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MANUAL REVISION
6881200C75-B
HT 1000™, JT 1000®, MT 2000™, MTS 2000™, and MTX Series Handie-Talkie® Portable Radios Service Manual

This revision outlines changes that have occurred since the printing of your manual. Use this information to supplement your manual.

REVISION CHANGE:

Page	Section No.	Section Title	Paragraph	Description
20	Chapter 5	Front-End Pre-selector (VHF/UHF only)	NOTE	Note added to section for VHF only.
21-22	Chapter 5			Pages shifted due to addition of note.
63	Chapter 9	Electrical Parts List, VHF Transceivers NUD7091B, NUD7092B, NUD/PMUD7095C, NUD7096B		RF Board PN updated from NUD/PMUD7095B to NUD/PMUD7095C. A new varactor (Motorola part number: 4809877C17) replaced previous PNs for Reference Symbols CR1, CR2, CR3, CR4, CR6, CR7, CR8, and CR9. A new resistor (Motorola part number: 0662057P95) replaced previous PNs for Reference Symbol C77.
64	Chapter 9	Schematics		RF Board PN updated from NUD/PMUD7095B to NUD/PMUD7095C.

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Each SERVICE screen provides the capability to increase or decrease the 'softpot' value with the keyboard UP/DOWN arrow keys respectively. A graphical scale is displayed indicating the minimum, maximum, and proposed value of the softpot, as shown in Figure 3.

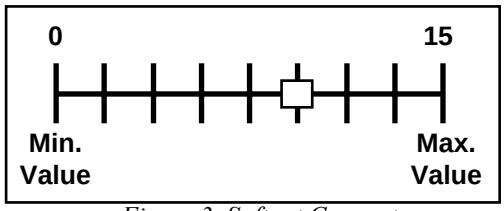


Figure 3 Softpot Concept

Adjusting the softpot value sends information to the radio to increase (or decrease) a DC voltage in the corresponding circuit. For example, pressing the UP arrow key at the Reference Oscillator screen instructs the radio microprocessor to increases the voltage across a varactor in the reference oscillator to increase the frequency.

In ALL cases, the softpot value is just a relative number corresponding to a D/A (Digital-to-Analog) generated voltage in the radio. All standard measurement procedures and test equipment are similar to previous radios.

Perform the following procedures in the sequence indicated.

Reference Oscillator Alignment

Adjustment of the reference oscillator is critical for proper radio operation. Improper adjustment will not only result in poor operation, but also a misaligned radio that will interfere with other users operating on adjacent channels. For this reason, the reference oscillator should be checked every time the radio is serviced or once a year, whichever comes first. The frequency counter used for this procedure must have a stability of 0.1 ppm (or better).

1. From the SERVICE menu, press F2 to select TRANSMITTER alignment.
2. Press F2 again to select the REFERENCE OSCILLATOR softpot.
3. Press F6 to key the radio. The screen will indicate that the radio is transmitting.
4. Measure the transmit frequency on your service monitor.
5. Use the UP/DOWN arrow keys to adjust the reference oscillator per the targets shown in Table 13.

Table 13 Reference Oscillator Alignment

BAND	TARGET
VHF	0 to 300 Hz
UHF	0 to 300 Hz
800/900 MHz	0 to 300 Hz

Front-End Pre-Selector (VHF/UHF only)

NOTE: This procedure is only required for tuning the front-end filter varactors in the VHF and UHF models. The 800 and 900 MHz models utilize a stripline pre-selector.

1. Set the Test Box (RTX4005B) meter selection switch to the "VOL" position, and connect a dc voltmeter capable of 1mV resolution on a 2Vscale to the Test Box AC/DC meter port to monitor the Received Signal Strength Indicator (RSSI).
2. From the SERVICE menu, press F3 to select RECEIVER alignment.
3. Press F2 to select the FRONT END FILTER softpot. The screen will indicate the receive frequencies at which the filter is to be tuned.
4. Set the RF test generator to the first receive frequency +150Hz. Set the RF level at the radio standard antenna port to 4.0µVolts with no modulation.
5. Adjust the UP/DOWN arrow keys to obtain a peak voltage on the dc voltmeter.

   NOTE: ***For VHF ONLY:*** Write down this soft-pot value. Go to a soft-pot value of 121 and adjust UP to see if there is another peak voltage for the same frequency. If a new peak is found, disregard the first reading and start adjusting UP/DOW arrow keys from a soft-pot value above 121 for all test frequencies. If no other peak voltage is found use the original soft-pot value. This is only necessary for the first test frequency; if another peak is found do not go bellow 121 for the remaining frequencies.

6. Press F8 to program the soft pot value.
7. Repeat steps 4-6 for the remaining frequencies.
8. Press F10 and F2 to return to the RECEIVER menu.

Rated Audio

1. Set test box (RTX-4005B) meter selection switch to the “AUDIO PA” position and connect an ac voltmeter to the test box ac/dc meter port.
2. Press F3 to select the RATED AUDIO softpot. The screen will indicate the receive test frequency to be used.
3. Set the RF test generator to the receive test frequency, and set the RF level at the radio standard antenna port to 1 mV modulated with standard test modulation (see Table 14).

Table 14 Standard Test Modulation (1 kHz Tone)

Band	Deviation
VHF/UHF/800 MHz	3.0 kHz
900 MHz	1.5 kHz

4. Adjust the UP/DOWN arrow keys to obtain rated audio (as close as possible to 3.74 Vrms) into a speaker (28 ohms) or equivalent resistive load.
5. Press F8 to program the softpot value.

6. For HearClear-equipped radios, go to step 7; otherwise press F10 to return to the RECEIVER menu.
7. Now set the RF test generator to the receive test frequency, and set the RF level at the radio standard antenna port to 1 mV modulated with a 1kHz tone, 1.2kHz deviation.
8. Select the Hear Clear RATED AUDIO softpot, and adjust the UP/DOWN arrow keys to obtain rated audio (3.74 Vrms) into a speaker (28 ohms) or equivalent resistive load.
9. Press F8 to program the softpot value.
10. Press F10 to return to the RECEIVER menu.

Squelch

NOTE: Verify that audio output is set to rated audio (3.74 Vrms)

1. Select the 25kHZ squelch tuning menu. (note: 25 kHZ must be tuned before tuning either 12.5kHZ or 20kHZ squelch).
2. With no signal applied, decrease the softpot value until squelch opens. Set the RF test generator to the frequency plus the following offset; (VHF: +200HZ), (UHF: +200HZ), (800MHZ: +500HZ). Adjust the generator for 8 to 10 dB Sinad.
3. Increase the softpot until the squelch closes.
4. Monitor for squelch chatter. If chatter is present, increase the softpot until no chatter is detected. Press F8 to program the softpot value. Press ENTER to select the next softpot adjustment.
5. Repeat step 2 through 4 for all test frequencies shown on the screen.
6. If you are using 25kHZ channel spacing, skip to step 8. Otherwise, go into the 12.5kHZ or 20kHZ squelch tuning menus.
7. Repeat steps 2 through 5.
8. Press F10, then F10 again to return to the service menu.

Transmitter Power

VHF and UHF radios require two power-level adjustments, a high-power or rated-power adjustment, and a low-power adjustment. The low power adjustment is required since the radio may be used in a reduced power mode, or with a vehicular adapter.

NOTE: All power measurements are to be made at the antenna port.

1. From the SERVICE menu, press F2 to select TRANSMITTER alignment.
2. Press F3 to select the TRANSMIT POWER softpot. The screen will indicate the transmit test frequencies to be used.
3. Begin with the highest test frequency shown.
4. Press F6 to key the radio, and use the UP/DOWN arrow keys to adjust the transmit power per the value shown in Table 15.
5. Press F6 to dekey the radio, and then press F8 to program the value.
6. Repeat steps 4 and 5 for the remaining test frequencies.
7. Press F10, then F2 to return to the TRANSMIT menu

Table 15 Transmit Power Setting

VHF			**UHF**		
Power Level	Test Frequencies		Power Level	Test Frequencies	
	136 - 174MHz	177.975MHz		450 - 512MHz	512 - 520MHz
5 W	5.2 - 5.4	4.2 - 4.4	**4 W**	4.2 - 4.4	3.2 - 3.4
1 W	1.2 - 1.4	1.2 - 1.4	**1 W**	1.2 - 1.4	1.2 - 1.4
800 MHz			**900 MHz**		
Power Level	All Test Frequencies		Power Level	All Test Frequencies	
3 W	3.2 - 3.4		**2.4 W (Typ.)** **2.9 W (Max.)**	2.4 - 2.6	

Transmit Deviation Balance (Compensation)

Compensation alignment balances the modulation sensitivity of the VCO and reference modulation (synthesizer low frequency port) lines. The compensation algorithm is critical to the operation of signalling schemes that have very low frequency components (e.g. DPL) and could result in distorted waveforms if improperly adjusted.

NOTE: Disable all audio band filters on the service monitor.

NOTE: (Secure-Equipped Radios Only)
If a secure module is currently installed in the radio being aligned, refer to the appendix at the rear of this manual. Read section III, “Secure Alignment Procedure”, before performing the transmit deviation balance (compensation) procedure.

1. Press F4 to select the TRANSMIT DEVIATION BALANCE softpot. The screen will indicate the transmit test frequencies to be used.
2. Begin with the lowest test frequency shown on the screen.
3. Set the Test Box (RTX4005B) meter selector switch to the “MX DISC” position, and inject an 80Hz tone at 100mVrms into the AC/DC MTR port. Keep the ac voltmeter in parallel to ensure the proper input signal level.
4. Press F6 to key the radio, and measure deviation. Record this measurement.
5. Change the input tone to 3 kHz, 100mVrms and use the UP/DOWN arrow keys to adjust the deviation to within ±2% of the value recorded in step 4.
6. Change the input tone back to 80 Hz and measure the deviation.
7. Repeat steps 5 and 6 until the 3kHz tone deviation is within ±2% of the 80Hz tone deviation.
8. Press F6 to dekey the radio, and press F8 to program the softpot value. Press ENTER to move to next softpot value.

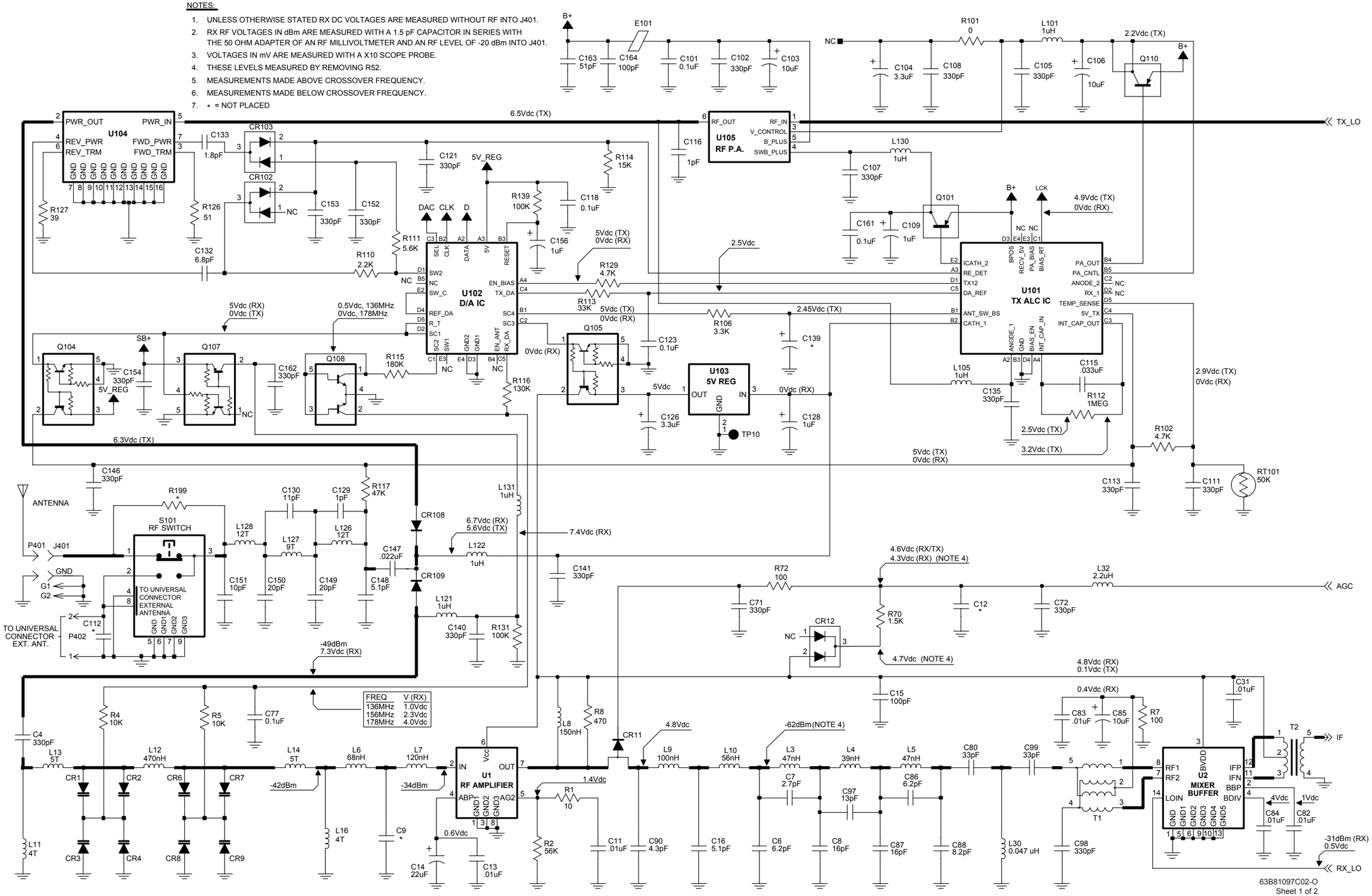
Electrical Parts List, VHF Transceivers
NUD7091B, NUD7092B, NUD/PMUD7095C, NUD7096B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pF ± 5% 50V unless stated
C4	2113931F13	330
C6	2113930F22	6.2 ± 0.25pF
C7	2113930F13	2.7 ± 0.25pF
C8	2113930F32	16
C9	- - - - - - - - -	Not Placed
C11	2113931F49	10nF
C12	- - - - - - - - -	Not Placed
C13	2113931F49	10nF
C14	2311049A66	22µF
C15	2113931F49	10nF
C16	2113930F27	10
	or 2113740F20	5.1 ± 0.25pF, used in NUD7091B, NUD7092B, NUD7096B
C31	2113931F49	10nF
C33	2113930F26	9.1
C34, 35	2113930F43	47
C36	2113930F18	4.3
C38	2113930F13	2.7
C39	0662057B47	0
C40	2113930F51	100
C41	2113743A19	0.1µF
C42 thru 46	2113743A23	0.22µF
C47	2109720D14	0.1µF
C48	2113741F16	430
C49	2311049A04	0.33µF
C50	2113932K15	0.1µF
C52	2113741A51	0.18µF
C53	2113743B17	0.150µF
C54	2113931F13	330
C55	2113930F37	27
C56, 57	2113930F42	43
C58	2113930F11	2.2
C60	2113932K15	0.1µF
C61	2109720D14	0.1µF
C62	- - - - - - - - -	Not Placed
C63	2113932K15	0.1µF
C65	2113931F49	10nF
C70	2113931F49	10nF
C71, 72	2113931F13	330
C77	0662057P95	0.1µF
C80	2113930F39	33
C82	2113931F49	10nF
C83	2113931F49	10nF
C84	2113931F49	10nF
C85	2311049A60	10µF; 4V
C86	2113930F22	6.2
C87	2113930F32	16
C88	2113930F25	8.2
C90	2113930F18	4.3
C95	2113930F33	18
C96	2113931F49	10nF
C97	2113740A32	13
C98	2113931F13	330
C99	2113930F39	33
C101	2113932K15	0.1µF
C102	2113931F13	330
C103	2311049J26	10µF, 16V
C104	2311049A54	3.3µF; 16V
C105	2113931F13	330
C106	2311049J26	10µF, 16V
C107, 108	2113931F13	330
C109	2311049A07	1µF ± 10%; 16V
C111	2113931F13	330
C112	- - - - - - - - -	Not Placed
C113	2113931F13	330
C115	2113932K03	33nF
C116	2113930F03	1
C118	2113932K15	0.1µF
C121	2113931F13	330
C123	2113932K15	0.1µF
C125, 126	2311049A54	3.3µF; 16V
C128	2311049A07	1µF ± 10%; 16V
C129	2113930F03	1
C130	2113930F28	11
C132	2113930F23	6.8
C133	2113930F09	1.8
C135	2113931F13	330
C139	- - - - - - - - -	Not Placed
C140, 141, 146	2113931F13	330
C147	2113932E07	22nF
C148	2113930F20	5.1
C149, 150	2113930F34	20
C151	2113930F27	10
C152 thru 154	2113931F13	330
C161	2113932K15	0.1µF
C162	2113931F13	330
C163	2113930F44	51
C164	2113930F51	100
C165	2311049A86	1µF; 10V
C202	2113930F27	10
C203	2113930F20	5.1
C204	2113931F13	330
C205	2113930F14	3
C206	2113931F20	620
C207	2113930F03	1
C208	2113930F22	6.2
C209	2113932K15	0.1µF
C210	2113932E07	22nF
C211	2113931F13	330
C212	- - - - - - - - -	Not Placed
C213	2113930F21	5.6
C214	- - - - - - - - -	Not Placed
C219	2113930F27	10
C220	2113930F31	15
C221	2113931F13	330
C222	2113930F24	7.5
C223	2113906C02	ATC, 4pF
C225	2113930F08	1.6
C226	2113930F46	62
C227, C228	2113931F13	330
C230	2113930F29	12
C231	2311049A60	10µF, 4V
C233	2113931F13	330
C235	2113930F31	15
C236	2113930F28	11
C237	2113930F30	13
C238	2113931F25	1nF
C240	2113906C02	ATC, 4pF
C241	2113930F38	30
C243	2113930F36	24
C244	2109720D09	22nF
C245	2113931F25	1nF
C246	2109720D09	22nF
C247	2311049A07	1µF ± 10%; 16V
C248	2113932K15	0.1µF
C250	2113931F25	1nF
C251	2113931F13	330
C252	2113931F49	10nF
C253	2311049J23	10µF, 6V
C254	2113928L05	4.7µF
C255	2113931F25	1nF
C256, 257	2113931F49	10nF
C258	2311049J11	4.7µF, 16V
C259	2311049A33	0.22µF
C260	2113932K05	39nF
C266, 267	2113931F49	10nF
C270	2113931F25	1nF
C271	2385688A01	4.7µF; 10V
C274	- - - - - - - - -	Not Placed
C277	2113931F13	330
C280	2113930F51	100
C284	2113931F49	10nF
C285, 286	2113931F13	330
C287	2113930F14	3
C288	2113931F13	330
C289	2109720D09	22nF
C291, 292	2113932E07	22nF
C293	- - - - - - - - -	Not Placed
C294	2113931F13	330
C303	2113932E07	22nF
C304	2113931F13	330
C305	2113930F51	100
C306	2113930F51	100
C307	2113930F51	100
C308	2113930F51	100
C309	2113931F37	3.3nF
C310	2113931F13	330
C311	2113931F37	3.3nF
C314	- - - - - - - - -	Not Placed
C315	2113931F13	330
		DIODE: See Note 1
CR1	4809877C17	Varactor
CR2	4809877C17	Varactor
CR3	4809877C17	Varactor
CR4	4809877C17	Varactor
CR5	4809877C17	Varactor
CR6	4809877C17	Varactor
CR7	4809877C17	Varactor
CR8	4809877C17	Varactor
CR9	4809877C17	Varactor
CR11	4805129M96	Pin
CR12	4805218N57	Dual
CR102	4805129M67	Dual
CR103	4805129M67	Dual
CR108	4802482J02	Pin
CR109	4802482J02	Pin
CR201	4802245J29	Varactor
CR202	4862824C03	Varactor
CR203	4862824C03	Varactor
CR204	4802233J09	Triple
CR205	4802233J09	Triple
CR206	4805129M06	Dual
CR207	- - - - - - - - -	Not Placed
CR208	4802245J29	Varactor
		CORE:
E101	2484657R01	Bead, Ferrite
		FUSE:
F1	6505757V01	1-Amp
		FILTER:
FL1	4802655J05	Crystal, 44.85MHz, See Note 2
		CONNECTOR:
FOIL	2602819X02	Shield, Foil VCO Back
G1	3905643V01	Contact, Antenna Ground
G2	3905643V01	Contact, Ground
		JACK:
J301	0905461X03	Connector; 20 contacts
J401	3905264W01	Contact, Antenna
		COIL, RF:
L3	2462587T42	47nH
L4	2462587T41	39nH
L5	2462587T42	47nH
L6	2462587T15	100nH, used in NUD7092B, NUD7095B
	or 2462587T13	68nH, used in NUD7091B, NUD7096B
L7	2462587T16	120nH
L8	2462587T17	150nH
L9	2462587T15	100nH
L10	2462587T12	56nH
L11	2460591M12	4 turns, airwound
L12	2462587T23	470nH
L13	2460591N36	5 turns, airwound
L14	2460591N36	5 turns, airwound
L16	2460591M12	4 turns, airwound
L19	2462587T20	270nH
L20	2462587N69	1.2µH
L22	2462587T30	1µH
L23	2462587Q50	1.8µH
L24	2462587T23	470nH
L25	2462587Q20	2.2µH
L30	2462575A21	47nH
L32	2462587Q20	2.2µH
L33	2462587Q20	2.2µH
L101	2462587T30	1µH
L105	2462587T30	1µH
L121	2462587T30	1µH
L122	2462587T30	1µH
L126	2460591K82	12 turns, airwound
L127	2460591G24	9 turns, airwound
L128	2460591K82	12 turns, airwound
L130	2462587T30	1µH
L131	2462587T30	1µH
L201	2462587T40	33nH
L204	2462587T30	1µH
L205	2462587V28	33nH
L208	2462587T30	1µH
L209	2462587T30	1µH
L210	2462587T39	27nH
L211	2462587T12	56nH
L212	2462587T14	82nH
L213	2462587T30	1µH
L215	2462587T30	1µH
L216	2462587T41	39nH
L217	2462587T30	1µH
L218	2462587T30	1µH
L219	2462587T38	22nH
L220	2462587T17	150nH
L221	2462587Q42	390nH
L222	2462587Q42	390nH
L223	2462587T18	180nH
L224	2462587Q40	270nH
L225	2462587Q20	2.2µH
L301	2462587Q47	1µH
L302	2462587Q47	1µH
P404	3905861X02	Connector, battery, 2-pin
		TRANSISTOR: See Note 1
Q1	4805218N63	NPN
Q4	4805218N63	NPN
Q5	4880048M04	PNP
Q101	4805128M16	PNP
Q104	4805921T02	PNP NPN
Q105	4805921T02	PNP NPN
Q107	4805921T02	PNP NPN
Q108	4802245J10	NPN dual
Q110	4813822A10	PNP
Q201	4802245J15	JFET
Q202	4805218N55	NPN
		RESISTOR, Fixed: Ω ± 5% .0625W unless stated
R1	0662057A01	10
R2	0662057A91	56K
R4	0662057A73	10K
R5	0662057A73	10K
R7	0662057A25	100
R8	0662057A41	470
R16	0662057A59	2700
R17	0662057A80	20K
R32	0662057A59	2700
R33	0662057A59	2700
R34	0662057A89	47K
R35	0662057A89	47K
R40	0662057A35	270
R41	0662057A09	22
R42	0662057A35	270
R43	0662057A42	510
R44	0662057A77	15K
R45	0662057A90	51K
R46	0662057A89	47K
R47	0662057A09	22
R49	0662057A53	1500
R50	0662057A63	3900
R51	0662057B05	200K
R70	0662057A53	1500
R72	0662057A25	100
R73	0662057A73	10K
R101	0662057C01	0 +.050
R102	0662057A65	4700
R106	0662057A61	3300
R110	0662057A57	2200
R111	0662057A67	5600
R112	0662057B22	1.0 MEG
R113	0662057A73	10K
R114	0662057A77	15K
R115	0660078L28	180k ± 1%
R116	0662057G19	130k ± 1%; 0.1W
R117	0662057A89	47K
R126	0662057A18	51
R127	0662057A15	39
R130	0662057A65	4700
R131	0662057A97	100K
R132	0662057A97	100K
R199	0662057B47	0
	or- - - - - - - - -	Not Placed in NUD7092B, NUD7095B
R203	0662057A09	22
R204	0662057A80	20K
R205	0662057A84	30K
R206	0662057A80	20K
R207	0662057A80	20K
R208	0662057A65	4700
R209	0662057A42	510
R210	0662057A42	510
R211	0662057A20	62
R212	0662057A44	620
R213	0662057A35	270
R214	0662057A88	43K
R215	0662057A84	30K
R217	0662057A84	30K
R218	0662057A97	100K
R219	0662057A09	22
R220	0662057A56	2000
R221	- - - - - - - - -	Not Placed
R222	0662057A51	1200
R223	0662057A89	47K
		THERMISTOR:
RT101	0605621T02	50k
		SWITCH:
S101	4005831W01	SWITCH LONG RF
	or- - - - - - - - -	Not used in NUD7091B, NUD7096B
		TRANSFORMER:
T1	2505515V08	Balun: 4:1
T2	2505515V11	Balun: 16:1
		MODULES: See Note 1
U1	5105457W50	RF amplifier
U2	5105457W52	Mixer
U3	5186296A02	ZIF
U101	5105835µ52	TX ALC
U102	5105835µ51	DAC
U103	5160880B02	5V Regulator
U104	5102001J69	Stripline Coupler
U105	5105385Y36	5-watt PA
U201	5102227J37	VCO
U202	5105469E65	5V Regulator
U203	5105385Y42	Ref. Oscillator, 16.8MHz
U204	5105457W81	Synthesizer
		MECHANICAL PARTS
ME1	2602657J01	SHIELD, VCO
ME2	2602658J01	SHIELD, Pendulum
ME3	2602659J01	SHIELD, ZIF
ME4	2602661J01	SHIELD, Varactor Filter, VHF
ME5	2602832X01	SHIELD, ZIF Back
ME6	2602674J02	SHIELD, VCO Back
ME7	2602675J01	SHIELD, Synthesizer, Back
ME8	2602815X01	SHIELD, Fixed Tuned Filter

Notes:
1. For optimum performance, order replacement diodes, transistors, and circuit modules by Motorola part number only.
2. When ordering crystals, specify carrier frequency, crystal frequency, crystal type number, and Motorola part number.
3. "Not Placed" means that components are for future use, and are not placed on the circuit board at this time.

NOTES:

1. UNLESS OTHERWISE STATED RX DC VOLTAGES ARE MEASURED WITHOUT RF INTO J401.
2. RX RF VOLTAGES IN dBm ARE MEASURED WITH A 1.5 pF CAPACITOR IN SERIES WITH THE 50 OHM ADAPTER OF AN RF MILLIVOLTMETER AND AN RF LEVEL OF -20 dBm INTO J401.
3. VOLTAGES IN mV ARE MEASURED WITH A X10 SCOPE PROBE.
4. THESE LEVELS MEASURED BY REMOVING R52.
5. MEASUREMENTS MADE ABOVE CROSSOVER FREQUENCY.
6. MEASUREMENTS MADE BELOW CROSSOVER FREQUENCY.
7. * = NOT PLACED



NUD7091B, NUD7092B, NUD/PMUD7095C, AND NUD7096B VHF (136-178MHz) TRANSCEIVER BOARDS' SCHEMATIC DIAGRAM (Sheet 1 of 2)