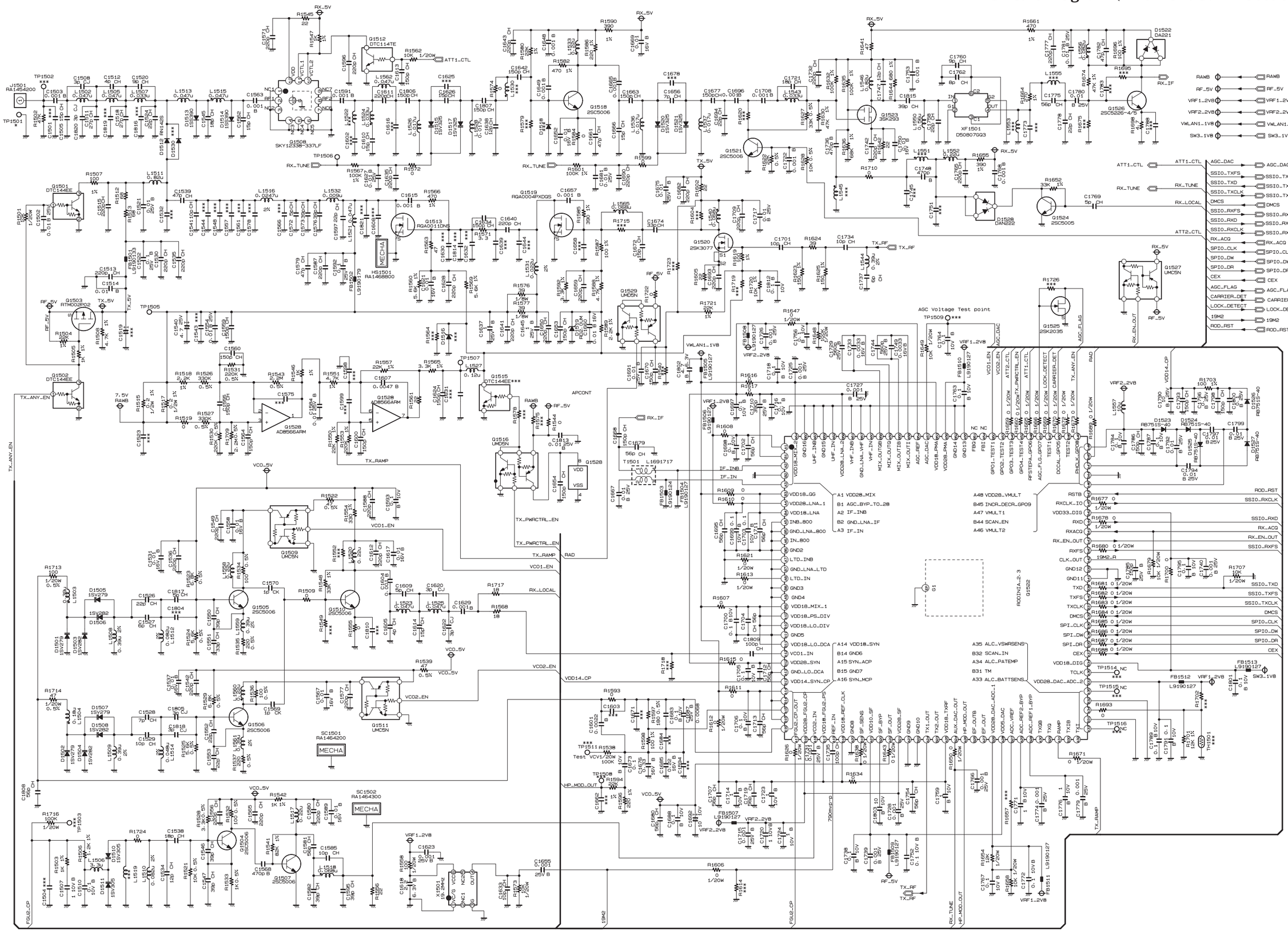




DDR ROM
FLASH ROM NAND
OPTION BOARD MAN DOWN CONNECTOR
Reserve Option Connect
Reserve Keypad and display
Connect to Interface & Power Supply Section
Connect to RF Section
UART
MECHA

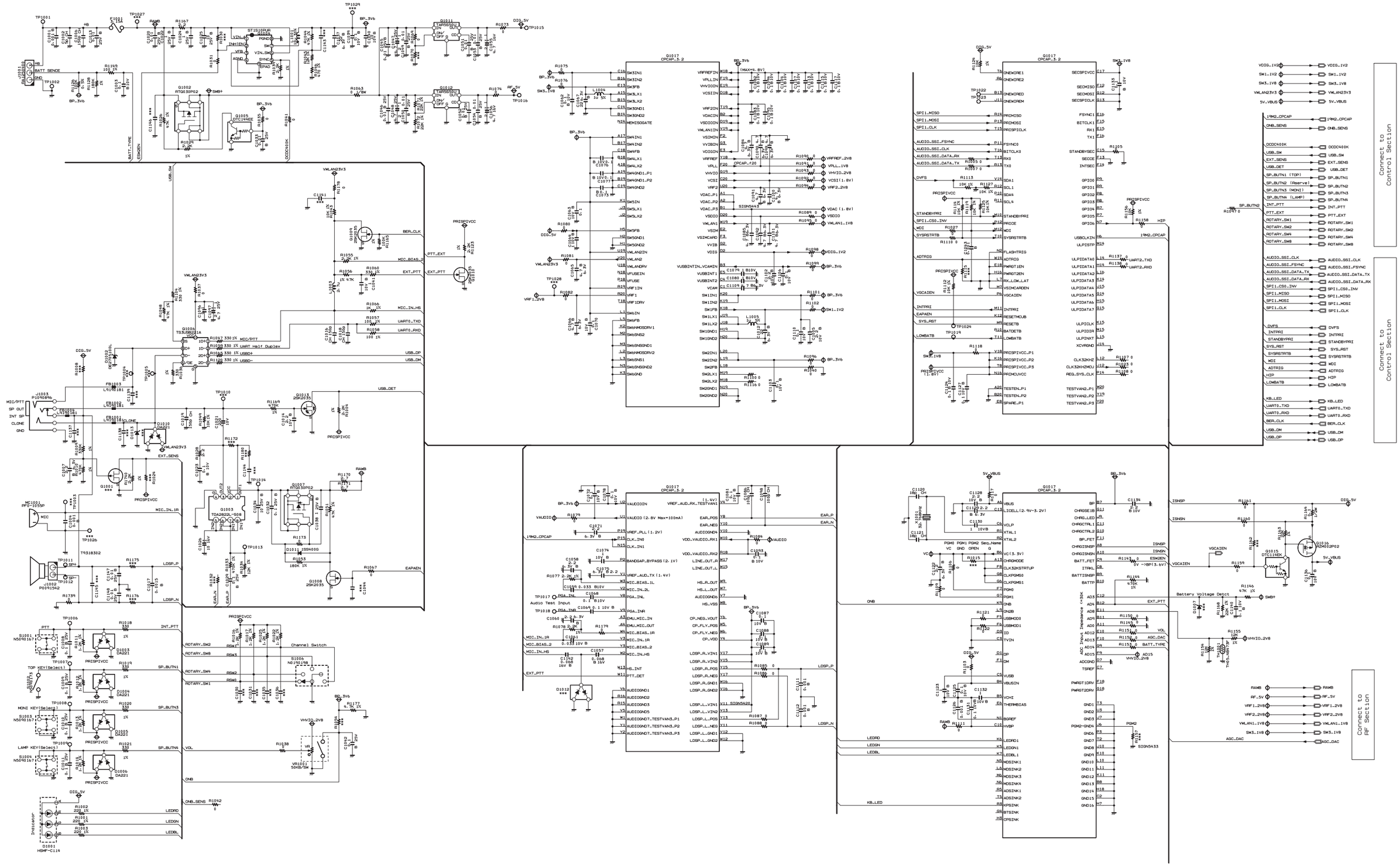
MAIN Unit (w/o Option Connector: Replaced by MAIN-5 Unit)

Circuit Diagram (FR024510C: RF Section)



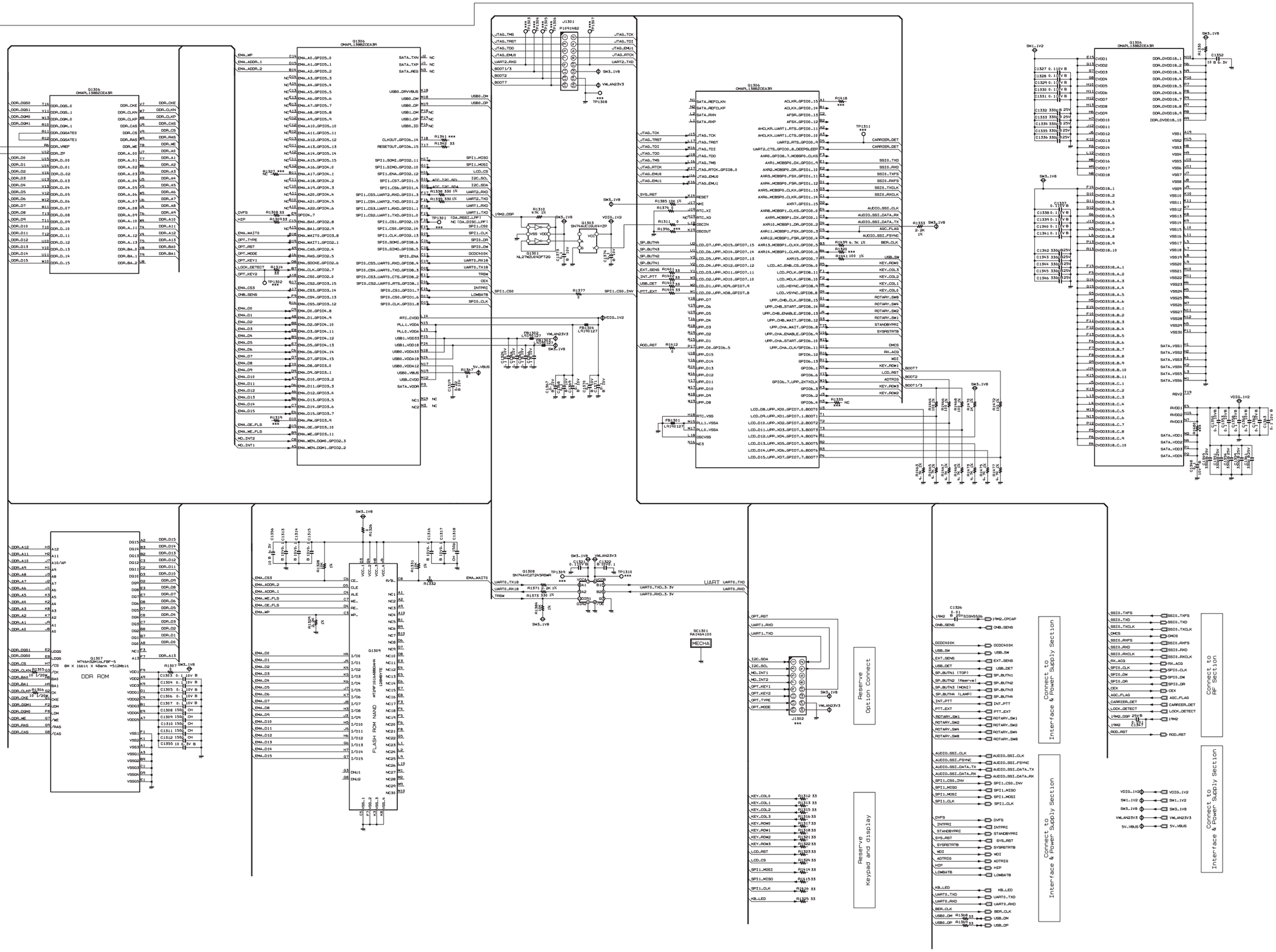
MAIN Unit (w/o Option Connector: Replaced by MAIN-5 Unit)

Circuit Diagram (FR024510E: Interface & Power Supply Sections)



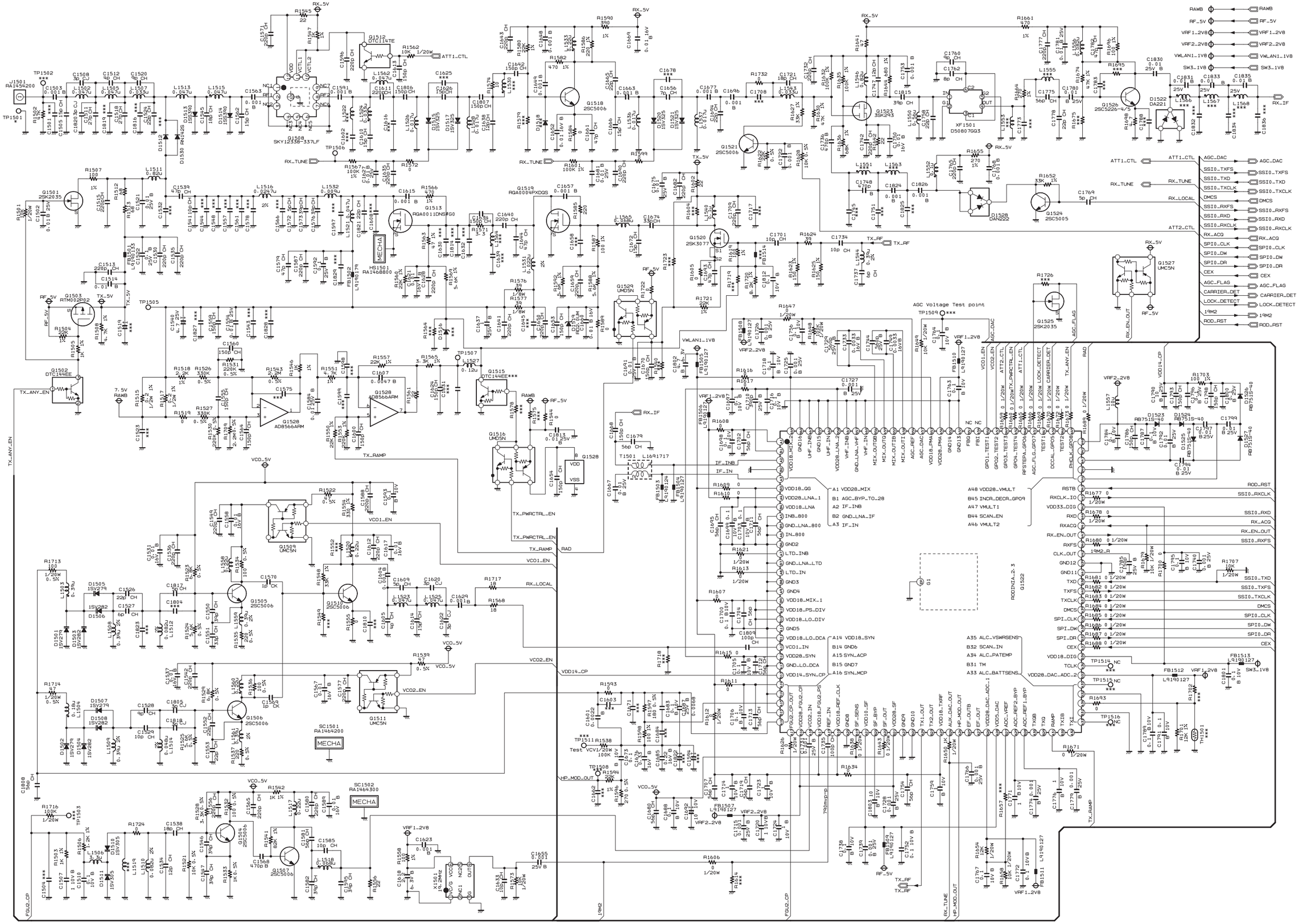
MAIN Unit (w/o Option Connector: Replaced by MAIN-5 Unit)

Circuit Diagram (FR024510E: Control Section)



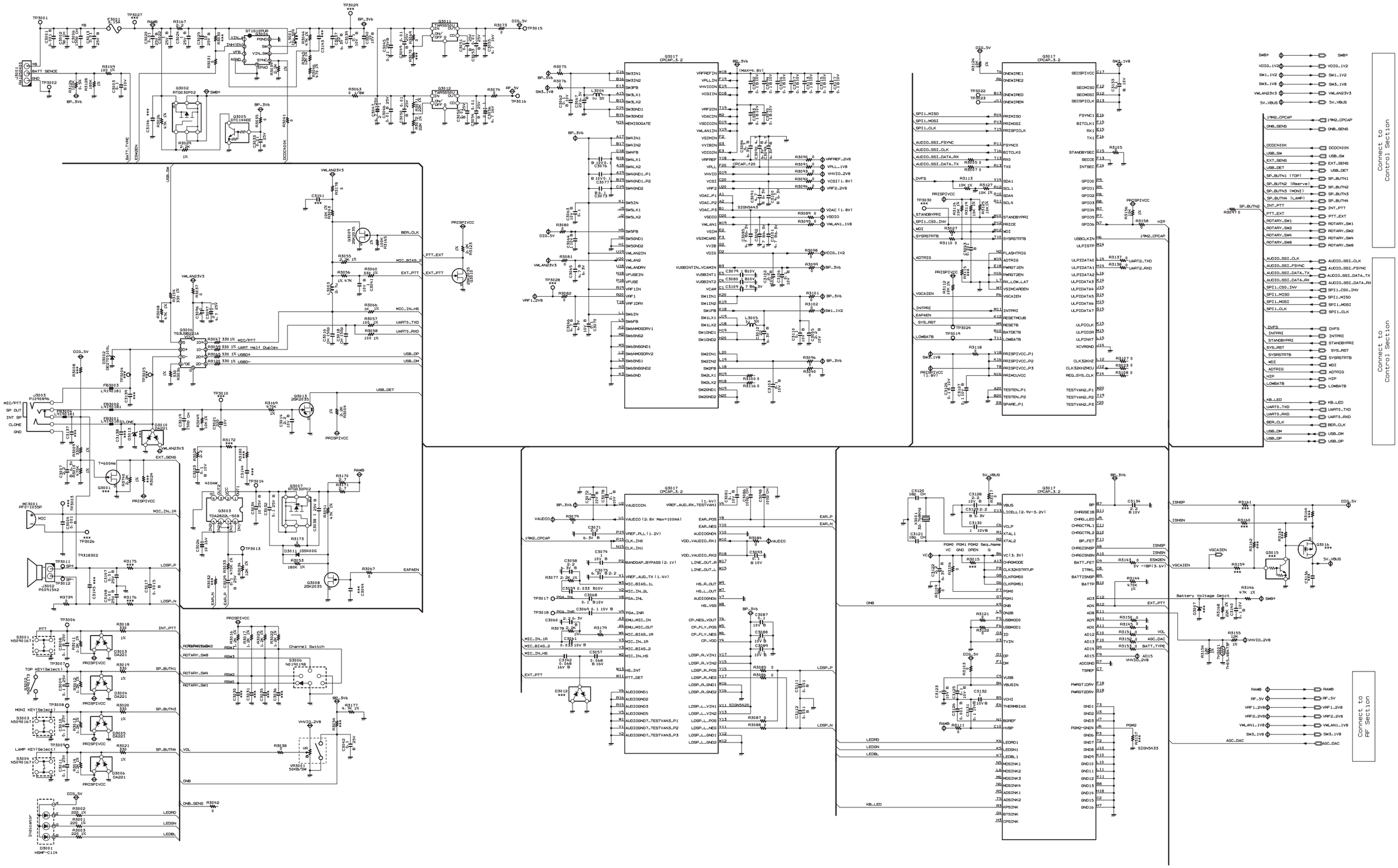
MAIN Unit (w/o Option Connector: Replaced by MAIN-5 Unit)

Circuit Diagram (FR024510E: RF Section)



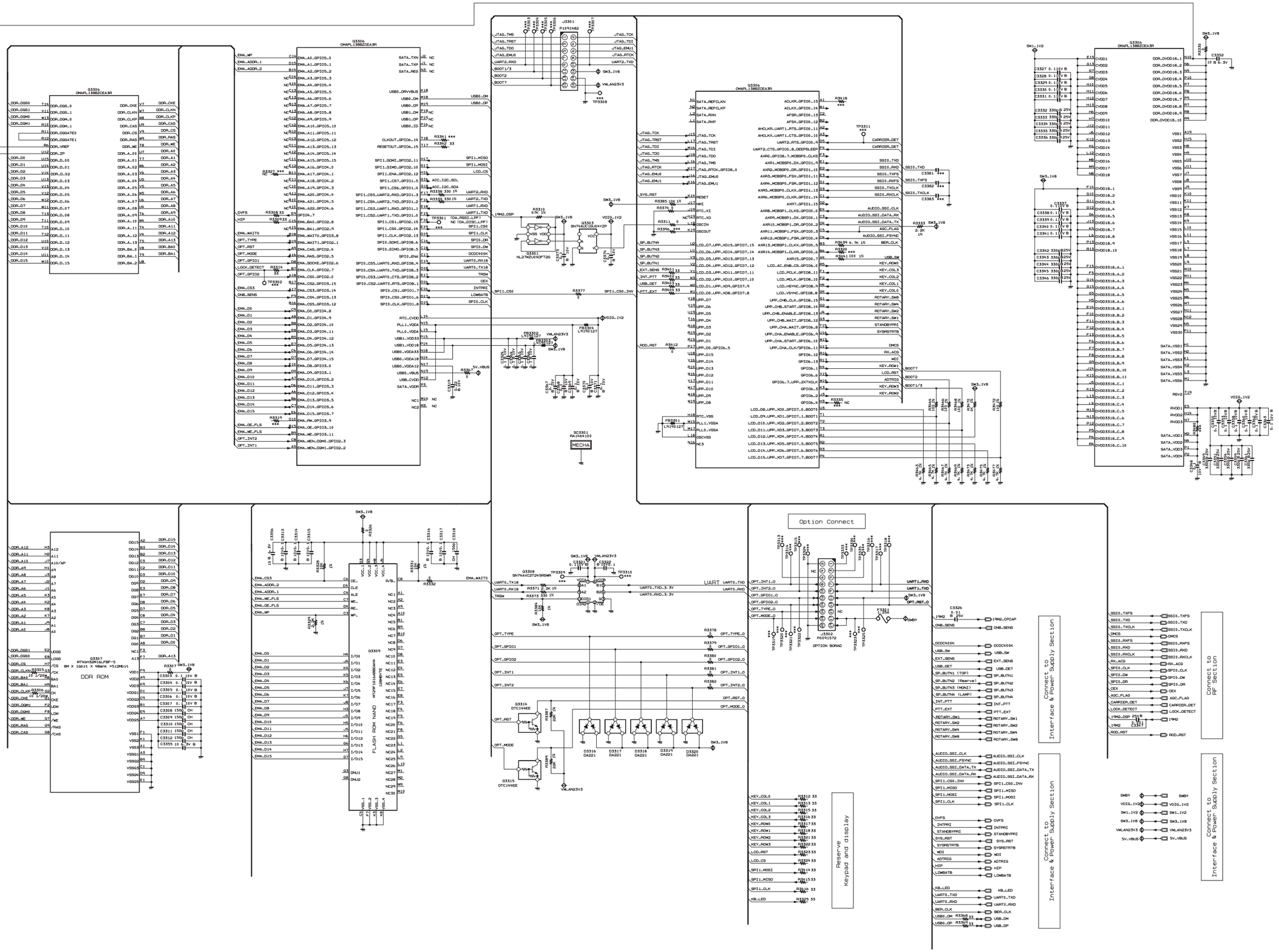
MAIN-3 Unit (w/ Option Connector: Replaced by MAIN-5 Unit)

Circuit Diagram (FR025740A: Interface & Power Supply Sections)



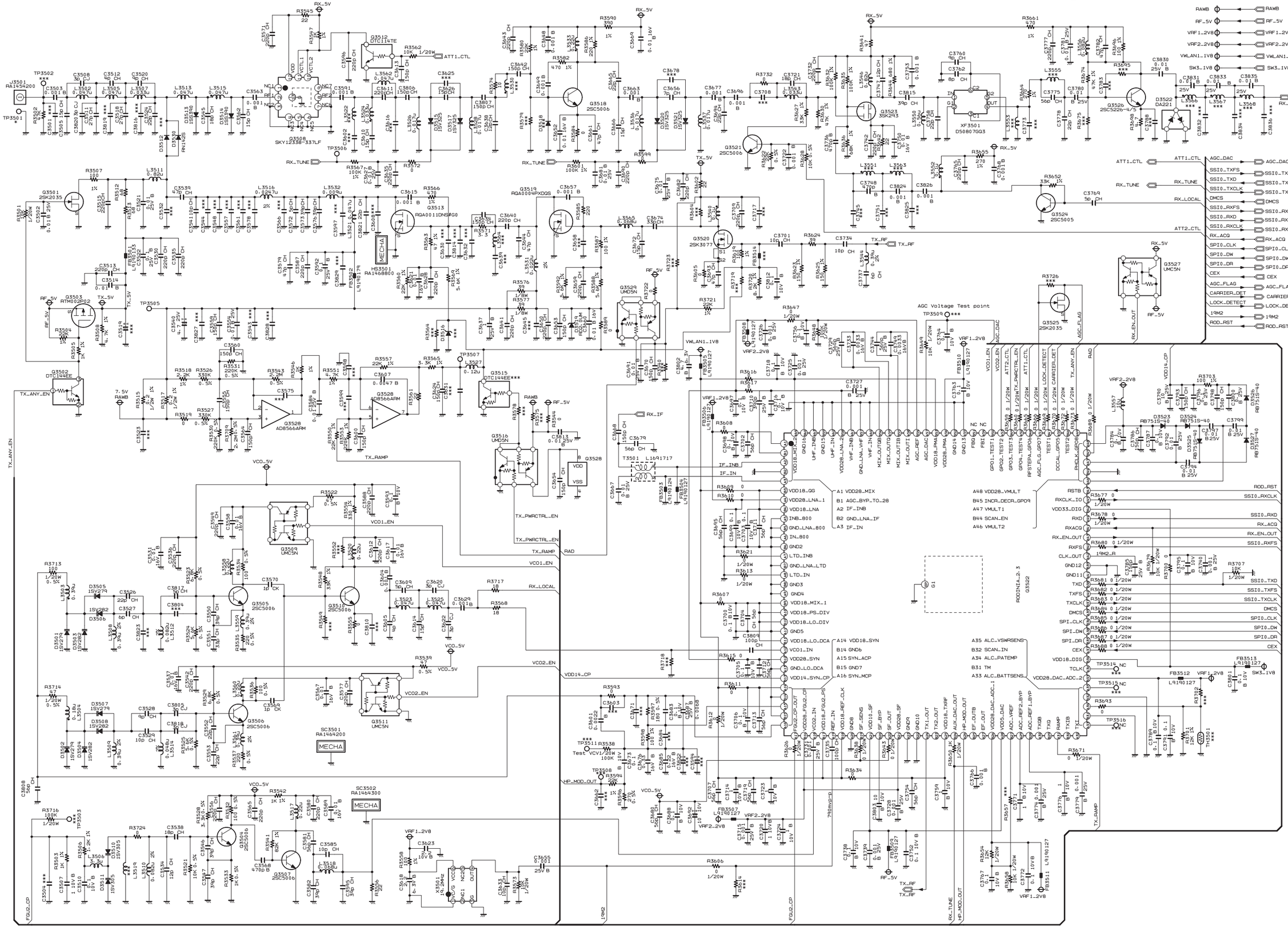
MAIN-3 Unit (w/ Option Connector: Replaced by MAIN-5 Unit)

Circuit Diagram (FR025740A: Control Section)



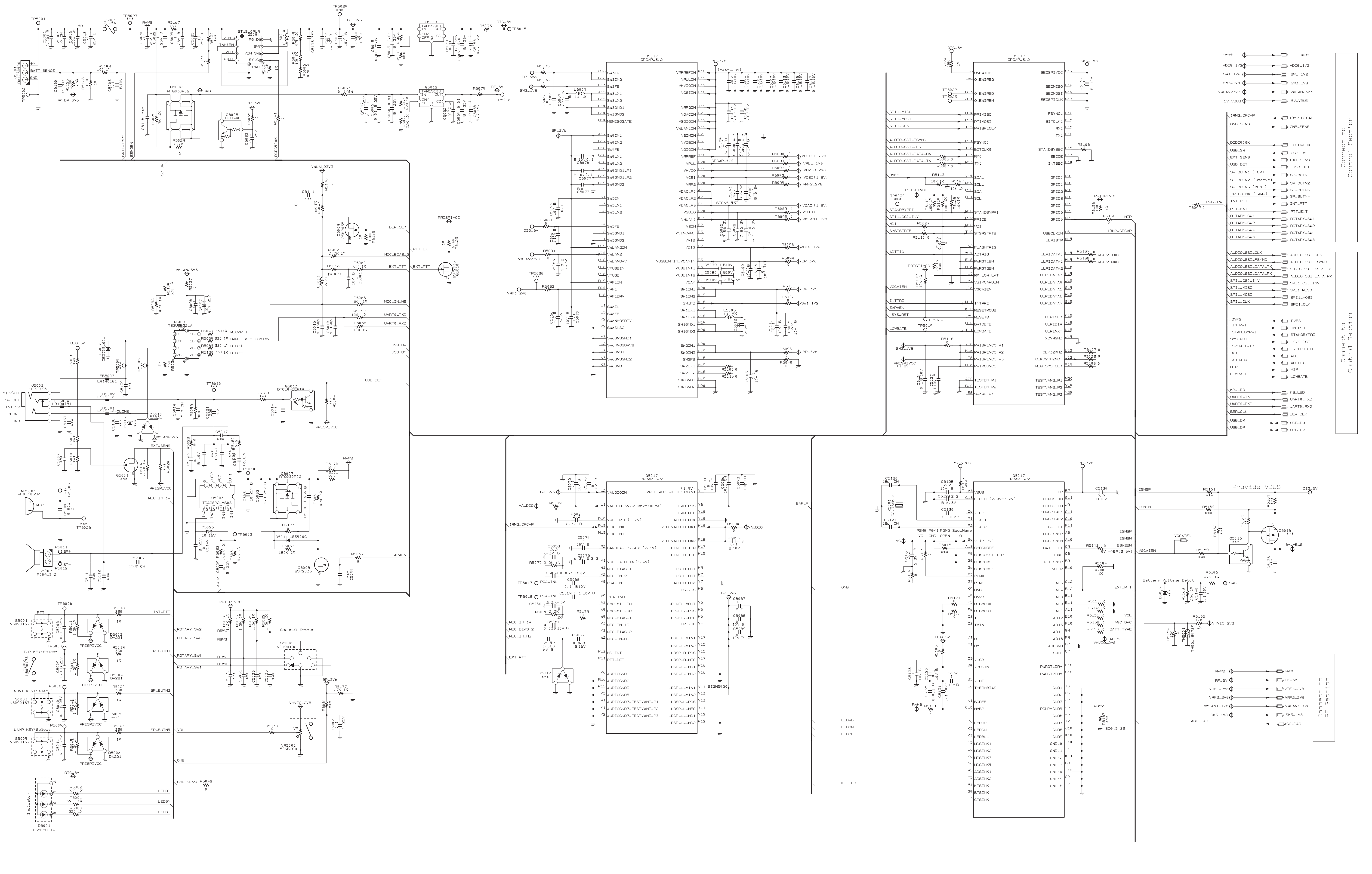
MAIN-3 Unit (w/ Option Connector: Replaced by MAIN-5 Unit)

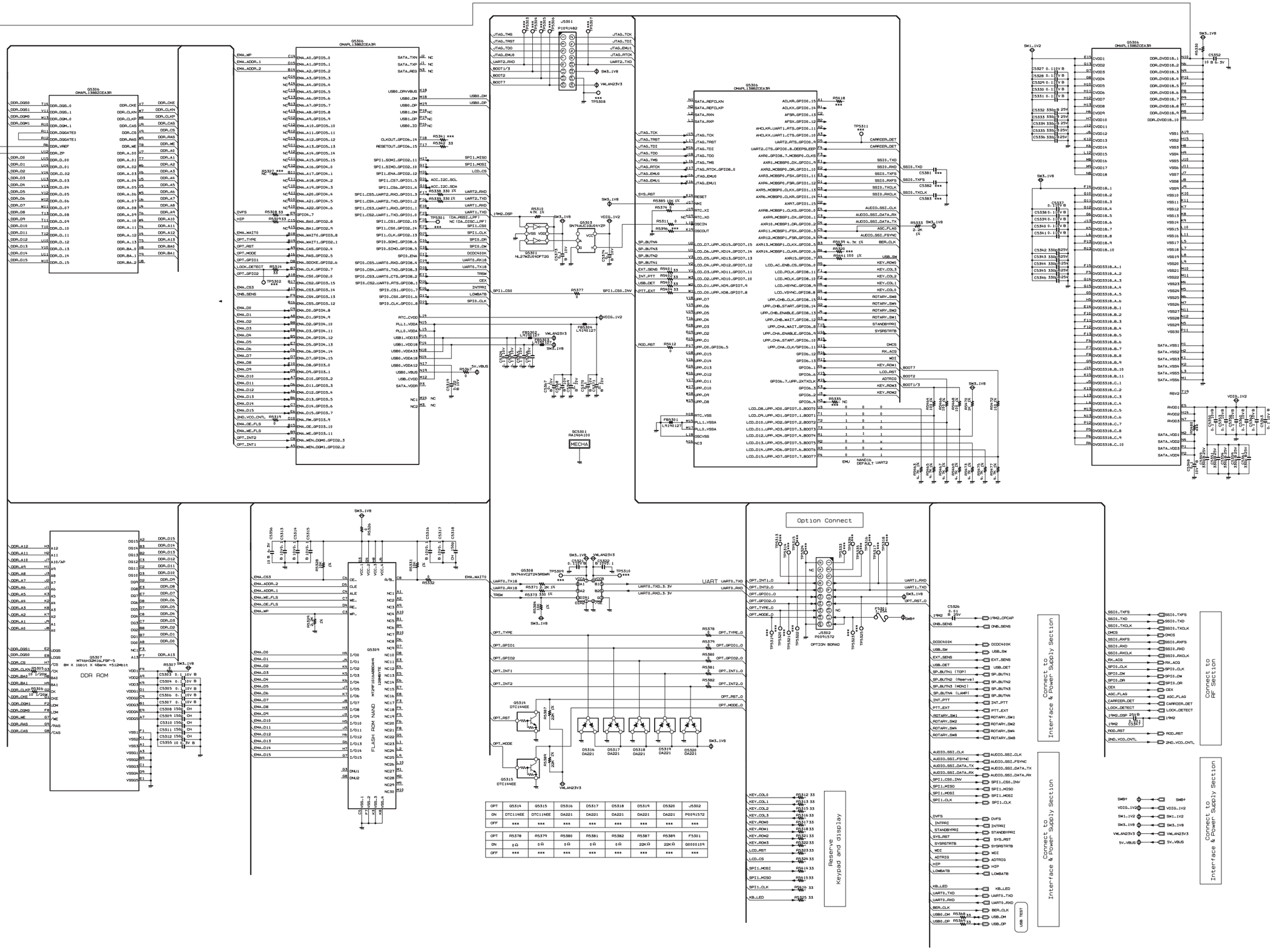
Circuit Diagram (FR025740A: RF Section)



MAIN-5 Unit

Circuit Diagram (FR028030A: Interface & Power Supply Sections)



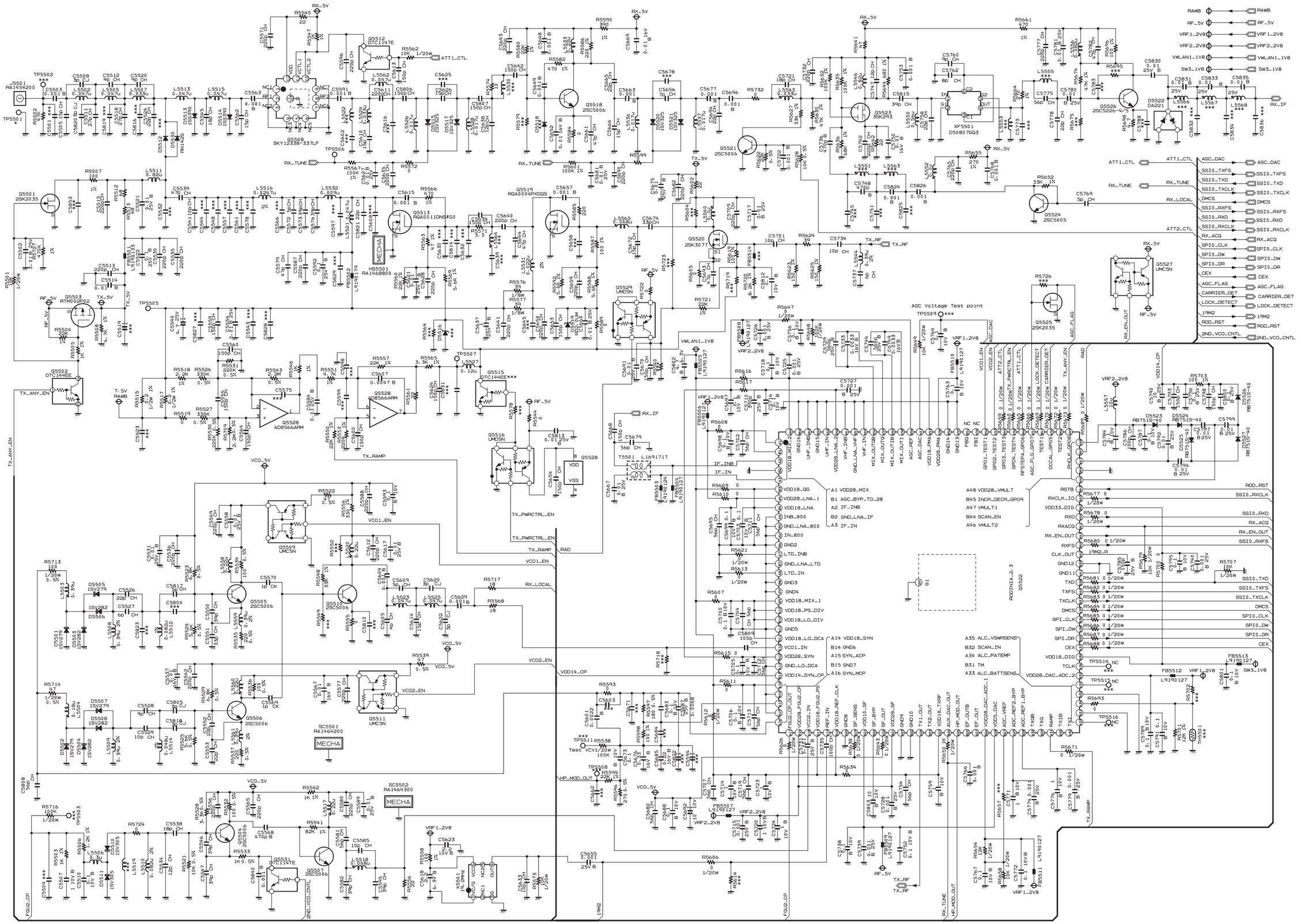


	Q5314	Q5315	Q5316	Q5317	Q5318	Q5319	Q5320	J5302
ON	DTC114EE	DTC114EE	DA221	DA221	DA221	DA221	DA221	P0091572
OFF	***	***	***	***	***	***	***	***

	R5378	R5379	R5380	R5381	R5382	R5387	R5389	F5301
ON	0Ω	0Ω	0Ω	0Ω	0Ω	22kΩ	22kΩ	Q0000109
OFF	***	***	***	***	***	***	***	***

MAIN-5 Unit

Circuit Diagram (FR028030A: RF Section)



Vertex Standard