ASTRO® XTS™ 3000 and XTS™ 3000 R

Portable Radios

MOTOROLA

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Detailed Service Manual

Foreword

The information contained in this manual relates to all ASTRO® XTS™ 3000 portable radios, unless otherwise specified. This manual provides sufficient information to enable qualified service shop technicians to troubleshoot and repair an ASTRO XTS 3000 portable radio to the component level.

For details on the operation of the radio or level 1 or 2 maintenance procedures, refer to the applicable manuals, which are available separately. A list of related publications is provided in the section, “Related Publications” on page iv.

Product Safety and RF Exposure Compliance

Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio.

ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 6881095C98) to ensure compliance with RF energy exposure limits.

For a list of Motorola-approved antennas, batteries, and other accessories, visit the following web site which lists approved accessories: <http://www.motorola.com/cgiss/index.shtml>

Manual Revisions

Changes which occur after this manual is printed are described in FMRs (Florida Manual Revisions). These FMRs provide complete replacement pages for all added, changed, and deleted items, including pertinent parts list data, schematics, and component layout diagrams. To obtain FMRs, contact the Radio Parts Services Division (refer to “Replacement Parts Ordering” at the back of the manual).

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MOTOROLA

ASTRO® Digital XTS™ 3000 and XTS™ 3000 R

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Detailed Service Manual

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8000 W. Sunrise Blvd., Ft. Lauderdale, FL 33322
Printed in U.S.A. 7/03

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6881083C90-B

Related Publications

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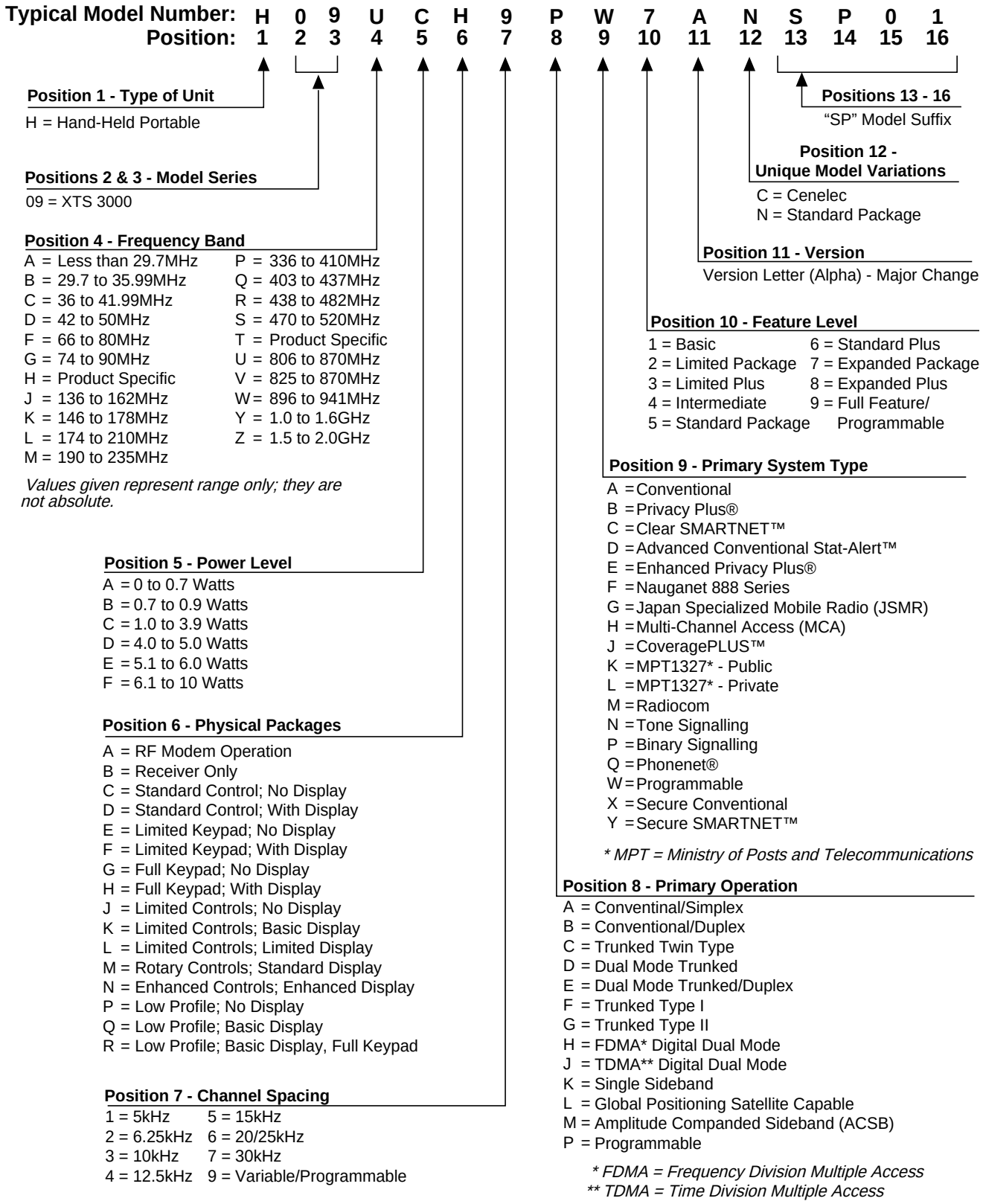
Portable Radio Model Numbering System



ASTRO Digital XTS 3000 Model Chart ("A" Models)

MODEL NUMBER	DESCRIPTION
H09KDC9PW5AN	VHF 1-5 Watt ASTRO Digital XTS 3000 Model I
H09KDF9PW7AN	VHF 1-5 Watt ASTRO Digital XTS 3000 Model II
H09KDH9PW7AN	VHF 1-5 Watt ASTRO Digital XTS 3000 Model III
H09RDC9PW5AN	UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model I
H09RDF9PW7AN	UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model II
H09RDH9PW7AN	UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model III
H09SDC9PW5AN	UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model I
H09SDF9PW7AN	UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model II
H09SDH9PW7AN	UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model III
H09UCC9PW5AN	800MHz 3 Watt ASTRO Digital XTS 3000 Model I
H09UCF9PW7AN	800MHz 3 Watt ASTRO Digital XTS 3000 Model II
H09UCH9PW7AN	800MHz 3 Watt ASTRO Digital XTS 3000 Model III

												ITEM NUMBER	DESCRIPTION
X	X	X	X	X	X	X	X	X	X	X	X	NCN6128_	Board, Controller *
X	X	X										NLD8898_	Board, VHF Transceiver (136-174MHz)
			X	X	X							NLE4249_	Board, UHF Range 1 Transceiver (403-470MHz)
						X	X	X				NLE4250_	Board, UHF Range 2 Transceiver (450-520MHz)
X	X	X	X	X	X	X	X	X	X	X	X	NTN8250_	Board, Vocoder **
X	X	X	X	X	X	X	X	X	X	X	X	NTN8266_	Belt Clip Kit
X	X	X	X	X	X	X	X	X	X	X	X	NTN8294_	Battery, Nickel-Cadmium (1525mAh)
		X			X			X			X	NTN8311_	Board, Keypad, Model III
	X			X			X			X		NTN8493_	Board, Keypad, Model II
X			X			X			X			NTN8272_	Kit, Front Cover, Model I
	X			X			X			X		NTN8495_	Kit, Front Cover Kit, Model II
		X			X			X			X	NTN8273_	Kit, Front Cover, Model III
									X	X	X	NUF6472_	Board, 800MHz Transceiver (806-870MHz)
X	X	X	X	X	X	X	X	X	X	X	X	0705330Z01	Bracket, Display Flex
X	X	X	X	X	X	X	X	X	X	X	X	0705368Z01	Bracket, Keypad Flex
X	X	X	X	X	X	X	X	X	X	X	X	0905585Z02	Assembly, B+ Connector
X			X			X			X			1405874Z01	Insulator, Controller
X	X	X	X	X	X	X	X	X	X	X	X	1505348Z01	Assembly, Casting
X	X	X	X	X	X	X	X	X	X	X	X	1505579Z01	Cover, Accessory Connector
X	X	X	X	X	X	X	X	X	X	X	X	2605342Z01	Shield, Controller Board
X	X	X	X	X	X	X	X	X	X	X	X	2605343Z01	Shield, RF Board
X	X	X	X	X	X	X	X	X	X	X	X	2605344Z01	Shield, Vocoder
X	X	X	X	X	X	X	X	X	X	X	X	2805214Z03	Connector, Compression, 50 Pin
X	X	X	X	X	X	X	X	X	X	X	X	2805216Z03	Connector, Compression, 20 Pin
X	X	X	X	X	X	X	X	X	X	X	X	3205082E96	Gasket, Antenna O-Ring
X	X	X	X	X	X	X	X	X	X	X	X	3205349Z03	Seal, Main
X	X	X	X	X	X	X	X	X	X	X	X	3205351Z02	Seal, B+
X	X	X	X	X	X	X	X	X	X	X	X	4205631Z01	Clip, Locking
	X	X		X	X		X	X		X	X	5105385Y19	Module, LCD Display
		X			X			X			X	7505293Z01	Keypad, Model III
	X	X		X	X		X	X		X	X	7505336Z01	Pad, Display Locator
	X			X			X			X		7585696A01	Keypad, Model II
									X	X	X	8505241U03	Antenna, 800MHz
			X	X	X	X	X	X				8505241U05	Antenna, UHF
X	X	X										8505518V01	Antenna, VHF

Notes:

X = Item Included

* = The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the Controller Board.

- The model number and (sometimes) the FLASHcode, can be found on the FCC label on the back of the radio.
- The model number, Host code, DSP code, and (sometimes) the FLASHcode, can be found by putting a Model II or III radiointo the Test Mode.
- The model number, Host code, DSP code, and FLASHcode can be found by using the Smart RIB (RLN1015_) and the RSS to read a Model I, II, or III radio.

** = The Host code and the DSP code are required when placing an order for the Vocoder Board.

ASTRO Digital XTS 3000 Model Chart (”B” Models)

MODEL NUMBER													DESCRIPTION
H09KDC9PW5BN													VHF 1-5 Watt ASTRO Digital XTS 3000 Model I
	H09KDF9PW7BN												VHF 1-5 Watt ASTRO Digital XTS 3000 Model II
		H09KDH9PW7BN											VHF 1-5 Watt ASTRO Digital XTS 3000 Model III
			H09RDC9PW5BN										UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model I
				H09RDF9PW7BN									UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model II
					H09RDH9PW7BN								UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model III
						H09SDC9PW5BN							UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model I
							H09SDF9PW7BN						UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model II
								H09SDH9PW7BN					UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model III
									H09UCC9PW5BN				800MHz 3 Watt ASTRO Digital XTS 3000 Model I
										H09UCF9PW7BN			800MHz 3 Watt ASTRO Digital XTS 3000 Model II
											H09UCH9PW7BN		800MHz 3 Watt ASTRO Digital XTS 3000 Model III
												ITEM NUMBER	DESCRIPTION
X	X	X	X	X	X	X	X	X	X	X	X	NCN6167_	Board, Controller *
X	X	X										NLD8898_	Board, VHF Transceiver (136-174MHz)
			X	X	X							NLE4249_	Board, UHF Range 1 Transceiver (403-470MHz)
						X	X	X				NLE4250_	Board, UHF Range 2 Transceiver (450-520MHz)
X	X	X	X	X	X	X	X	X	X	X	X	NTN8250_	Board, Vocoder **
X	X	X	X	X	X	X	X	X	X	X	X	NTN8266_	Belt Clip Kit
X	X	X	X	X	X	X	X	X	X	X	X	NTN8294_	Battery, Nickel-Cadmium (1525mAh)
		X			X			X			X	NTN8311_	Board, Keypad, Model III
	X			X			X			X		NTN8493_	Board, Keypad, Model II
X			X			X			X			NTN8751_	Kit, Front Cover, Model I
	X			X			X			X		NTN8752_	Kit, Front Cover Kit, Model II
		X			X			X			X	NTN8753_	Kit, Front Cover, Model III
									X	X	X	NUF6472_	Board, 800MHz Transceiver (806-870MHz)
X	X	X	X	X	X	X	X	X	X	X	X	0705330Z01	Bracket, Display Flex
X	X	X	X	X	X	X	X	X	X	X	X	0705368Z01	Bracket, Keypad Flex
X	X	X	X	X	X	X	X	X	X	X	X	0905585Z02	Assembly, B+ Connector
X			X			X			X			1405874Z01	Insulator, Controller
X	X	X	X	X	X	X	X	X	X	X	X	1505348Z01	Assembly, Casting
X	X	X	X	X	X	X	X	X	X	X	X	1505579Z01	Cover, Accessory Connector
X	X	X	X	X	X	X	X	X	X	X	X	2605342Z01	Shield, Controller Board
X	X	X	X	X	X	X	X	X	X	X	X	2605343Z01	Shield, RF Board
X	X	X	X	X	X	X	X	X	X	X	X	2605344Z01	Shield, Vocoder
X	X	X	X	X	X	X	X	X	X	X	X	2805214Z03	Connector, Compression, 50 Pin
X	X	X	X	X	X	X	X	X	X	X	X	2805216Z03	Connector, Compression, 20 Pin
X	X	X	X	X	X	X	X	X	X	X	X	3205082E96	Gasket, Antenna O-Ring
X	X	X	X	X	X	X	X	X	X	X	X	3205349Z03	Seal, Main
X	X	X	X	X	X	X	X	X	X	X	X	3205351Z02	Seal, B+
X	X	X	X	X	X	X	X	X	X	X	X	4205631Z01	Clip, Locking
	X	X		X	X		X	X		X	X	5105385Y19	Module, LCD Display
		X			X			X			X	7505293Z01	Keypad, Model III
	X	X		X	X		X	X		X	X	7505336Z01	Pad, Display Locator
	X			X			X			X		7585696A01	Keypad, Model II
									X	X	X	8505241U03	Antenna, 800MHz
			X	X	X	X	X	X				8505241U05	Antenna, UHF
X	X	X										8505518V01	Antenna, VHF

Notes:

X = Item Included

* = The radio’s model number, FLASHcode, Host code, and DSP code are required when placing an order for the Controller Board.

- The model number and (sometimes) the FLASHcode, can be found on the FCC label on the back of the radio.
- The model number, Host code, DSP code, and (sometimes) the FLASHcode, can be found by putting a Model II or III radio into the Test Mode.
- The model number, Host code, DSP code, and FLASHcode can be found by using the Smart RIB (RLN1015_) and the RSS to read a Model I, II, or III radio.

** = The Host code and the DSP code are required when placing an order for the Vocoder Board.

ASTRO Digital XTS 3000 R (Ruggedized) Model Chart

MODEL NUMBER												DESCRIPTION
H09KDC9PW5BN												Ruggedized VHF 1-5 Watt ASTRO Digital XTS 3000 Model I
	H09KDF9PW7BN											Ruggedized VHF 1-5 Watt ASTRO Digital XTS 3000 Model II
		H09KDH9PW7BN										Ruggedized VHF 1-5 Watt ASTRO Digital XTS 3000 Model III
			H09RDC9PW5BN									Ruggedized UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model I
				H09RDF9PW7BN								Ruggedized UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model II
					H09RDH9PW7BN							Ruggedized UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model III
						H09SDC9PW5BN						Ruggedized UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model I
							H09SDF9PW7BN					Ruggedized UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model II
								H09SDH9PW7BN				Ruggedized UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model III
									H09UCC9PW5BN			Ruggedized 800MHz 3 Watt ASTRO Digital XTS 3000 Model I
										H09UCF9PW7BN		Ruggedized 800MHz 3 Watt ASTRO Digital XTS 3000 Model II
											H09UCH9PW7BN	Ruggedized 800MHz 3 Watt ASTRO Digital XTS 3000 Model III
											ITEM NUMBER	DESCRIPTION
X	X	X	X	X	X	X	X	X	X	X	X	NCN6167_	Board, Controller *
X	X	X										NLD8898_	Board, VHF Transceiver (136-174MHz)
			X	X	X							NLE4249_	Board, UHF Range 1 Transceiver (403-470MHz)
						X	X	X				NLE4250_	Board, UHF Range 2 Transceiver (450-520MHz)
X	X	X	X	X	X	X	X	X	X	X	X	NTN8250_	Board, Vocoder **
X	X	X	X	X	X	X	X	X	X	X	X	NTN8266_	Belt Clip Kit
X	X	X	X	X	X	X	X	X	X	X	X	NTN8297_	Battery, Nickel-Cadmium (1525mAh)
		X			X			X			X	NTN8311_	Board, Keypad, Model III
	X			X			X			X		NTN8493_	Board, Keypad, Model II
X			X			X			X			NTN8650_	Kit, Ruggedized Front Cover, Model I
	X			X			X			X		NTN8651_	Kit, Ruggedized Front Cover, Model II
		X			X			X			X	NTN8652_	Kit, Ruggedized Front Cover, Model III
									X	X	X	NUF6472_	Board, 800MHz Transceiver (806-870MHz)
X	X	X	X	X	X	X	X	X	X	X	X	0705330Z01	Bracket, Display Flex
X	X	X	X	X	X	X	X	X	X	X	X	0705368Z01	Bracket, Keypad Flex
X	X	X	X	X	X	X	X	X	X	X	X	0905585Z03	Assembly, B+ Connector
X			X			X			X			1405874Z01	Insulator, Controller
X	X	X	X	X	X	X	X	X	X	X	X	1505348Z10	Assembly, Casting
X	X	X	X	X	X	X	X	X	X	X	X	1505579Z01	Cover, Accessory Connector
X	X	X	X	X	X	X	X	X	X	X	X	2605342Z01	Shield, Controller Board
X	X	X	X	X	X	X	X	X	X	X	X	2605343Z01	Shield, RF Board
X	X	X	X	X	X	X	X	X	X	X	X	2605344Z01	Shield, Vocoder
X	X	X	X	X	X	X	X	X	X	X	X	2805214Z03	Connector, Compression, 50 Pin
X	X	X	X	X	X	X	X	X	X	X	X	2805216Z03	Connector, Compression, 20 Pin
X	X	X	X	X	X	X	X	X	X	X	X	3205082E96	Gasket, Antenna O-Ring
X	X	X	X	X	X	X	X	X	X	X	X	3205349Z04	Seal, Main
X	X	X	X	X	X	X	X	X	X	X	X	3205351Z02	Seal, B+
X	X	X	X	X	X	X	X	X	X	X	X	4205631Z01	Clip, Locking
	X	X		X	X		X	X		X	X	5105385Y19	Module, LCD Display
		X			X			X			X	7505293Z02	Keypad, Model III
	X	X		X	X		X	X		X	X	7505336Z01	Pad, Display Locator
	X			X			X			X		7585696A02	Keypad, Model II
									X	X	X	8505241U03	Antenna, 800MHz
			X	X	X	X	X	X				8505241U05	Antenna, UHF
X	X	X										8505518V01	Antenna, VHF

Notes:

X = Item Included

* = The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the Controller Board.

- The model number and (sometimes) the FLASHcode, can be found on the FCC label on the back of the radio.
- The model number, Host code, DSP code, and (sometimes) the FLASHcode, can be found by putting a Model II or III radio into the Test Mode.
- The model number, Host code, DSP code, and FLASHcode can be found by using the Smart RIB (RLN1015_) and the RSS to read a Model I, II, or III radio.

** = The Host code and the DSP code are required when placing an order for the Vocoder Board.

ASTRO Digital XTS 3000 R (Ruggedized) Yellow Model Chart

MODEL NUMBER												DESCRIPTION
H09KDC9PW5BN												Ruggedized Yellow VHF 1-5 Watt ASTRO Digital XTS 3000 Model I
	H09KDF9PW7BN											Ruggedized Yellow VHF 1-5 Watt ASTRO Digital XTS 3000 Model II
		H09KDH9PW7BN										Ruggedized Yellow VHF 1-5 Watt ASTRO Digital XTS 3000 Model III
			H09RDC9PW5BN									Ruggedized Yellow UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model I
				H09RDF9PW7BN								Ruggedized Yellow UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model II
					H09RDH9PW7BN							Ruggedized Yellow UHF Range 1 1-4 Watt ASTRO Digital XTS 3000 Model III
						H09SDC9PW5BN						Ruggedized Yellow UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model I
							H09SDF9PW7BN					Ruggedized Yellow UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model II
								H09SDH9PW7AN				Ruggedized Yellow UHF Range 2 1-4 Watt ASTRO Digital XTS 3000 Model III
									H09UCC9PW5BN			Ruggedized Yellow 800MHz 3 Watt ASTRO Digital XTS 3000 Model I
										H09UCF9PW7BN		Ruggedized Yellow 800MHz 3 Watt ASTRO Digital XTS 3000 Model II
											H09UCH9PW7BN	Ruggedized Yellow 800MHz 3 Watt ASTRO Digital XTS 3000 Model III
											ITEM NUMBER	DESCRIPTION
X	X	X	X	X	X	X	X	X	X	X	X	NCN6167_ Board, Controller *
X	X	X										NLD8898_ Board, VHF Transceiver (136-174MHz)
			X	X	X							NLE4249_ Board, UHF Range 1 Transceiver (403-470MHz)
						X	X	X				NLE4250_ Board, UHF Range 2 Transceiver (450-520MHz)
X	X	X	X	X	X	X	X	X	X	X	X	NTN8250_ Board, Vocoder **
X	X	X	X	X	X	X	X	X	X	X	X	NTN8266_ Belt Clip Kit
X	X	X	X	X	X	X	X	X	X	X	X	NTN8294_ Battery, Nickel-Cadmium (1525mAh)
		X			X			X			X	NTN8311_ Board, Keypad, Model III
	X			X			X			X		NTN8493_ Board, Keypad, Model II
X			X			X			X			NTN8669_ Kit, Ruggedized Yellow Front Cover, Model I
	X			X			X			X		NTN8670_ Kit, Ruggedized Yellow Front Cover, Model II
		X			X			X			X	NTN8671_ Kit, Ruggedized Yellow Front Cover, Model III
									X	X	X	NUF6472_ Board, 800MHz Transceiver (806-870MHz)
X	X	X	X	X	X	X	X	X	X	X	X	0705330Z01 Bracket, Display Flex
X	X	X	X	X	X	X	X	X	X	X	X	0705368Z01 Bracket, Keypad Flex
X	X	X	X	X	X	X	X	X	X	X	X	0905585Z03 Assembly, B+ Connector
X			X			X			X			1405874Z01 Insulator, Controller
X	X	X	X	X	X	X	X	X	X	X	X	1505348Z10 Assembly, Casting
X	X	X	X	X	X	X	X	X	X	X	X	1505579Z01 Cover, Accessory Connector
X	X	X	X	X	X	X	X	X	X	X	X	2605342Z01 Shield, Controller Board
X	X	X	X	X	X	X	X	X	X	X	X	2605343Z01 Shield, RF Board
X	X	X	X	X	X	X	X	X	X	X	X	2605344Z01 Shield, Vocoder
X	X	X	X	X	X	X	X	X	X	X	X	2805214Z03 Connector, Compression, 50 Pin
X	X	X	X	X	X	X	X	X	X	X	X	2805216Z03 Connector, Compression, 20 Pin
X	X	X	X	X	X	X	X	X	X	X	X	3205082E96 Gasket, Antenna O-Ring
X	X	X	X	X	X	X	X	X	X	X	X	3205349Z04 Seal, Main
X	X	X	X	X	X	X	X	X	X	X	X	3205351Z02 Seal, B+
X	X	X	X	X	X	X	X	X	X	X	X	4205631Z01 Clip, Locking
	X	X		X	X		X	X		X	X	5105385Y19 Module, LCD Display
		X			X			X			X	7505293Z02 Keypad, Model III
	X	X		X	X		X	X		X	X	7505336Z01 Pad, Display Locator
	X			X			X			X		7585696A02 Keypad, Model II
									X	X	X	8505241U03 Antenna, 800MHz
			X	X	X	X	X	X				8505241U05 Antenna, UHF
X	X	X										8505518V01 Antenna, VHF

Notes:

X = Item Included

* = The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the Controller Board.

- The model number and (sometimes) the FLASHcode, can be found on the FCC label on the back of the radio.
- The model number, Host code, DSP code, and (sometimes) the FLASHcode, can be found by putting a Model II or III radio into the Test Mode.
- The model number, Host code, DSP code, and FLASHcode can be found by using the Smart RIB (RLN1015_) and the RSS to read a Model I, II, or III radio.

** = The Host code and the DSP code are required when placing an order for the Vocoder Board.

Notes

Glossary

A/D	Analog to **D**igital converter; converts an instantaneous dc voltage level to a corresponding digital value.
ABACUS IC	Custom integrated circuit providing a digital receiver IF backend.
ADSIC	ABACUS/**D**SP **S**upport **IC**; custom integrated circuit providing peripheral functions for the DSP.
ALC	**A**utomatic **L**evel **C**ontrol; a circuit in the transmit RF path that controls RF power amplifier output, provides leveling over frequency and voltage, and protects against high VSWR.
CBI	**C**ontroller **B**oard **I**nitialization; a process by which a replacement Controller Board can be initialized with the serial number of the radio into which it will be installed. This initialization is a one-shot process, and must therefore be approached with care.
D/A	**D**igital to **A**nalog converter; converts a digital value to a corresponding dc voltage value.
DTMF	**D**ual **T**one **M**ulti-**F**requency
DPL	**D**igital **P**rivate-**L**ine™
DSP	**D**igital **S**ignal **P**rocessor; microcontroller specifically tailored for signal processing computations. In this case refers specifically to Motorola DSP56001.
DSP Code	**D**igital **S**ignal **P**rocessor Code; object code executed by the Digital Signal Processor in an ASTRO or XTS3000 subscriber radio. The DSP is responsible for computation-intensive tasks, such as decoding ASTRO signalling
Firmware	Code executed by an embedded processor such as the Host or DSP in a subscriber radio. This type of code is typically resident in non-volatile memory and as such is more difficult to change than code executed from RAM.
FGU	**F**requency **G**eneration **U**nit
FLASHcode	A 13-digit code which uniquely identifies the System Software Package and Software Revenue Options that are enabled in a particular subscriber radio. FLASHcodes are only applicable for radios which are upgradeable through the FLASHport process.
FLASHport™	A Motorola term that describes the ability of a radio to change memory. Every FLASHport radio contains a FLASHport EEPROM memory chip that can be software written and rewritten to, again and again.
Host	Motorola HC11F1 microcontrol unit U204 (see MCU).
Host Code	Object code executed by the Host Processor in an ASTRO or XTS3000 subscriber radio. The Host is responsible for control-oriented tasks such as decoding and responding to user inputs.

Host Port	Parallel memory mapped interface consisting of eight registers in the DSP56001.
IC	**I**ntegrated **C**ircuit
IMBE	A sub-band, voice encoding algorithm used in ASTRO digital voice.
ISW	**I**nbound **S**ignalling **W**ord; data transmitted on the control channel from a subscriber unit to the central control unit.
LSH	**L**ow **S**peed **H**andshake; 150 baud digital data sent to the radio during trunked operation while receiving audio.
MCU	**M**icro**C**ontrol **U**nit
MDC	**M**otorola **D**igital **C**ommunications
OMPAC	**O**ver-**M**olded **P**ad-**A**rray **C**arrier; a Motorola custom IC package, distinguished by the presence of solder balls on the bottom pads.
Open Architecture	A controller configuration that utilizes a microprocessor with extended ROM, RAM, and EEPROM.
OSW	**O**utbound **S**ignalling **W**ord; data transmitted on the control channel from the central controller to the subscriber unit.
PC Board	**P**rinted **C**ircuit board
PL	**P**rivate-**L**ine® tone squelch; a continuous sub-audible tone that is transmitted along with the carrier.
PLL	**P**hase-**L**ocked **L**oop; a circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PTT	**P**ush-**T**o-**T**alk; the switch located on the left side of the radio which, when pressed, causes the radio to transmit.
Registers	Short-term data-storage circuits within the microcontrol unit or programmable logic IC.
Repeater	Remote transmit/receive facility that re-transmits received signals in order to improve communications coverage.
RESET	Reset line; an input to the microcontroller that restarts execution.
RF PA	**R**adio **F**requency **P**ower **A**mplifier
RSS	**R**adio **S**ervice **S**oftware
RPT/TA	**R**e**P**ea**T**er/**T**alk-**A**round
RX DATA	Recovered digital data line.
Signal Qualifier Mode	An operating mode whereby the radio is muted but still continues to analyze receive data to determine RX signal type.

SCI IN	**S**erial **C**ommunication **I**nterface **IN**put line
SLIC	**S**upport-**L**ogic **IC**; a custom gate array used to provide I/O and memory expansion for the microcontroller.
Smart RIB	Smart **R**adio **I**nterface **B**ox; a service aid that enables communications between the radio and the computer's serial communications adapter. Used in conjunction with the RSS to read the DSP Code, FLASHcode, Host Code, and model number.
Softpot	Software potentiometer; a computer-adjustable electronic attenuator.
Software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
SPI	**S**erial **P**eripheral **I**nterface; how the microcontroller communicates to modules and ICs through the CLOCK and DATA lines.
Squelch	Muting of audio circuits when received signal levels fall below a pre-determined value.
SRAM	**S**tatic-**RAM** chip used for volatile, program/data memory.
SSI	**S**ynchronous **S**erial **I**nterface on the DSP56001 consisting of six signals and used for an RX and TX modulated data interface to the ADSIC.
Standby Mode	An operating mode whereby the radio is muted but still continues to monitor data.
System Central Controllers	Main control unit of the trunked dispatch system; handles ISW and OSW messages to and from subscriber units (see ISW and OSW).
System Select	The act of selecting the desired operating system with the system-select switch (also, the name given to this switch).
TOT	**T**ime-**O**ut **T**imer; a timer that limits the length of a transmission.
TSOP	**T**hin **S**mall-**O**utline **P**ackage
UART	**U**niversal **A**synchronous **R**eceiver **T**ransmitter.
µC	Microcontrol unit (see MCU).
VCO	**V**oltage-**C**ontrolled **O**scillator; an oscillator whereby the frequency of oscillation can be varied by changing a control voltage.
VCOB IC	**V**oltage-**C**ontrolled **O**scillator **B**uffer **IC**
Vocoder	**VO**ice en**CODER**; the DSP-based system for digitally processing the analog signals, includes the capabilities of performing voice compression algorithms or voice encoding.
VSELP	**V**ector **S**um **E**xcited **L**inear **P**redictive coding; a voice encoding technique used in ASTRO digital voice.
VSWR	**V**oltage **S**tanding **W**ave **R**atio

Notes

Introduction

1

General

This manual includes all the information needed to maintain peak product performance and maximum working-time. This detailed level of service (component level) is typical of some service centers, self-maintained customers, and distributors. This manual is to be used in conjunction with the ASTRO Digital XTS 3000 Portable Radios Basic Service Manual (Motorola part number 68P81083C85), which uses the pass/fail service approach to radio problems.

Conduct the basic performance checks first. This will verify the actual need for analyzing the radio and help pinpoint the functional problem area. In addition, the technician will become familiar with the radio test mode of operation, which is a helpful tool. If any basic receive or transmitter parameters fail, then the radio should be aligned per the radio alignment procedure.

Included in other areas of this manual are disassembly/reassembly procedures, functional block diagrams, detailed theory of operation, troubleshooting charts and waveforms, schematics and parts lists, a nd exploded view and parts list. The technician should be very familiar with these sections to aid in determining the problem circuit. Also included are component location diagrams to aid in locating individual circuit components and some IC diagrams, which point out some convenient probe points.

The theory of operation sections of this manual contain detailed descriptions of the operations of many circuits. Once the area of the problem is located, it would be strongly advisable to review the operation of the circuit pertaining to the troubleshooting flow chart.

Notations Used in This Manual

Throughout the text in this publication, you will notice the use of warnings, cautions, and notes. These notations are used to emphasize that safety hazards exist, and care must be taken and observed.

NOTE: An operational procedure, practice, or condition, etc., which is essential to emphasize.

Caution

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in equipment damage. To properly word a caution, first identify the gravity of the risk, then describe the nature of the risk, then tell the user how to avoid the risk, and finally communicate this risk clearly to the person exposed to the risk.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or injury. To properly word a caution, first identify the gravity of the risk, then describe the nature of the risk, then tell the user how to avoid the risk, and finally communicate this risk clearly to the person exposed to the risk.

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or injury. To properly word a caution, first identify the gravity of the risk, then describe the nature of the risk, then tell the user how to avoid the risk, and finally communicate this risk clearly to the person exposed to the risk.

In this publication you will also find the use of the asterisk symbol (*) to indicate a negative or NOT logic true signal.

XTS 3000 R Radios Only

Caution

- The XTS 3000 R radio casting has a vent hole that allows for pressure equalization in the radio. Never poke this vent with any objects, such as needles, tweezers, or screwdrivers. This will create a leak path into the radio and the radio's submersibility will be lost.
- This pressure equalization vent is located on the chassis, just below the battery contact. Never obstruct or cover the two slots with any object, including a label. Ensure that no oily substances come in contact with this vent.
- The XTS 3000 R radio is designed to be submersed to a maximum depth of 6 feet and a maximum submersion time of 4 hours. Exceeding either maximum limit may result in damage to the radio.

1. If the radio has been submersed in water, shake the radio well to remove any water that may be trapped inside the speaker grille and microphone port. Otherwise, the water will decrease the audio quality of the radio. Dry the radio and battery.
2. If the radio's battery contact area has been exposed to water, dry the battery contacts (both on the radio and the battery) before attaching the battery to the radio. Otherwise, the water could short-circuit the radio.
3. If the radio has been submersed in corrosive medium (such as salt water), rinse the radio and battery in fresh water, and dry the radio and battery.
4. If cleaning is desired, use a diluted solution of mild dishwashing detergent and fresh water (one teaspoon of detergent to one gallon of water).
5. Do not disassemble the radio. This could damage radio seals and result in leak paths into the radio. Any radio maintenance should be performed by only a qualified service person.

Notes

General Overview of an ASTRO Digital XTS 3000 Radio

2

The ASTRO Digital XTS 3000 radio is a dual-mode (trunked/conventional), microcontroller-based transceiver incorporating a Digital Signal Processor (DSP). The microcontroller handles the general radio control, monitors status, and processes commands input from the keypad or other user controls. The DSP processes the typical analog signals and generates the standard signaling digitally to provide compatibility with existing analog systems. In addition, it provides for digital modulation techniques, utilizing voice encoding techniques with error correction schemes, to provide the user with enhanced range and audio quality all in a reduced bandwidth channel requirement. It allows embedded signaling which can mix system information and data with digital voice to add the capability of supporting a multitude of system features.

The three ASTRO Digital XTS 3000 radio models (I, II, and III) are available in the VHF (136-174MHz) band, two UHF bands (403-470MHz and 450-512MHz), and the 800MHz (806-870MHz) band.

The ASTRO Digital XTS 3000 radio consists of:

- a vocoder (DSP) board,
- a controller board,
- a band-dependent transceiver (RF) board,
- display and keypad assemblies (models II and III only), and
- an encryption board (in secure models only).

The vocoder board consists of a Digital Signal Processor (DSP), Static-RAM (SRAM), FLASH program memory, and a custom ABACUS/DSP support integrated circuit (ADSIC). This section handles all the analog and signaling functions previously accomplished with analog integrated circuits (ICs) by processing the signals digitally. In addition, it provides advanced digital signal processing functions which include digital modulation and voice encoding techniques while still maintaining compatibility with today's analog radio systems.

The controller board consists of a microcontroller with FLASH program memory, EEPROM, SRAM, audio power amplifier (audio PA), and a custom IC—the SLIC. This section handles general radio control and ergonomics through the various user buttons, and rotary knobs.

The transceiver is frequency dependent, and one transceiver exists for each of the bands: VHF, UHF (range 1 and 2), and 800MHz. The distinction with these transceivers is the incorporation of the ABACUS IC. The ABACUS is a digital IF/Discriminator which provides a true digital interface to the digital circuitry of the vocoder.

The display module is a four-line x 12-character, liquid-crystal display (LCD) with associated circuitry. This module utilizes chip-on-board technology and is not considered field repairable.

The keypad module is either a 6 x 3- or a 2 x 3-button module with backlighting.

The encryption board (secure models only) connects directly to the controller board and interfaces directly with the vocoder digital circuitry. It contains an independent microcontroller and two custom ICs to perform digital, numerical, encryption algorithms.

Analog Mode of Operation

When the radio is *receiving*, the signal comes from the antenna/antenna-switch connector to the transceiver board, passes through the RX/TX switch and the receiver front end. The signal is then filtered, amplified, and mixed with the first local-oscillator signal generated by the voltage-controlled oscillator (VCO). The resulting intermediate frequency (IF) signal is fed to the IF circuitry, where it is again filtered and amplified. This amplified signal is passed to the digital back-end IC, where it is mixed with the second local oscillator to create the second IF at 450kHz. It is then converted to a digital bit stream and mixed a third time to produce a baseband signal. This signal is passed to the vocoder board through a current-driven differential output. On the vocoder board, the ADSIC (ABACUS DSP Support IC) digitally filters and discriminates the signal, and passes it to the digital-signal processor (DSP). The DSP decodes the information in the signal and identifies the appropriate destination for it. For a voice signal, the DSP will route the digital voice data to the ADSIC for conversion to an analog signal. The ADSIC will then present the signal to the controller board's audio power amplifier, which drives the speaker. For signalling information, the DSP will decode the message and pass it to the microcontrol unit.

When the radio is *transmitting*, microphone audio is passed from the audio power amplifier (PA) to the ADSIC, where the signal is digitized. The ADSIC passes digital data to the DSP, where pre-emphasis and low-pass (splatter) filtering are done. The DSP returns this signal to the ADSIC, where it is reconverted into an analog signal and scaled for application to the voltage-controlled oscillator as a modulation signal. Transmitted signalling information is accepted by the DSP from the microcontrol unit, coded appropriately, and passed to the ADSIC, which handles it the same as a voice signal. Analog modulation information is passed to the synthesizer along the modulation line. A modulated carrier is provided to the RF PA, which transmits the signal under dynamic power control.

ASTRO Mode (Digital Mode) of Operation

In the ASTRO mode (digital mode) of operation, the transmitted or received signal is limited to a discrete set of four deviation levels. The receiver handles an ASTRO-mode signal identically to an analog-mode signal up to the point where the DSP decodes the received data. In the ASTRO receive mode, the DSP uses a specifically defined algorithm to recover information. In the ASTRO transmit mode, microphone audio is processed identically to an analog mode with the exception of the

algorithm the DSP uses to encode the information. This algorithm will result in deviation levels that are limited to four discrete levels.

Transceiver Board Overview

The receiver front end consists of a preselector, an RF amplifier, a second preselector, and a mixer. In the VHF and UHF radios, both preselectors are varactor-tuned, two-pole filters controlled by the microcontrol unit (MCU) through the digital/analog (D/A) IC. On the 800MHz receiver front end, these filters are fixed-tuned. The RF amplifier is a dual-gate, gallium- arsenide based IC. The mixer is a double-balanced, active mixer coupled by transformers. Injection is provided by the VCO through an injection filter. See Table 14 for local oscillator (LO) and first IF information.

The frequency generation function is performed by three ICs and associated circuitry. The reference oscillator provides a frequency standard to the synthesizer/prescaler IC, which controls the VCO IC. The VCO IC actually generates the first LO and transmit-injection signals and buffers them to the required power level. The synthesizer/prescaler circuit module incorporates frequency-division and comparison circuitry to keep the VCO signals stable. The synthesizer/prescaler IC is controlled by the microcontrol unit through a serial bus. Most of the synthesizer circuitry is enclosed in rigid metal cans on the transceiver board to reduce microphonic effects.

The receiver back end consists of a two-pole crystal filter, an IF amplifier, a second two-pole crystal filter, and the digital back-end IC (ABACUS). The two-pole filters are wide enough to accommodate 5kHz modulation. Final IF filtering is done digitally in the ADSIC.

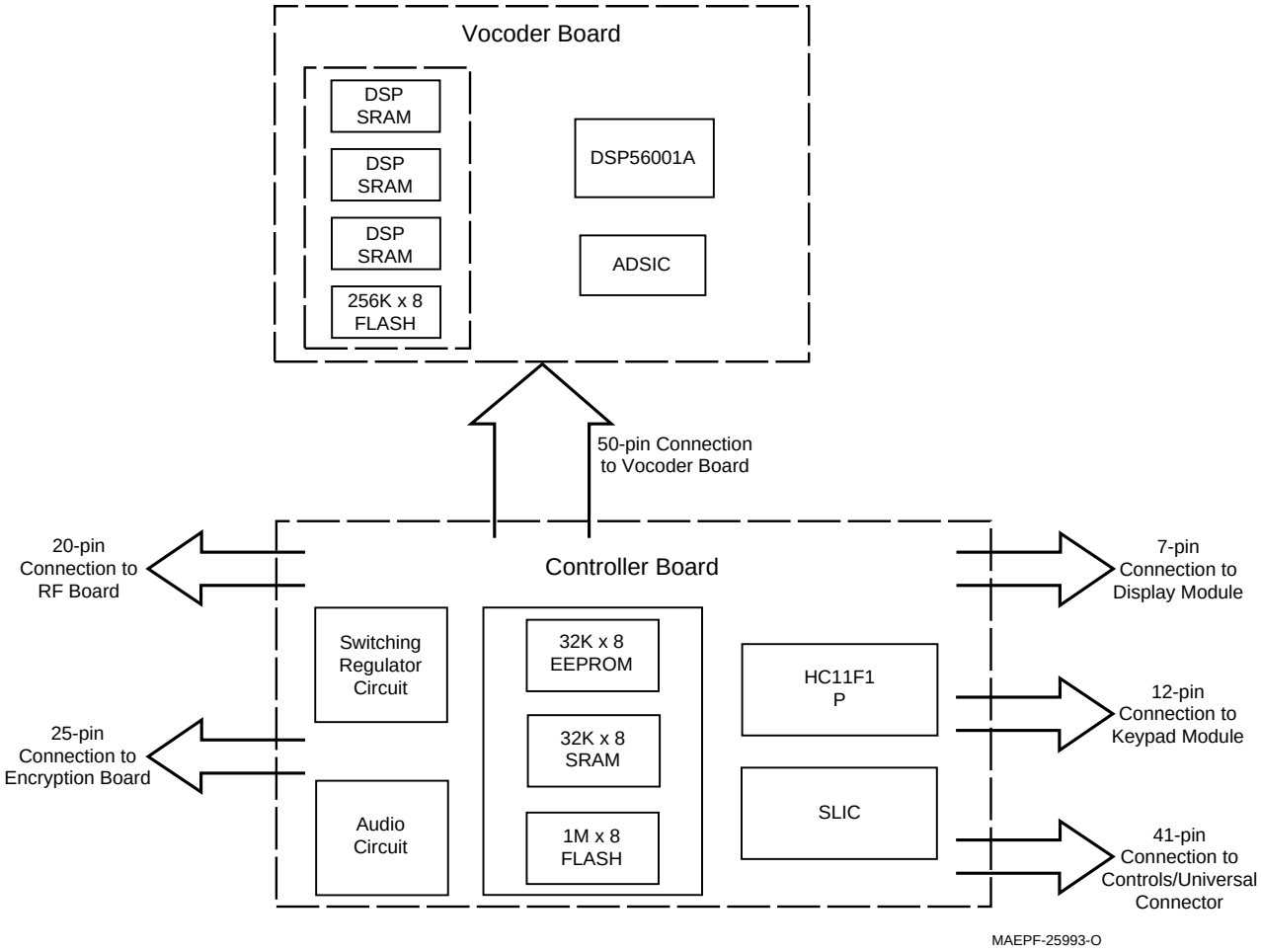
The digital back-end IC (ABACUS) consists of an amplifier, the second mixer, an IF analog-to-digital converter, a baseband down-converter, and a 2.4MHz synthesis circuit to provide a clock to the ADSIC on the vocoder board. The second LO is generated by discrete components external to the IC. The output of the ABACUS IC is a digital bit stream that is current driven on a differential pair for a reduction in noise generation.

The transmitter consists of an RF PA IC that gets an injection signal from the VCO. Transmit power is controlled by two custom ICs that monitor the output of a directional coupler and adjust PA control voltages correspondingly. The signal passes through a RX/TX switch that uses PIN diodes to automatically provide an appropriate interface to transmit or receive signals. Antenna selection is done mechanically in the control top.

Controller Board Overview

The controller board (see Figure 2-1.) contains the radio's microcontrol unit with its memory and support circuits, voltage regulators, audio, and power control circuits. Connected to the controller board are the display module, keypad module, transceiver board, vocoder board, secure module, and front cover housing assembly.

The microcontrol unit (MCU) controls receive/transmit frequencies, power levels, display, and other radio functions, using either direct logic control or serial communications paths to the devices.The



microcontrol unit executes a stored program located in its FLASH ROM. Data is transferred to and from memory by the microcontrol unit data bus. The memory location from which data is read, or to which data is written, is selected by the address lines.

Figure 2-1. Controller Board/Vocoder Board Interconnection

The SLIC acts as an extension of the microcontrol unit by providing logic functions such as lower address latch, reset, memory address decoding, and additional control lines for the radio. The microcontrol unit controls the crystal-pull circuit to adjust the crystal oscillator's frequency on the microcontrol unit, so that the E-clock' s harmonics do not cause interference with the radio's receive channel.

Switched +5V is used for all circuits on the vocoder and controller boards, except the audio PA, which is sourced from 7.5V. The regulator automatically provides 5V when the radio is turned on. The regulator's power-down mode is controlled by the microcontrol unit, which senses the position of the on/off/volume control knob.

Vocoder Board Overview

The vocoder board (see Figure 2-1.) contains the radio's DSP and ADSIC circuitry. It is responsible for all voice and data processing and signalling.

The DSP performs all signalling and voice encoding and decoding as well as audio filtering and volume control. This includes Private-Line®/Digital Private Line™ (PL/DPL) encode and alert-tone generation. The IC transmits pre-emphasis on analog signals and applies a low-pass (splatter) filter to all transmitted signals. It is programmed using parallel programming from the microcontrol unit and the ADSIC.

The DSP executes a stored program located in its FLASH ROM. The code is actually moved out of the FLASH ROM to the DSP's high-speed SRAM, and executed from there.

The DSP also controls a crystal pull circuit to adjust its oscillator frequency, preventing harmonics from interfering with the radio's receive channel.

The ADSIC performs analog-to-digital and digital-to-analog conversions on audio signals. It contains attenuators for volume, squelch, deviation, and compensation, and it executes receiver filtering and discrimination. The IC requires a 2.4MHz clock to function (generated by the ABACUS IC) and is programmed by the microcontrol unit SPI bus.

Notes

Radio Power

3

Introduction to This Section

This section of the manual provides a detailed circuit description of the power distribution for an ASTRO Digital XTS 3000 radio.

General

In the ASTRO XTS 3000 radio, power (B+) is distributed to two boards: the transceiver board and the controller board. In the case of a secure model radio, B+ is also supplied to the encryption module.

Power for the radio is provided through a battery supplying a nominal 7.5Vdc directly to the transceiver. The battery is available in the following forms:

- Nickel-Cadmium, 1525 mAh
- Nickel-Cadmium, 1525 mAh, FM Approved
- Nickel-Metal-Hydride, 1650 mAh
- Nickel-Metal-Hydride, 1650 mAh, FM Approved

B+ from the battery is electrically switched to most of the radio, rather than routed through the on/off/volume control knob, S1. The electrical switching of B+ supports a “keep-alive” mode. Under software control, even when the on/off/volume control knob has been turned to the “off” position, power remains on until the MCU completes its power-down, at which time the radio is physically powered-down.

B+ Routing for VHF/UHF Transceiver Boards

Refer to Figure 3-2 and the appropriate schematic diagram.

Raw B+ (7.5V) from the battery (Batt B+) enters the radio on the transceiver board through a 3-contact connector (J3). From J3 it is routed through two ferrite beads (E1, E101) on the VHF board, or three ferrite beads (E1, E101, E106) on the UHF board, to the RF power amplifier module (U105) and ALC IC (U101). Battery B+ is fused, and then routed through connector J1, pins 15 and 20, to the controller board (P201, pins 15 and 20). The B+ supply is routed through the controller board to the on/off/volume control knob (S1) on the control top/PTT flex at plug P101. With the mechanical on/off switch (S1) placed in the “on” position, switched B+ (B+ SENSE) is routed from the control top flex at connector plug P101, pin 32, and applied to the controller board at connector jack J101, pin 32. This signal is also fed to resistive divider R170, R172 on the controller board, so that the microcontrol unit (U701) can monitor the battery voltage.

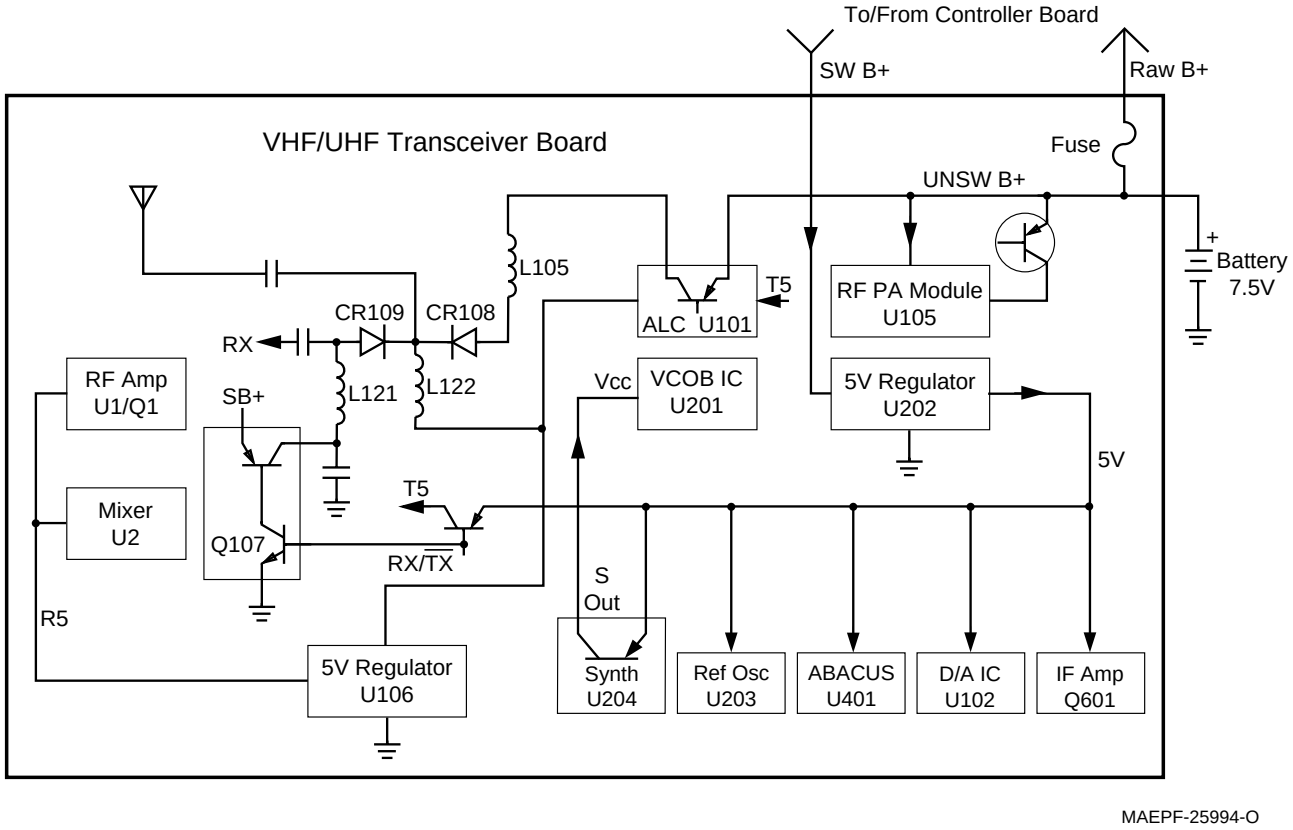


Figure 3-2 B+ Routing for VHF/UHF Transceiver Boards

The switched B+ voltage supplies power to circuits on the transceiver board. This voltage is applied to the 5-volt regulator (U202) via decoupling component C302 to produce a stable 5.0-volt output. Raw B+ (7.5V), which is connected to the ALC IC (U101), is switched through the output (CATH1) to another 5-volt regulator (U106).

Regulator U202 supplies those circuits which need to remain on at all times, such as the reference oscillator (U203), fractional-N synthesizer (U204), D/A IC (U102), and the ABACUS IC (U401). The D/A IC controls dc switching of the transceiver board. The SC1 signal at U102, pin 12 controls transistors Q107, Q111, and the transmit 5 volts (T5). The SC3 signal at U102, pin C4 controls the Rx 5V switch U106, and the receive 5 volts (R5). A voltage on the synthesizer SOUT line at U204, pin 19 supplies power (Vcc) to the VCO buffer at U201, pin 3.

During the receive mode, regulator U106 supplies regulated 5V (R5) to the receiver front end. In the battery-saver mode, R5 can be switched on and off by controlling pin 3 of U106. Module U106 is not used during the transmit mode. During the transmit mode, transmit 5 volts (T5) for the ALC IC and other TX circuitry is obtained from U202 via switching transistor Q111.

B+ Routing for 800MHz Transceiver Boards

Refer to Figure 3-3 and the appropriate schematic diagram.

Raw B+ (7.5V) from the battery (Batt B+) enters the radio on the transceiver board through a 3-contact connector (J3). From J3 it is routed through four ferrite beads (E1, E2, E3, E4) and applied to the RF power amplifier (U502) and the ALC IC (U504). Battery B+ is fused and then routed to the controller board, where it enters on connector J1, pins 15 and 20. On secure radios, Raw B+ is also routed to the encryption board so that it can perform key management and other functions independent of SW B+.

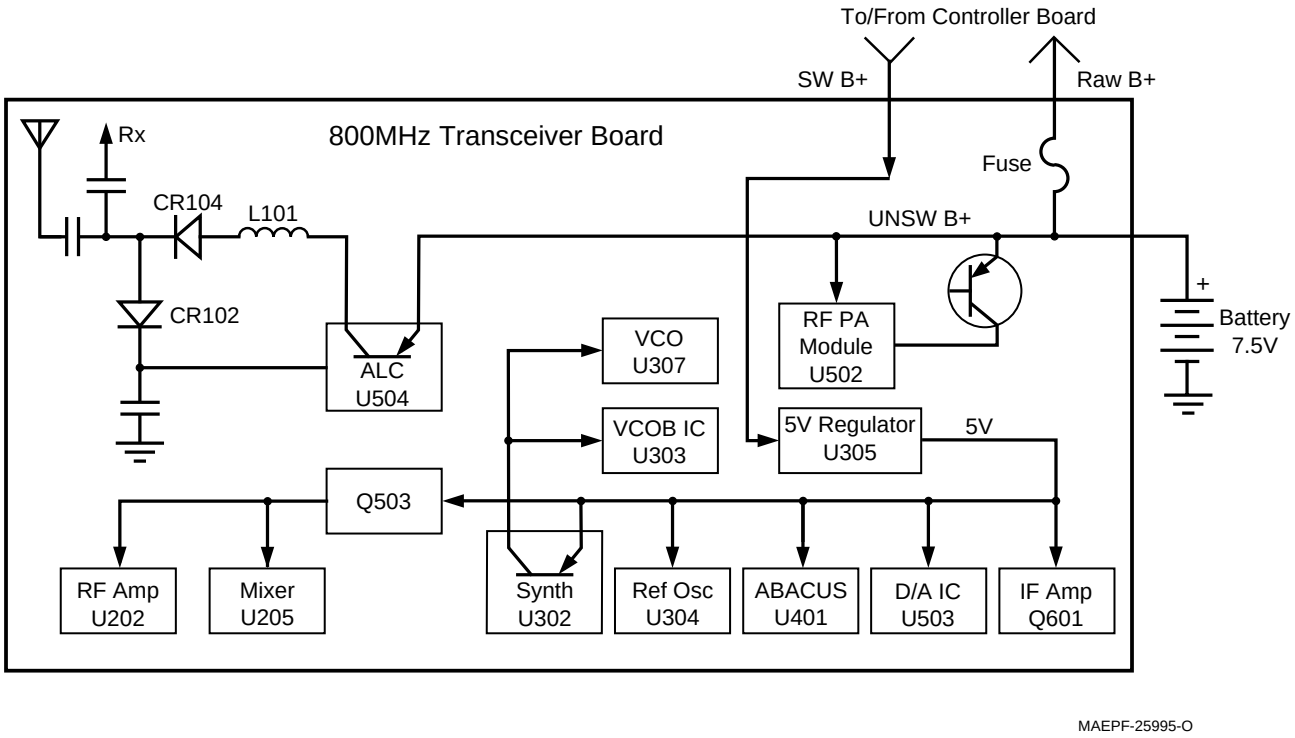


Figure 3-3 B+ Routing for 800MHz Transceiver Boards

The SW B+ is applied to the 5V regulator (U305) to produce a stable 5.0 volt output. Regulator U305 supplies those circuits which need to remain on at all times, such as the reference oscillator (U304), fractional-N synthesizer (U302), D/A IC (U503), and the ABACUS IC (U401). The D/A IC controls dc switching of the transceiver board. The SCI signal at U503, pin B4 controls Q503 and transmit 5 volts (T5). The SC3 signal at U503, pin C4 controls the RX 5V switch in Q503 and the receive 5 volts (R5). During the receive mode, switch Q503 supplies regulated 5volts (R5) to the receiver front end.

B+ and +5V Routing for Controller and Vocoder Boards

Refer to Figures 3-4 and 3-5 and the appropriate schematic diagrams.

Power for the radio is derived from a 7.5 volt battery, which is applied to the transceiver board through J3. This Raw B+, or unswitched B+ (UNSW B+), is routed to J1 on the transceiver board and then on to P201 on the controller board. Here the UNSW B+ is forwarded to the radio's control top on/off/volume knob through J101 and a flex circuit. The on/off/volume knob controls B+_SENSE to Q105, which in turn controls Q106. Transistor Q106 is a solid-state power switch that provides SW B+ to the controller and transceiver board's analog 5V regulators, the audio PA, and back to the transceiver board. In addition, UNSW B+ is routed to the main digital 5V regulator (U709); B+ SENSE provides for enabling or disabling this regulator.

In the case of a secure radio model, SW B+ and UNSW B+ are also supplied to the encryption module through J601.

Q106 is also under the control of the microcontrol unit (MC—-U701) through a port on the SLIC IC (U702). This allows the MCU to follow an orderly power-down sequence when it senses the SW B+ is off. This sense is provided through the resistor network of R170 and R172, which provides an input to the A/D port on the MCU.

The controller board contains two 5V regulators partitioned between the digital logic circuitry and the analog circuitry. The 5V regulator for the digital circuitry consists of U709, D104, L119, C180, and associated components. This circuit is a switched mode regulator. Switched mode regulators use a switched storage device (L119) to supply just enough energy to the output to maintain regulation. This allows for much greater efficiency and lower power dissipation. This +5V digital supply powers all digital ICs on both the controller and vocoder boards, as well as the display and keypad modules.

The analog circuitry of the ADSIC (U406) and the audio PA (U718) is powered through a separate 5V linear regulator (U710).

It should also be noted that a system reset is provided by U726. This device brings the system out of reset on power-up. It provides a system reset to the microcomputer on power-down or if the digital 5V regulator falls out of regulation.

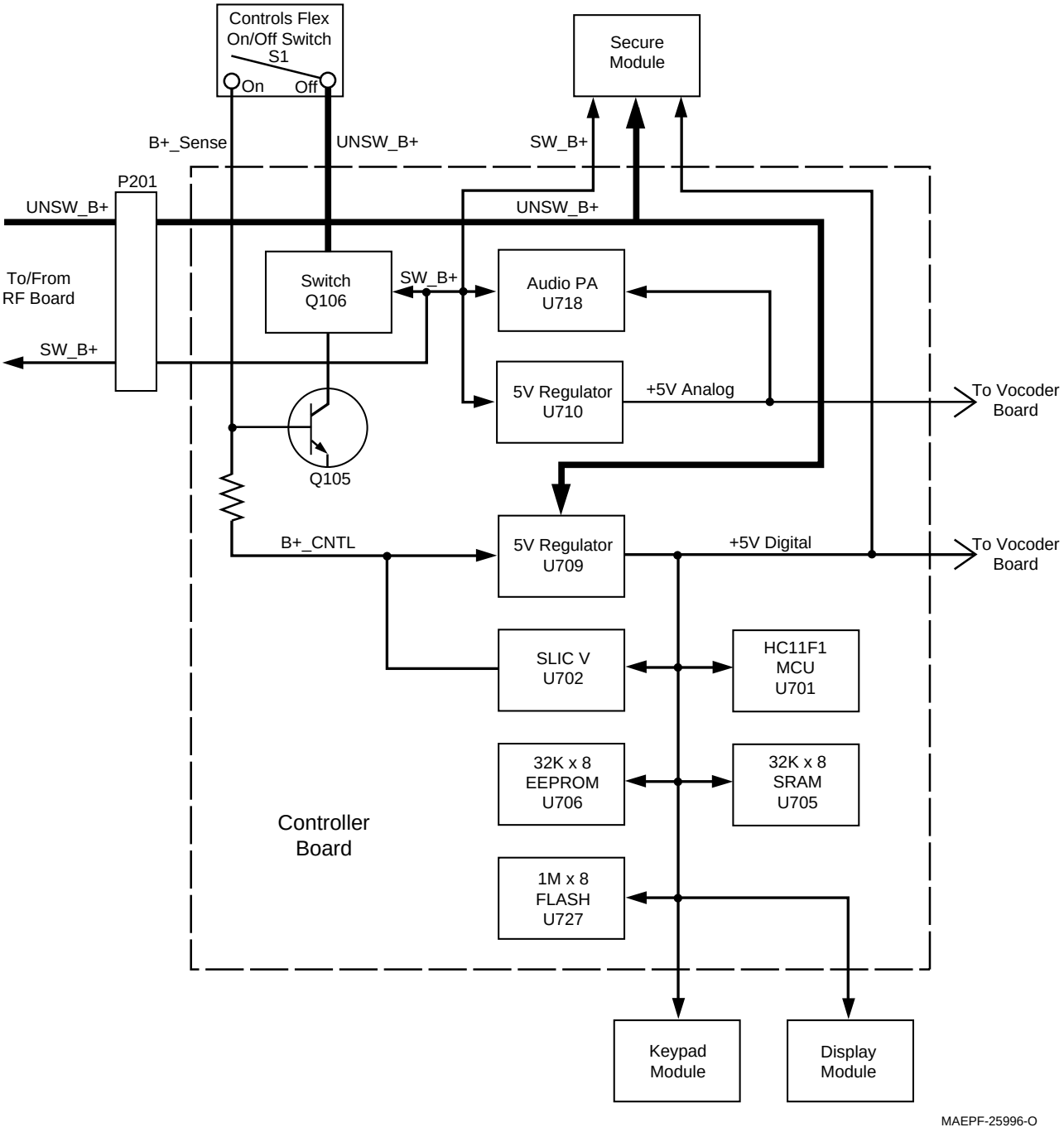


Figure 3-4 B+ Routing for Controller Board

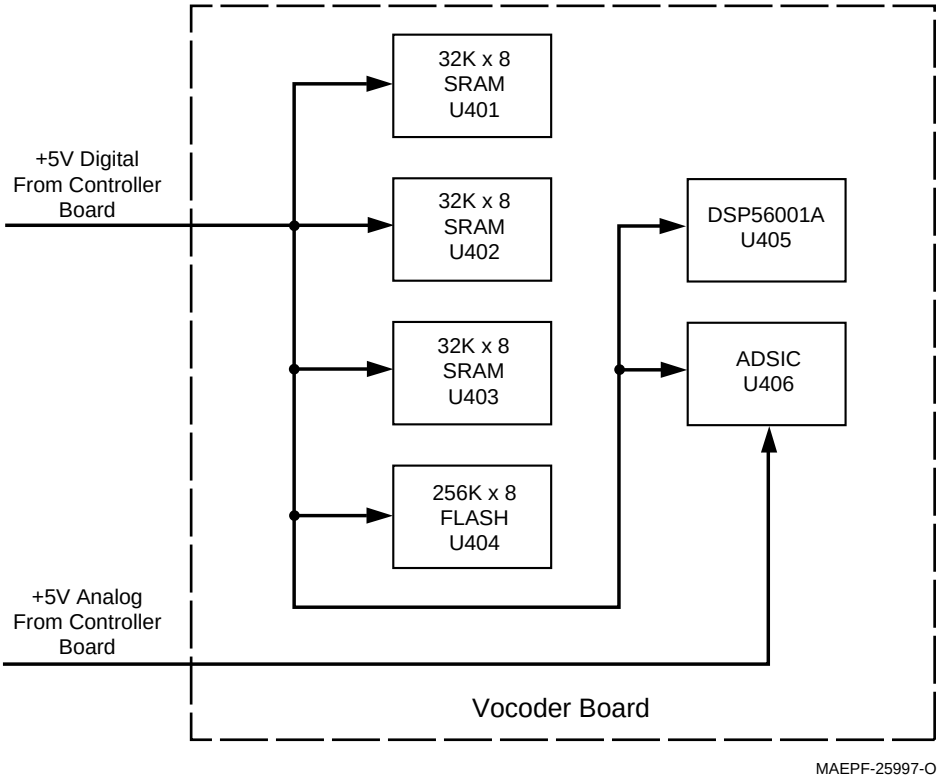


Figure 3-5 +5V Routing for Vocoder Board

VHF/UHF Transceiver Board Detailed Theory of Operation

4

Introduction to This Section

This section of the manual provides a detailed circuit description of the ASTRO Digital XTS 3000 VHF and UHF transceiver boards. When reading the theory of operation, refer to the appropriate schematic and component location diagrams located in the back section of this manual. This detailed theory of operation will help isolate the problem to a particular component.

Frequency Generation Unit (FGU)

The frequency generation unit (FGU) consists of three major sections: the high stability reference oscillator (U203), the fractional-N synthesizer (U204,) and the VCO buffer (U201). A 5V regulator (U202), supplies power to the FGU. The synthesizer receives the 5V REG at U204, and applies it to a filtering circuit within the module and capacitor C253. The well-filtered 5-volt output at U204, pin 19 is distributed to the TX and RX VCOs and the VCO buffer IC. The mixer's LO injection signal and transmit frequency are generated by the RX VCO and TX VCO respectively. The RX VCO uses an external active device (Q202), whereas the VHF TX VCO's active device is a transistor inside the VCO buffer. The UHF TX VCO uses two active devices, one external (Q203) and the other internal to the VCO buffer. The base and emitter connections of this internal transistor are pins 11 and 12 of U201.

The RX VCO is a Colpitts-type oscillator, with capacitors C235 and C236 providing feedback. The RX VCO transistor (Q202) is turned on when pin 38 of U204 switches from high to low. The RX VCO signal is received by the VCO buffer at U201, pin 9, where it is amplified by a buffer inside the IC. The amplified signal at pin 2 is routed through a low-pass filter (L201 and associated capacitors) and injected as the first LO signal into the mixer (U2, pin 8). In the VCO buffer, the RX VCO signal (or the TX VCO signal during transmit) is also routed to an internal prescaler buffer. The buffered output at U201, pin 16 is applied to a low-pass filter (L205 and associated capacitors). After filtering, the signal is routed to a prescaler divider in the synthesizer at U204, pin 21.

The divide ratios for the prescaler circuits are determined from information stored in a codeplug, which is part of the microcontrol unit (U701 on the controller board). The microprocessor extracts data for the division ratio as determined by the position of the channel-select switch (U1), and busses the signal to a comparator in the synthesizer. A 16.8MHz reference oscillator, U203, applies the 16.8MHz signal to the synthesizer at U204 pin 14. The oscillator signal is divided into one of three pre-determined frequencies. A time-based algorithm is used to generate the fractional-N ratio.

If the two frequencies in the synthesizer's comparator differ, a control (error) voltage is produced. The phase detector error voltage (V control) at pins 31 and 33 of U204 is applied to the loop filter consisting of resistors R211, R212, and R213, and capacitors C244, C246, C247, and C248. The filtered voltage alters the VCO frequency until the correct frequency is synthesized. The phase detector gain is set by components connected to U204, pins 28 and 29.

In the TX mode, U204, pin 38 goes high and U201, pin 14 goes low, which turns off transistor Q202 and turns on the internal TX VCO transistor in U204 and the external TX VCO buffer Q203 on the UHF circuit. The TX VCO feedback capacitors are C219 and C220. Varactor diode CR203/CR207 sets the TX frequency while varactor CR202 is the TX modulation varactor. The modulation of the carrier is achieved by using a two-port modulation technique. The modulation of low-frequency tones such as DPL/TPL is achieved by injecting the tones into the A/D section of the fractional-N synthesizer. The digitized signal is modulated by the fractional-N divider, generating the required deviation. Modulation of the high-frequency audio signals is achieved by modulating the varactor (CR203) through a frequency compensation network. Resistors R207 and R208 form a potential divider for the higher-frequency audio signals.

In order to cover the very wide bandwidths, positive and negative V-control voltages are used. High control voltages are achieved using positive and negative multipliers. The positive voltage multiplier circuit consists of components CR204, C256, C257, and reservoir capacitor C258.The negative multiplier circuit consists of components CR205, CR206, C266, C267, and reservoir capacitor C254 in VHF and UHF radios. Out-of-phase clocks for the positive multiplier appear at U204, pins 9 and 10. Out-of-phase clocks for the negative multiplier appear at U204, pins 7 and 8, and only when the negative V-control is required (that is, when the VCO frequency exceeds the crossover frequency). When the negative V-control is not required, transistor Q201 is turned on, and capacitor C259 discharges. The 13V supply generated by the positive multiplier is used to power-up the phase detector circuitry. The negative V-control is applied to the anodes of the VCO varactors.

The TX VCO signal is amplified by an internal buffer in U201, routed through a low pass filter and routed to the TX PA module, U105, pin 1. The TX and RX VCOs and buffers are activated via a control signal from U204, pin 38.

The reference oscillator supplies a 16.8MHz clock to the synthesizer where it is divided down to a 2.1MHz clock. This divided-down clock is fed to the ABACUS IC (U401), where it is further processed for internal use.

Antenna Switch

Two antenna switches are part of the radio circuitry. One of the switches is a mechanical connector that attaches to the external antenna bushing. It switches between the radio antenna and a remote antenna. Switching is accomplished by a plunger located on the accessory connector. With a remote antenna installed, continuity between the radio antenna and the RF input line is broken; continuity is made from the remote antenna to the radio RF line.

The second switch is a current device. It is a pair of diodes (CR108/ CR109) that electronically steer RF between the receiver and the transmitter. In the transmit mode, RF is routed through transmit switching diode CR108, and sent to the antenna. In the receive mode, RF is received from the antenna, routed through receive switching diode CR109, and applied to the RF amplifier, U1 (UHF), Q1 (VHF). In transmit, bias current, sourced from U101, pin 21, is routed through L105, U104, CR108, and L122 in VHF, and L105, CR108, and L122 in UHF. Sinking of the bias current is through the transmit ALC module, U101, pin 19. In the receive mode, bias current, sourced from switched B+, is routed through Q107 (pin 3 to pin 2), L123 (UHF), L121, CR109, and L122. Sinking of the bias current is through the 5-volt regulator, U106, pin 8.

Receiver Front End

The RF signal is received by the antenna and coupled through the external RF switch. The UHF board applies the RF signal to a low-pass filter comprising L126, L127, L128, C149, C150, and C151. The VHF board bypasses the lowpass filter. The filtered RF signal is passed through the antenna switch (CR109) and applied to a bandpass filter comprising: VHF— L11 through L14, CR1 through CR9, C4, C2, and C3, or UHF—L30, L31, L32, L34, L35, CR6 through CR9, C1, C2, and C3. The bandpass filter is tuned by applying a control voltage to the varactor diodes in the filter (CR1 through CR9 in VHF and CR6 through CR9 in UHF).

The bandpass filter is electronically tuned by the D/A IC (U102), which is controlled by the microcomputer.The D/A output range is extended through the use of a current mirror: transistor Q108 and associated resistors R115 and R116. When Q108 is turned on via R115, the D/A output is reduced due to the voltage drop across R116. Depending on the carrier frequency, the microcomputer will turn Q108 on or off. Wideband operation of the filter is achieved by retuning the bandpass filter across the band.

The output of the bandpass filter is applied to a wideband GaAs RF amplifier IC, U1 (RF AMP), on the UHF transceiver board. The VHF board uses an active device for RF amplification (Q1). After being amplified by the RF AMP, the RF signal is further filtered by a second broadband, fixed-tuned, bandpass filter consisting of C6, C7, C8, C80, C86, C87, C88, C97, C99, L3, L4, L5, and L30 (VHF); or C4 through C7, C88 through C94, C99, and L11 through L15 (UHF) to improve the spurious rejection.

The filtered RF signal is routed through a broadband 50-ohm transformer (T1) to the input of a broadband mixer/buffer (U2). Mixer U2 uses GaAs FETs in a double-balanced, Gilbert Cell configuration.

The RF signal is applied to the mixer at U2 pins 1 and 15. An injection signal (1st LO) of about -10dBm, supplied by the FGU, is applied to U2, pin 8. Mixing of the RF and the 1st LO results in an output signal that is the first IF frequency. The first IF frequencies of the VHF and UHF bands are 45.15MHz and 73.35MHz respectively. The 1st LO signal for VHF is 45.15MHz higher than the carrier frequency, while that for the UHF is 73.35MHz lower than the carrier frequency. The 1st IF signal output at U2, pins 4 and 6 is routed through transformer T2 and impedance matching components, and applied to a two-pole crystal filter (FL1), which is the final stage of the receiver front end. The two-pole crystal filter removes unwanted mixer products. Impedance matching between the output of the transformer (T2) and the input of the filter (FL1) is accomplished by C605 and L605 (VHF); or C611, C614, and L605 (UHF).

Receiver Back End

The output of crystal filter FL1 is matched to the input of IF buffer amplifier transistor Q601 by components C610 and L604 (VHF), and C609, C610, and L600 (UHF). Transistor Q601 is biased by the 5V regulator (U202). The IF frequency on the collector of Q601 is applied to a second crystal filter through a matching circuit. The second crystal filter (FL2) input is matched by C604, C603, and L601 (VHF); or C604, L601, and L602 (UHF). The filter supplies further attenuation at the IF sidebands to increase the radios selectivity. The output of FL2 routed to pin 32 of U401 through a matching circuit which consists of L603, L606, and C608 (VHF); or L603, C606, and C605 (UHF).

In the ABACUS IC (U401), the first IF frequency is amplified and then down-converted to 450kHz, the second IF frequency. At this point, the analog signal is converted into two digital bit streams by a sigma-delta A/D converter. The bit streams are then digitally filtered, mixed down to baseband, and filtered again. The differential output data stream is then sent to the ADSIC (U406) on the vocoder board, where it is decoded to produce the recovered audio.

The ABACUS IC (U401) is electronically programmable, and the amount of filtering, which is dependent on the radio channel spacing and signal type, is controlled by the microcomputer. Additional filtering, which used to be provided externally by a conventional ceramic filter, is replaced by internal digital filters in the ABACUS IC. The ABACUS IC contains a feedback AGC circuit to expand the dynamic range of the sigma-delta converter. The differential output data contains the quadrature (I and Q) information in 16-bit words, the AGC information in a 9-bit word, imbedded word sync information, and fill bits dependent on sampling speed. A fractional-N synthesizer is also incorporated on the ABACUS IC for 2nd LO generation.

The 2nd LO/VCO is a Colpitts oscillator built around transistor Q401 (VHF) or Q1 (UHF). The VCO has a varactor diode, VR401 (VHF) or CR5 (UHF), to adjust the VCO frequency. The control signal for the varactor is derived from a loop filter consisting of C426, C428, and R413.

Transmitter

The transmitter consists of three major sections:

- Harmonic Filter
- RF Power Amplifier Module
- ALC Circuits

Harmonic Filter

RF from the power amplifier (PA) module (U105) is routed through the coupler (U104), passed through the transmit antenna switch (CR108), and applied to a harmonic filtering network in UHF. In the case of a VHF transceiver board, RF from the PA module (U105) is routed through the coupler (U104), then through the harmonic filtering network, and on to the antenna switch (CR108). The harmonic filtering circuit is composed of the following components: L126, L127, L128, C149, C150, and C151 (for VHF models); or L126, L127, L128, C149, C150, and C151 (for UHF models). Resistor R128 (UHF) or R117 (VHF) provides a current-limited 5V to J2 for mobile ASTRO XTS 3000 vehicular adapter (VA) applications.

RF Power Amplifier Module

The RF power amplifier module (U105) is a wide-band, multi-stage amplifier (three stages for the VHF models and four stages for the UHF models). Nominal input and output impedance of U105 is 50 ohms. The dc bias for U105 is on pins 2, 4, 5. In the transmit mode, the voltage on U105, pins 2 and 4 (close to the B+ level) is obtained via switching transistor Q101. Transistor Q101 receives its control base signal as follows:

- the microcomputer keys the D/A IC to produce a ready signal at U102 pin 3,
- the ready signal at U102 pin 3 is applied to the TX ALC IC at U101 pin 14 (5V), and
- the synthesizer sends a LOC signal to the TX ALC IC (U204 pin 40 to U101 pin 16).

When the LOC signal and the ready signal are both received, the TX ALC IC (pin 13) sends a control signal to turn on transistor Q101.

ALC Circuits

Coupler module U104 samples the forward and reverse power of the PA output voltage. Reverse power is present when there is other than 50 ohms impedance at the antenna port. Sampling is achieved by coupling some of the forward and/or reverse power, and applying it to CR102 (VHF) or CR101 (UHF) and CR103 for rectification and summing. The resultant dc signal is then applied to the TX ALC IC (U101, pin 2) as RFDET to be used as an RF strength indicator.

The transmit ALC circuit, built around U101, is the heart of the power control loop. Circuits in the TX ALC module compare the signals at U101, pins 2 and 7. The resultant signal, C BIAS, at U101, pin 4 is applied to the base of transistor Q110. In response to the base drive, transistor Q110 varies the dc control voltages applied to the RF PA at U105, pin 3, thus controlling the RF power of module (U105).

Thermistor RT101 senses the temperature of the TX ALC IC. If an abnormal operating condition exists that causes the PA slab temperature to rise to an unacceptable level, the thermistor forces the ALC to reduce the set power.

Notes

800MHz Transceiver Board Detailed Theory of Operation

5

Introduction to This Section

This section of the manual provides a detailed circuit description of an ASTRO Digital XTS 3000 800MHz Transceiver Board. When reading the theory of operation, refer to your appropriate schematic and component location diagrams located in the back section of this manual. This detailed theory of operation will help isolate the problem to a particular component.

Frequency Synthesis

The complete synthesizer subsystem consists of the reference oscillator (U304), the voltage-controlled oscillator (VCO)(U307), a buffer IC (U303), and the synthesizer (U302).

The reference oscillator contains a temperature-compensated 16.8MHz crystal. This oscillator is digitally tuned and contains a temperature-referenced, five-bit, analog-to-digital (A/D) converter. The output of the oscillator (pin 10 on U304) is applied to pin 14 (XTAL1) on U302 through capacitor C309 and resistor R306.

Module U307, the voltage-controlled oscillator, is varactor tuned. That is, as the voltage (2-11V) being applied to pins 1 and 7 of the VCO varies, so does the varactor's capacitance, thereby changing the VCO's output frequency. The 800MHz VCO is a dual-range oscillator that covers the 806-825MHz and the 851-870MHz frequency bands. The low-band VCO (777-825MHz) provides the first LO injection frequencies (777-797MHz) that will be 73.35MHz below the carrier frequency. In addition, when the radio is operated through a repeater, the low-band VCO will generate the transmit frequencies (806-825MHz) that will be 45MHz below the receiver frequencies. The low-band VCO is selected by pulling pin 3 high and pin 8 low on U307. When radio-to-radio or talk-around operation is necessary, the high band VCO (851-870MHz) is selected. This is accomplished by pulling pin 3 low and pin 8 high on U307.

The buffer IC (U303) includes a TX, RX, and prescaler buffer whose main purpose is to individually maintain a constant output and provide isolation.The TX buffer is chosen by setting pin 7 of U303 high; the RX buffer is chosen by setting pin 7 of U303 low. The prescaler buffer will always be on. In order to select the proper combination of VCO and buffer, the following conditions must be true at pin 6 of U303 (or pin 38 of U302) and pin 7 of U303 (or pin 39 of U302):

- for the first LO injection frequencies 777-797MHz, pins 6 and 7 must both be low;
- for the TX repeater frequencies 806-825MHz, pins 6 and 7 must both be high;

- for talkaround TX frequencies 851-870MHz, pin 6 must be low while pin 7 must be high.

The synthesizer IC (U302) consists of a prescaler, a programmable loop divider, a divider control logic, a phase detector, a charge pump, an A/D converter for low-frequency digital modulation, a balance attenuator to balance the high-frequency analog modulation to the low-frequency digital modulation, a 13V positive-voltage multiplier, a serial interface for control, and finally, a filter for the regulated 5 volts. This filtered five volts is present at pin 19 of U302, pin 9 of U307, and pins 2, 3, 4, and 15 of U303. It is also applied directly to resistors R309, R315, and R311. Additionally, the 13V, being generated by the positive voltage multiplier circuitry, should be present at pin 35 of U302. The serial interface (SRL) is connected to the microprocessor via the data line (pin 2 of U302), clock line (pin 3 of U302), and chip-enable line (pin 4 of U302).

The complete synthesizer subsystem works as follows:

- The output of the VCO, pin 4 on U307, is fed into the RF input port (pin 9) of U303. In the TX mode, the RF signal will be present at pin 4 of U303; in the RX mode, the RF signal will be present at pin 3 of U303.
- The output of the prescaler buffer, pin 15 of U303, is applied to the PREIN port (pin 21) of U302. The prescaler in U302 is a dual-modulus type with selectable divider ratios. This divider ratio is controlled by the loop divider, which in turn receives its inputs from the SRL. The loop divider adds or subtracts phase to the prescaler divider by changing the divide ratio via the modulus control line.
- The output of the prescaler is then applied to the loop divider.
- The output of the loop divider is then applied to the phase detector. The phase detector will then compare the loop divider's output signal with the signal from U304 (that is divided down after it is applied to pin 14 of U302). The result of the signal comparison is a pulsed dc signal which is applied to the charge pump.
- The charge pump outputs a current that will be present at pin 32 of U302. The loop filter (which consists of capacitors C322, C317, C318, C329, C324, and C315, and resistors R307, R305, and R314) will transform this current into a voltage that will be applied to pins 1 and 7 of U307, and alter the VCO's output frequency.

In order to modulate the PLL, the two-port modulation method is utilized. The analog modulating signal is applied to the A/D converter as well as the balance attenuator, via U302, pin 5. The A/D converter converts the low-frequency analog modulating signal into a digital code that is applied to the loop divider, thereby causing the carrier to deviate. The balance attenuator is used to adjust the VCO's deviation sensitivity to high-frequency modulating signals.

Antenna Switch

Switching between the standard and external antenna ports is accomplished with the external mechanical switch that is actuated by a plunger, located on the accessory connector.

An electronic PIN diode switch steers RF between the receiver and transmitter. The common node of the switch is at capacitor C101. In the transmit mode, RF is routed to the anode of diode CR104. In receive mode, RF is routed to pin 1 of U201. In transmit, bias current, sourced from U504, pin 21 is routed through PIN diodes CR104 and CR102, biasing them to a low-impedance state. Bias current returns to ground through U504, pin 20. In receive, U504, pin 21 is pulled down to ground and pin 20 is pulled up to B+, reverse-biasing diodes CR104 and CR102 to a high impedance.

Receiver Front End

For the purposes of this discussion, the receiver front end is defined as being the circuitry from the antenna switch to the output of the IF crystal filter. The 800MHz front end converts the received RF signal to the 1st IF frequency of 73.35MHz, while at the same time providing for spurious immunity and adjacent channel selectivity. A review of the interstage components of the front end will now be presented, with emphasis on troubleshooting considerations.

The received RF signal is passed through antenna switch input matching components C101, L105, and C114, tank components C106 and L103 (which are anti-resonant at the radios transmitter frequencies), and output matching components C103 and L104. Both pin diodes CR102 and CR104 must be back-biased to properly route the received signal.

The stage following the antenna switch is a 50-ohm, inter-digitated, three-pole, stripline preselector (U201). The preselector is positioned after the antenna switch to provide the receiver preamp with some protection to strong signal, out-of-band signals.

After the preselector (U201), the received signal is processed through the receiver preamp, U202. The preamp is a dual-gate, GaAs MESFET transistor which has been internally biased for optimum IM, NF, and gain performance. Components L201 and L202 match the input (gate 1) of the amp to the first preselector, while at the same time connecting gate 1 to ground potential. The output (drain) of the amp is pin 7, and is matched to the subsequent receiver stage through components L204 and C222. A supply voltage of 5Vdc is provided to pin 3 through RF choke L203 and bypass capacitor C204. The 5-volt supply is also present at pin 4, which connects to a voltage divider network that biases gate 2 (pin 5) to a predefined quiescent voltage of 1.2Vdc. Resistor R202 and capacitor C203 are connected to pin 5 to provide amp stability. The FET source (pin 3) is internally biased at 0.55 to 0.7Vdc for proper operation with bypass capacitors C201 and C202, connected to the same node.

The output of the amp is matched to a second three-pole preselector (U203) of the type previously discussed. The subsequent stage in the receiver chain is the 1st mixer, U205, which uses low-side injection to convert the RF carrier to an intermediate frequency (IF) of 73.35MHz.

Since low-side injection is used, the LO frequency is offset below the RF carrier by 73.35MHz, or Flo = Frf - 73.35MHz. The mixer utilizes GaAs FETs in a double-balanced, Gilbert Cell configuration. The LO port (pin 8) incorporates an internal buffer and a phase shift network to eliminate the need for a LO transformer. The LO buffer bypass capacitors (C208, C221, and C216) are connected to pin 10 of U205, and should exhibit a nominal dc voltage of 1.2 to 1.4Vdc. Pin 11 of U205 is LO buffer Vdd (5Vdc), with associated bypass capacitors C226 and C209 connected to the same node. An internal voltage divider network within the LO buffer is bypassed to virtual ground at pin 12 of U205 through bypass capacitor C213. The mixer's LO port is matched to the radio's PLL by a capacitive tap, C207 and C206.

A balun transformer (T202) is used to couple the RF signal into the mixer. The primary winding of T202 is matched to the preceding stage by capacitor C223, with C227 providing a dc block to ground. The secondary winding of T202 provides a differential output, with a 180° phase differential being achieved by setting the secondary center tap to virtual ground using bypass capacitors C210, C211 and C212. The secondary of transformer T202 is connected to pins 1 and 15 of the mixer IC, which drives the source leg of dual FETs used to toggle the paralleled differential amplifier configuration within the Gilbert Cell.

The final stage in the receiver front end is a two-pole crystal filter (FL1). The crystal filter provides some of the receiver's adjacent channel selectivity. The input to the crystal filter is matched to the 1st mixer using components L605, C600, and C614. The output of the crystal filter is matched to the input of IF buffer amplifier transistor Q601 by components L600, C609, and C610.

Receiver Back End

The IF frequency on the collector of Q601 is applied to a second crystal filter (FL2) through a matching circuit consisting of L601, L602, C604, and C612. The filter supplies further attenuation at the IF sidebands to increase the radio's selectivity. The output of FL2 is routed to pin 32 of U401 through a matching circuit consisting of L603, C603, and C606, and dc block capacitor C613.

In the ABACUS IC (U401), the first IF frequency is amplified and then down-converted to 450kHz, the second IF frequency. At this point, the analog signal is converted into two digital bit streams by a sigma-delta A/D converter. The bit streams are then digitally filtered, mixed down to baseband, and filtered again. The differential output data stream is then sent to the ADSIC (U406) on the vocoder board, where it is decoded to produce the recovered audio.

The ABACUS IC (U401) is electronically programmable, and the amount of filtering, which is dependent on the radio channel spacing and signal type, is controlled by the microcomputer. Additional filtering, which used to be provided externally by a conventional ceramic filter, is replaced by internal digital filters in the ABACUS IC. The ABACUS IC contains a feedback AGC circuit to expand the dynamic range of the sigma-delta converter. The differential output data contains the quadrature (I and Q) information in 16-bit words, the AGC information in a 9-bit word, imbedded word sync information, and fill bits, dependent on sampling speed. A fractional-N synthesizer is also incorporated on the ABACUS IC for 2nd LO generation.

The second LO/VCO is a Colpitts oscillator built around transistor Q1. The VCO has a varactor diode (VR401), which is used to adjust the VCO frequency. The control signal for the varactor is derived from a loop filter consisting of C426, C428, and R413.

Transmitter

The 800MHz RF power amplifier (PA) is a five-stage amplifier (U502). The RF power amplifier has a nominal input and output impedance of 50 ohms.

An RF input drive level of approximately +3dBm, supplied from the VCO buffer IC (U303), is applied to pin 1 of U502. The dc bias for the internal stages of U502 is applied to pins 3 and 4 of the module; pin 3 is switched through Q502 and pin 4 is unswitched B+ to the final amplifier stage. Power control is achieved through the varying of the dc bias to pin 2, the third and fourth amplifier stages of the module. The amplified RF signal leaves the PA module at pin 5 and is applied to the directional coupler (U501).

The purpose of U501 is to sample both the forward power and the reverse power. The reverse power will be present when there is other than a 50-ohm load at the antenna port. The sampling will be achieved by coupling some of the reflected power, forward and/or reverse, to a coupled leg on the coupler. The sampled RF signals are applied to diode CR501 for rectification and summing. The resultant dc signal is applied to the ALC IC (U504, pin 2) as RFDET, to be used as an indicator of the strength of the RF signal being passed through the directional coupler (U501).

The transmit ALC IC (U504) is the heart of the power control loop. The REF V line (U504 pin 7), a dc signal supplied from the D/A IC (U503), and the RF DET signal described earlier, are compared internally in the ALC IC to determine the amount of C BIAS, pin 4, to be applied to the base of transistor Q501. Transistor Q501 responds to the base drive level by varying the dc control voltages applied to pin 2 of the RF PA, controlling the RF power level of module, U502. The ALC IC also controls the base switching to transistor Q502 via pin 12, BIAS.

The D/A IC (U503) controls the dc switching of the transceiver board. Its outputs, SC1 and SC3, pins 12 and 14 respectively, control transistor Q503, which then supplies TX 5V and RX 5V to the transceiver board. The D/A also supplies the dc bias to the detector diode (CR501) via pin 7, and the REF V signal to the ALC IC (U504).

Notes

Vocoder and Controller Boards Detailed Theory of Operation

6

Introduction to This Section

This section of the manual provides a detailed circuit description of the ASTRO Digital XTS 3000 vocoder and controller boards. When reading the theory of operation, refer to your appropriate schematic and component location diagrams located in the back section of this manual. This detailed theory of operation will help isolate the problem to a particular component.

General

The controller board is the central interface among the various subsystems of the radio. It is very similar to the digital logic portion of the controllers on many existing Motorola radios. Its main task is to interpret user input, provide user feedback, and schedule events in the radio operation, and includes programming ICs, steering the activities of the DSP, and driving the display.

The vocoder board performs the functions which were previously performed by analog circuitry. This includes all tone signaling, trunking signalling, conventional analog voice, etc. All analog signal processing is done digitally utilizing a DSP56001. In addition, the vocoder board provides a digital voice-plus-data capability, utilizing VSELP or IMBE voice compression algorithms. Vocoder is a general term used to refer to these DSP based systems and is short for voice encoder.

The vocoder and controller boards are connected through a 50-pin compression connector; they provide interconnection among the microcontrol unit (MCU), the DSP, and (on secure-equipped radios) the encryption board.

Vocoder Board

Refer to Figure 6-6 and the appropriate schematic diagram.

The vocoder board consists of a digital signal processor (DSP — U405), 32k x24 static-RAM (SRAMs — U401, U402, and U403), a 256kB FLASH ROM (U404), and an ABACUS/DSP support IC (ADSIC — U406).

The FLASH ROM (U404) contains the program code executed by the DSP. As with the FLASH ROM used on the controller board, the FLASH ROM is reprogrammable, so new features and algorithms can be updated in the field as they become available. Depending on the mode and operation of the DSP, corresponding program code is moved from the FLASH ROM into the faster SRAM, where it is executed at full bus rate.

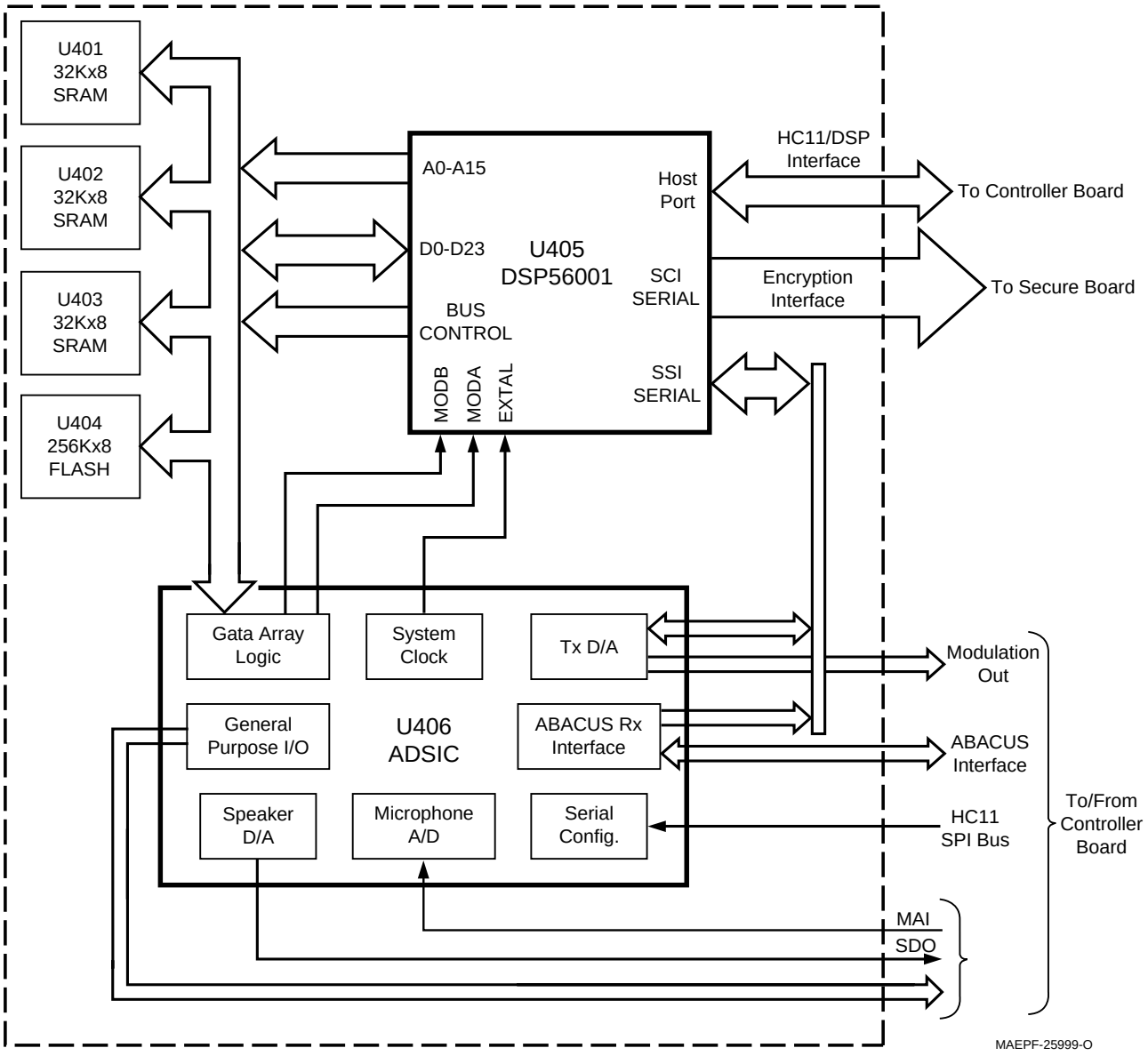


Figure 6-6 Vocoder Board

The ADSIC (U406) is basically a support IC for the DSP. It provides, among other things, the interface from the digital world of the DSP to the analog world. The ADSIC also provides interrupt control for the DSP processing algorithms and some memory management. The configuration programming of the ADSIC is performed by the MCU. However, some components of the ADSIC are controlled through a parallel memory mapped register bank by the DSP.

In the receive mode, The ADSIC (U406) acts as an interface with the ABACUS IC, which can provide IF data samples directly to the DSP for processing. Or, the IF data can be filtered and discriminated by the ADSIC and data provided to the DSP as raw discriminator sample data. The latter mode, with the ADSIC performing the IF filtering and discrimination, is the typical mode of operation.

The DSP sends the processed signal back to the ADSIC for D/A conversion. The result is then sent to the audio PA for the speaker output.

In the transmit mode, the ADSIC (U406) provides a serial digital-to-analog (D/A) converter. The data generated by the DSP is filtered and reconstructed as an analog signal, and sent to the VCO as a modulation signal. Both the transmit and receive data paths between the DSP and ADSIC are through the DSP SSI port.

The amplified microphone signal is provided to the ADSIC, which incorporates an analog-to-digital (A/D) converter to translate the analog waveform to a series of data. The data is available to the DSP through the ADSIC parallel registers. In the converse way, the DSP writes speaker data samples to a D/A in the ADSIC, which provides an analog speaker audio signal to the audio PA.

Controller Board

Refer to Figure 6-7 and the appropriate schematic diagram

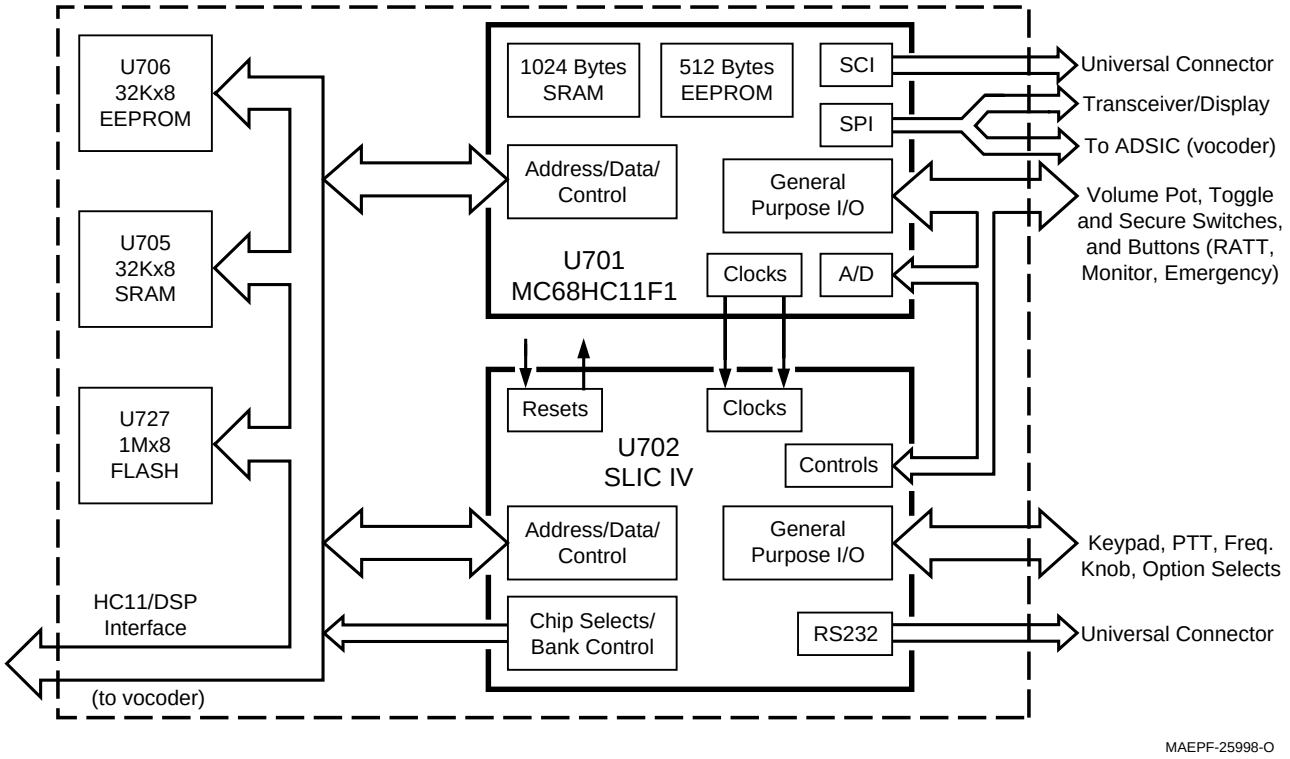


Figure 6-7 Controller Board

The controller board consists almost entirely of digital logic comprising a microcontrol unit (MCU — U701), a custom support logic IC (SLIC — U702), and memory consisting of: SRAM (U705), EEPROM (U706), and FLASH memory (U727). The board also contains the audio PA (U718) and its associated circuitry.

The MCU's (U701) memory system is composed of a 32k x 8 SRAM (U705), a 32k x 8 EEPROM (U706), and 1M x 8 FLASH ROM (U727). The MCU also contains 1024 bytes of internal SRAM and 512 bytes of internal EEPROM. The EEPROM memory is used to store customer

specific information and radio personality features. The FLASH ROM contains the programs which the HC11F1 executes. The FLASH ROM allows the controller firmware to be reprogrammed for future software upgrades or feature enhancements. The SRAM is used for scratchpad memory during program execution.

The SLIC (U702) performs many functions as a companion IC for the MCU. Among these are expanded input/output (I/O), memory decoding and management, and interrupt control. It also contains the universal asynchronous receiver transmitter (UART) used for the RS232 data communications. The SLIC control registers are mapped into the MCU's (U701) memory space.

The controller board's audio power amplifier (PA) (U718) is the only analog IC on the board. This IC is an audio amplifier for the microphone analog input and speaker analog output. The audio PA allows steering between the internal and external microphone and speaker. Steering is accomplished via four control lines provided by the ADSIC and controlled by the DSP through the ADSIC parallel registers. Refer to Figure 6-8.

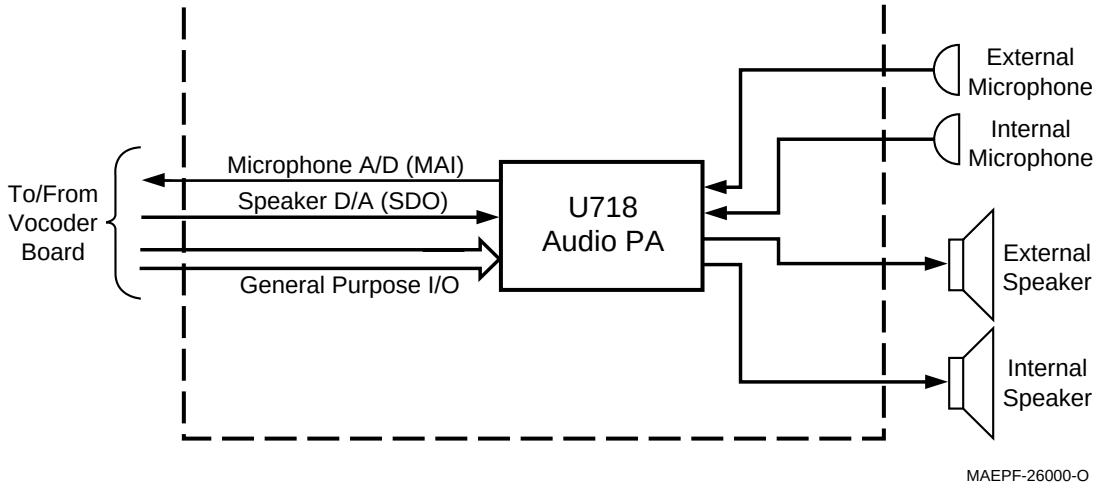


Figure 6-8 Audio Power Amplifier Steering

The controller performs the programming of all peripheral ICs. This is done via a serial peripheral interface (SPI) bus. ICs programmed via this bus include the synthesizer, DAIC, reference oscillator, display, and ADSIC. On secure-equipped models, the encryption board is also controlled through the SPI bus.

In addition to the SPI bus, the controller also maintains two asynchronous serial busses: the SB9600 bus and an RS232 serial bus. The SB9600 bus is for interfacing the controller section with different hardware option boards, some of which may be external to the radio. The RS232 is functions as a common data interface for external devices.

User input is handled by the controller through top rotary controls and side buttons. On models with a display, an additional 3 x 2 (model II) or 3 x 6 keypad (model III) are also read. User feedback is provided

by a single bicolor LED on the top and (on models II and III) a four-line, twelve-character display.

The controller schedules the activities of the DSP through the host port interface. This includes setting the operational modes and parameters of the DSP. The controlling of the DSP is analogous to programming analog signaling ICs on standard analog radios.

Switching Regulator

All of the digital circuitry on the vocoder and controller boards is supplied with 5-volt regulated dc by a switched-mode regulator on the controller board (see Figure 3-4). The fundamental parts of the regulator are U709, L119, C180, D104, C174, C175, and U726. Module U709 is a pulse-width modulating (PWM), switched, regulator controller. Coil L119 is an energy storage element, C180 is an output ripple filter, and D104 is a Schottky diode switch. Capacitors C174 and C175 are added for UNSW_B+ ripple filtering, and are necessary for the stability of the regulator. Module U726 is a supply supervisory IC, which provides a system reset function when the output of the regulator falls out of regulation, typically around 4.7 Vdc.

This switched-mode regulator works by supplying just sufficient energy to the storage element to maintain the output power of the regulator at 5Vdc. It can be related to a flywheel in the sense that just enough energy can be added to a spinning flywheel to keep it spinning at a constant speed. This is in contrast to a typical linear type regulator, which basically shunts unused current to ground through an active resistive divider. The switched-mode regulator is much more energy efficient. It can be noted that input current to the regulator is less than the load current. In fact, as input voltage to the regulator goes up, current supplied to the regulator actually goes down for a constant load.

Module U709 works off of a clock with a nominal operating frequency of 160kHz (kit number NCN6128), or 260kHz (kit number NCN6167). This may vary a little, based on the load and input voltage. Regulation is maintained by varying the duty cycle of a clock output driving L119. This signal is referred to as Lx on U709 (refer to *Waveform W1*). As long as the clock output is high, current flows from the supply into L119, allowing energy to be stored. When the clock output goes low, diode D104 conducts, allowing current to continue to flow from ground through L119. A pulse width on the Lx signal can be obtained, which provides the correct amount of energy to keep the output in regulation. Capacitor C180 is an output filter that reduces ripple on the output from the clock transitions.

Module U709 is supplied directly from the unswitched battery supply. It is turned on and off through the control line connected to SHDN*/ ON/OFF*. This is the same control line from the MCU, which controls the series pass element Q106, that switches SW_B+. A voltage level of approximately 2 Vdc is required to turn the regulator on.

RX Signal Path

The vocoder processes all received signals digitally. This requires a unique back end from a standard analog radio. This unique functionality is provided by the ABACUS IC, with the ADSIC (U406) acting as the interface to the DSP. The ABACUS IC, located on the transceiver board, provides a digital back end for the receiver section. It provides a digital output of I (in phase) and Q (quadrature) data words that represent the IF (Intermediate Frequency) signal at the receiver back end (refer to appropriate transceiver section for more details on ABACUS operation). This data is passed to the DSP via an interface with the ADSIC (U406) for appropriate processing.

The ADSIC interface with the ABACUS comprises the four signals: SBI, DIN, DIN*, and ODC (refer to Figure 6-9).

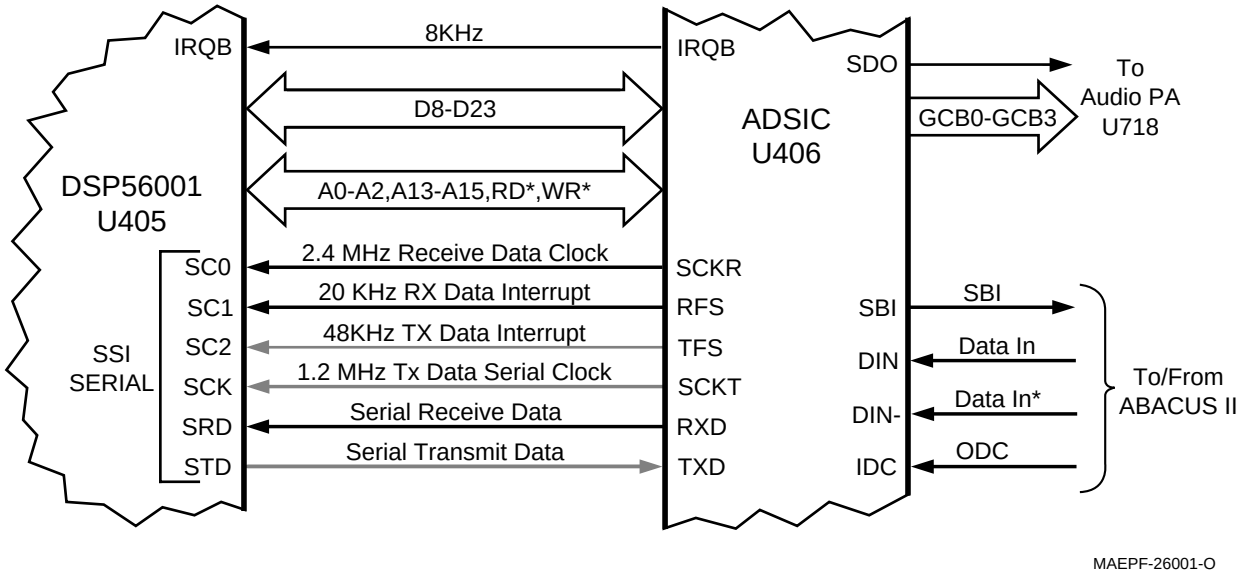


Figure 6-9 DSP RSSI Port - RX Mode

NOTE: An asterisk symbol (*) next to a signal name indicates a negative or NOT logic true signal.

SBI is a programming data line for the ABACUS. This line is used to configure the operation of the ABACUS, and is driven by the ADSIC. The MCU programs many of the ADSIC operational features through the SPI interface. There are 36 configuration registers in the ADSIC, of which four contain configuration data for the ABACUS. When these particular registers are programmed by the MCU, the ADSIC in turn sends this data to the ABACUS through the SBI.

*DIN and DIN** are the data lines in which the I and Q data words are transferred from the ABACUS. These signals make up a differentially encoded current loop. Instead of sending TTL-type voltage signals, the data is transferred by flowing current one way or the other through the loop. This helps reduce internally generated spurious emissions on the transceiver board. The ADSIC contains an internal current loop decoder which translates these signals back to TTL logic and stores the data in internal registers.

ODC is a clock that ABACUS provides to the ADSIC. Most internal ADSIC functions are clocked by this ODC signal at a rate of 2.4 MHz; it is available as soon as power is supplied to the circuitry. This signal initially may be 2.4 or 4.8MHz after power-up. The ODC signal is programmed by the ADSIC, via the SBI signal, to 2.4MHz when the ADSIC is initialized by the MCU through the SPI bus. For any functionality of the ADSIC to exist, including initial programming, this reference clock must be present.

In the fundamental mode of operation, the ADSIC transfers raw IF data to the DSP. The DSP can perform IF filtering and discriminator functions on this data to obtain a baseband demodulated signal. However, the ADSIC includes a digital IF and discriminator function, and can provide this baseband demodulated signal directly to the DSP; this is the typical mode of operation. The internal digital IF filter is programmable up to 24 taps. These taps are programmed by the MCU via the SPI interface.

The DSP accesses this data through its SSI serial port. This is a six-port, synchronous serial bus. It is actually used by the DSP for both transmit and receive data transfer, but only the receive functions will be discussed here. The ADSIC transfers the data on the SRD line to the DSP at a rate of 2.4 MHz. This is clocked synchronously by the ADSIC, which provides a 2.4MHz clock on SC0. In addition, a 20kHz interrupt is provided on SC1, signalling the arrival of a data packet. This means that a new I and Q sample data packet is available to the DSP at a 20kHz rate, which represents the sampling rate of the received data. The DSP then processes this data to extract audio, signalling, etc., based on the 20kHz interrupt.

In addition to the SPI programming bus, the ADSIC also contains a parallel configuration bus consisting of D8-D23, A0-A2, A13-A15, RD*, and WR*. This bus is used to access registers mapped into the DSP memory starting at Y:FFF0. Some of these registers are used for additional ADSIC configuration controlled directly by the DSP; some of the registers are data registers for the speaker D/A. Analog speaker audio is processed via this parallel bus, in which the DSP outputs the speaker's audio digital data words to the speaker's D/A, and an analog waveform, output on SDO (speaker data out), is generated. In conjunction with the speaker D/A, the ADSIC contains a programmable attenuator to set the rough signal attenuation. However, the fine levels and differences among signal types are adjusted through the DSP's software algorithms. The speaker D/A attenuator setting is programmed by the MCU via the SPI bus.

The ADSIC provides an 8kHz interrupt to the DSP on IRQB for processing the speaker data samples. IRQB is also one of the DSP mode configuration pins at start-up. This 8kHz signal must be enabled through the SPI programming bus by the MCU, and is necessary for any audio processing to occur.

For secure messages, the analog signal data may be passed to the secure module prior to processing speaker data for decryption. The DSP transfers the data to and from the secure module through its SCI port, consisting of TXD and RXD. The SCI port is a two-wire, duplex, asynchronous serial port. Configuration and mode control of the secure module is performed by the MCU via the SPI bus.

The ADSIC contains four general purpose I/O lines, labeled GCB0 through GCB3. These are connected to the AUDIO PA, and are used for enabling the speaker and microphone amplifiers in the IC and for steering the speaker and microphone audio paths from internal to external. These I/O lines are controlled by the DSP through the ADSIC parallel configuration bus. The DSP then writes speaker data samples, at an 8kHz rate, to the speaker D/A register via the parallel bus, and configures the AUDIO PA enable lines by writing the same bus to the register controlling the I/O.

The audio PA provides about 20dB of gain and a dual-ended differential output: SPKR_COMMON, and EXT_SPKR or INT_SPKR. Internal or external speaker drive is achieved by changing the phase of the outputs on INT_SPKR and EXT_SPKR to be either in-phase or out-of-phase with SPKR_COMMON. The signal which is out-of-phase with SPKR_COMMON will be driven.

Since all of the audio and signaling is processed in DSP software algorithms, all types of audio and signaling follow this same path.

TX Signal Path

The transmit signal path follows some of the same design structure as the receive signal path described above under “RX Signal Path” (refer to Figure 6-10). It is advisable to read through the “RX Signal Path” section prior to reading this section.

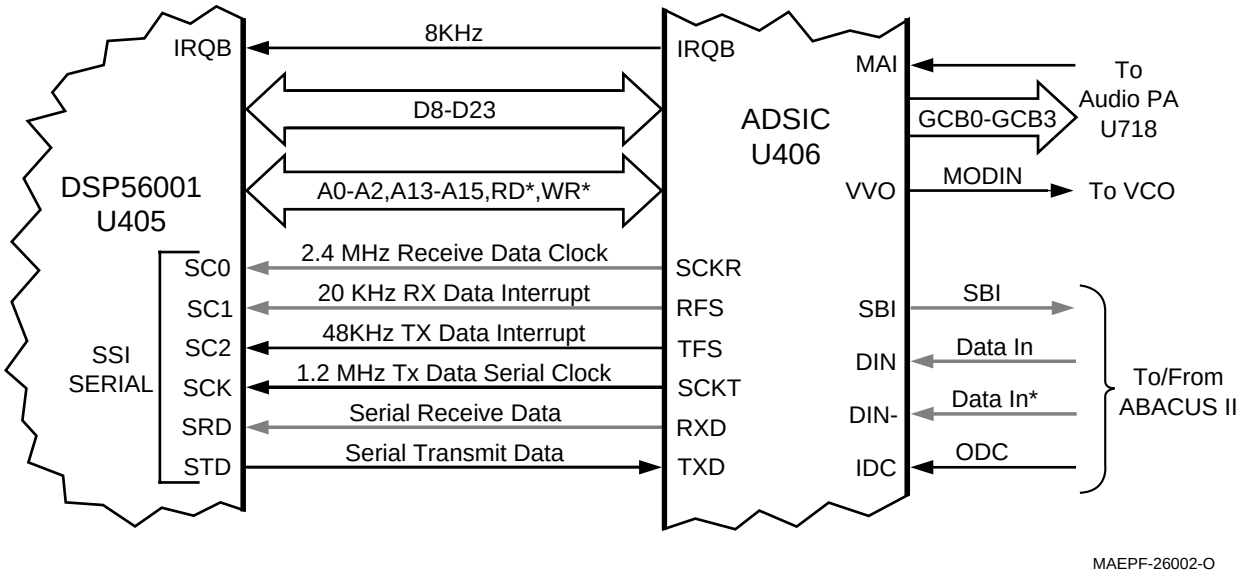


Figure 6-10 DSP RSSI Port - TX Mode

The ADSIC contains a microphone A/D with a programmable attenuator for coarse level adjustment. As with the speaker D/A attenuator, the microphone attenuator value is programmed by the MCU via the SPI bus. The analog microphone signal from the audio PA (U718) is input to the A/D on MAI (Mic Audio In). The microphone A/D converts the analog signal to a series of data words and stores them in internal registers. The DSP accesses this data through the parallel data bus parallel configuration bus consisting of D8-D23, A0-A2, A13-A15, RD*, and WR*. As with the speaker data samples, the DSP reads the microphone samples from registers mapped into its memory

space, starting at Y:FFF0. The ADSIC provides an 8kHz interrupt to the DSP on IRQB for processing these microphone data samples.

As with the received trunking low-speed data, low-speed data is processed by the MCU and returned to the DSP at the DSP SCLK port, connected to the MCU port PA0.

For secure messages, the analog signal may be passed to the secure module for encryption prior to further processing. The DSP transfers the data to and from the secure module through its SCI port, consisting of TXD and RXD. Configuration and mode control of the secure module is performed by the MCU via the SPI bus.

The DSP processes these microphone samples, generates and mixes the appropriate signalling, and filters the resultant data. This data is then transferred to the ADSIC IC on the DSP SSI port. The transmit side of the SSI port consists of SC2, SCK, and STD. The DSP SSI port is a synchronous serial port. SCK is the 1.2MHz clock input derived from the ADSIC, which makes it synchronous. The data is clocked over to the ADSIC on STD at a 1.2MHz rate.

The ADSIC generates a 48kHz interrupt on SC2 so that a new sample data packet is transferred at a 48kHz rate, and sets the transmit data sampling rate at 48ksp. These samples are then input to a transmit D/A converter, which converts the data to an analog waveform. This waveform is actually the modulation out signal from the ADSIC port VVO, and is connected directly to the VCO. The transmit side of the transceiver is virtually identical to a standard analog FM radio.

Also required is the 2.4MHz ODC signal from the ABACUS IC. Although the ABACUS IC provides receiver functions, it is important to note that this 2.4MHz reference is required for all of the ADSIC operations.

Controller Bootstrap and Asynchronous Buses

The SB9600 bus is an asynchronous serial communications bus utilizing a Motorola proprietary protocol. It provides a means for the MCU to communicate with other hardware devices. In the ASTRO Digital XTS 3000 radio, it communicates with hardware accessories connected to the universal connector.

The SB9600 bus utilizes the UART internal to the MCU, operating at 9600 baud. The SB9600 bus consists of LH_DATA (J101-2) and SB9600_BUSY (J101-8) signals. LH_DATA is actually the SCI TXD and RXD ports (U701 — PD0 and PD1) tied together through the MUX U704 (see Figure 6-11). This makes the bus a simplex, single-wire system. SB9600_BUSY (U701 — PA3) is an active low signal that is pulled low when a device wants control of the bus.

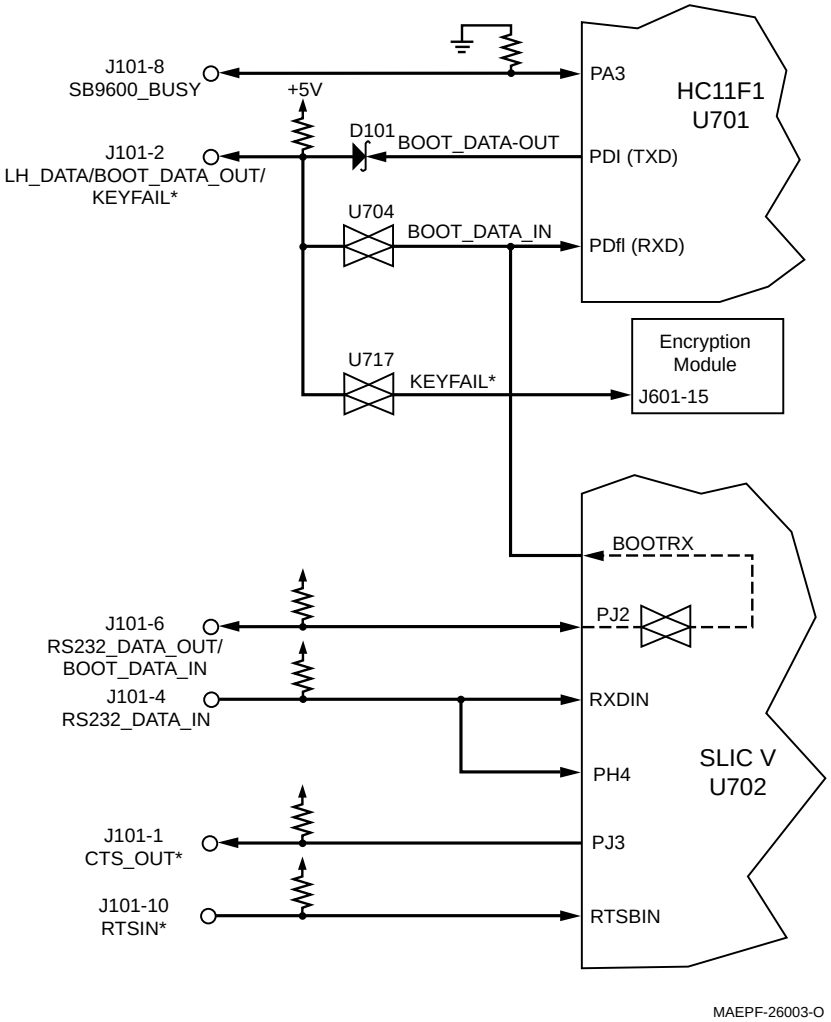


Figure 6-11 Host SB9600 and RS232 Ports

The same UART internal to the MCU is used in the controller bootstrap mode of operation. This mode is used primarily in downloading new program code to the FLASH ROMs on the vocoder and controller boards. In this mode, the MCU accepts special code, downloaded at 7200 baud via the SCI bus, instead of operating from program code resident in its ROMs. However, it must operate in a two-wire, duplex configuration.

A voltage applied to J101-12 (Vpp) of greater than 10 Vdc will trip the circuit consisting of Q104, and VR119. This circuit sets the MODA and MODB pins of the MCU to bootstrap mode (logic 0,0) and configures

the MUX (U704) to separate the RXD and TXD signals of the MCU SCI port. Now, if the Vpp voltage is raised to 12Vdc required on the FLASH devices for programming, the circuit comprising VR121, Q109, and Q110 will trip supplying Vpp to the FLASH devices U727 and U404. One more complication exists in that the BOOT_DATA_IN signal (RXD) is multiplexed with the RS232 data out signal RS232_DATA_OUT. This multiplexing occurs in the SLIC IV (U702), which must also be properly configured.

The ASTRO Digital XTS 3000 radio has an additional asynchronous serial bus which utilizes RS232 bus protocol. This bus utilizes the UART in the SLIC IC (U702). It consists of RS232_DATA_OUT (J101-6), RS232_DATA_IN (J101-4), CTSOUT* (J101-1), and RTSIN* (J101-10). It is a two-wire duplex bus, used to connect to external data devices. This bus is used to keyload radios equipped with encryption modules. When keyloading a radio, the RS232_DIN* and CTSOUT* lines are pulled low by the keyloader, and MUX U717 will be enabled by the MCU. The keyloading data (multiplexed with the LH_DATA/ BOOT_DATA_OUT line) is sent to the encryption module on the KEYFAIL* line. This data will be ignored at the MCU's PDI port.

Vocoder Bootstrap

The DSP has two modes of bootstrap: from program code stored in the FLASH ROM (U404), or retrieving code from the host port.

During normal modes of operation, the DSP executes program code stored in the FLASH ROM, U404. Unlike the MCU, however, the DSP moves the code from the FLASH ROM into the three SRAMs (U401, U402, and U403), where it is executed from. Since, at initial start-up, the DSP must execute this process before it can begin to execute system code, it is considered a bootstrap process. In this process, the DSP fetches 512 words, 1536 bytes, of code from the FLASH ROM, starting at physical address $C000, and moves it into internal P memory. This code contains the system vectors, including the reset vector. It then executes this piece of bootstrap code, which basically in turn moves additional code into the external SRAMs.

A second mode of bootstrap allows the DSP to load this initial 512 words of data from the host port, being supplied by the MCU. This mode is used for FLASH programming the DSP ROM when the ROM may initially be blank. In addition, this mode may be used for downloading some diagnostic software for evaluating that portion of the board.

The bootstrap mode for the DSP is controlled by three signals: MODA/ IRQA*, MODB/IRQB*, and D23 (kit number NTN8250D), or MODC (kit number NTN8250E). All three of these signals are on the DSP (U405). MODA and MODB configure the memory map of the DSP when the DSP reset becomes active. These two signals are controlled by the ADSIC (U406) during power-up, which sets MODA low and MODB high for proper configuration. Later, these lines become interrupts for analog signal processing. D23/MODC controls whether the DSP will look for code from the MCU or will retrieve code from the FLASH ROM. D23 high, or MODC low out of reset, causes the DSP to seek code from the FLASH ROM (U404). For the second mode of bootstrap, the MCU drives BOOTMODE low, causing D23 to go low and MODC to go high.

SPI Bus Interface

This bus is a synchronous serial bus made up of a data line, a clock line, and an individual IC unique select line. It's primary purpose is to configure the operating state of each IC. ICs programmed by this include: display module, ADSIC, fractional-N synthesizer, pendulum reference oscillator, DAIC and, if equipped, the secure module.

The MCU (U701) is configured as the master of the bus. It provides the synchronous clock (SPI_SCK), a select line, and data (MOSI [Master Out Slave In]). In general, the appropriate select line is pulled low to enable the target IC, and the data is clocked in. Actually, the SPI bus is a duplex bus with the return data being clocked in on MISO (master in slave out). The only place this is used is when communicating with the secure module. In this case, the return data is clocked back to the MCU on MISO (master in slave out).

Universal Connector and Option Selects

The universal connector is located on the side of the radio. It is the external port or interface to the outside, and is used for programming and interfacing to external accessories. The signals are shown in Figure 6-12. The universal connector connects to the controller board at J101 through a flex circuit, routed inside the external housing. Connections to the universal connector and J101 on the controller board are shown in Figures 6-12 and 6-13.

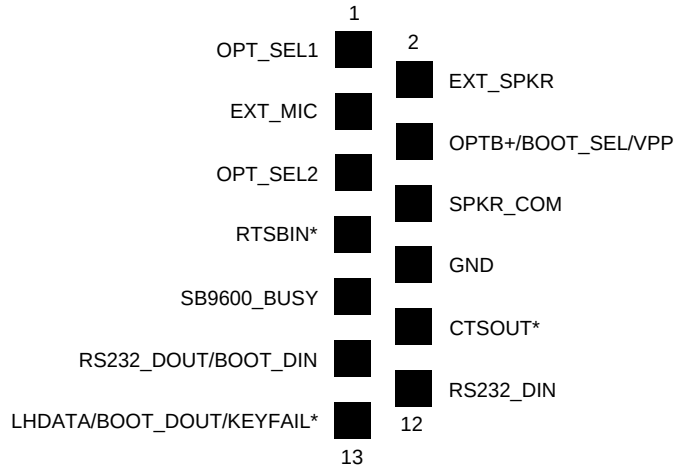


Figure 6-12 Universal (Side) Connector

Signal Name	J101-Pin #
OPT_SEL_1	11
EXT_SPKR	9
EXT_MIC	13
OPT_B+/BOOT_SEL/VPP	12
OPT_SEL_2	7
SPKR_COM	5
RTSIN*	10
GND	3
SB9600_BUSY	8
CTSOUT*	1
RS232_DOUT/BOOT_DIN	6
LH_DATA/BOOT_DOUT/KEYFAIL*	2
RS232_DIN	4

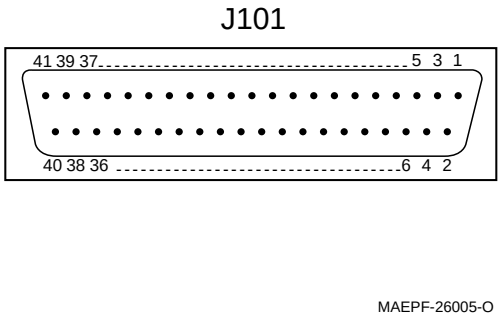


Figure 6-13 Controller Connector —- J101

Most of the signals are extensions of circuits described in other areas of this manual. However, there are two option select pins used to configure special modes: Option Select 1 and Option Select 2. These pins are controlled by accessories connected to the universal connector. Table 6-1 outlines their functions as defined at the universal connector.

Table 6-1 Option Select Functions

	Option Select 1	Option Select 2
External PTT	0	0
No Function (Normal)	1	1
External Speaker	0	1

Keypad and Display Module

An optional integral four-line by 12-character LCD display module is available with either a 3 x 2 keypad (model II radios) or 3 x 6 keypad (model III radios). This unit is not considered field repairable. The display module is connected to the controller through flex connector P301.

The display is controlled by the MCU, which programs the display through the SPI bus and DISP_EN* (select) line. In addition, display backlighting is provided by two white LEDs controlled by the BL_EN signal. Digital +5V, routed to the display, is used to power these LEDs, as well as all other circuitry on the display.

The keypad module is connected to the controller through flex connector P107. The keypad is read though a row and column matrix made up of ROW1, ROW2, ROW3, ROW4, ROW5, ROW6, and COL1, COL2, and COL3. These signals are input to I/O ports on the SLIC (U702) and individually pulled to a high state through resistors. When a key is pressed, the respective signals for a single row and a single column are set to logic zero. The MCU reads these ports through the SLIC parallel registers, provides for key debounce, and determines which key has been pressed.

Controls and Control Top Flex

The housing assembly top controls include an on/off switch/volume control (S1), a 16-position mode-select switch with programmable two-position concentric switch (U1), a programmable three-position (A,B,C) toggle switch (S2), and a programmable top (orange) button (SW3). The side controls include three programmable, momentary, push button switches (side button 1 [SB2], side button 2 [SB3], and top side button [SB1]) and a PTT switch (SW2). These components are connected through a flex circuit to the controller at J101 (see Figure 6-14). The assembly also contains the radio's internal speaker and internal microphone.

UNSW_B+ is routed through switch S1 to provide the B+_SENSE signal which provides radio power control. Refer to "Radio Power" on page 3-1 for further details.

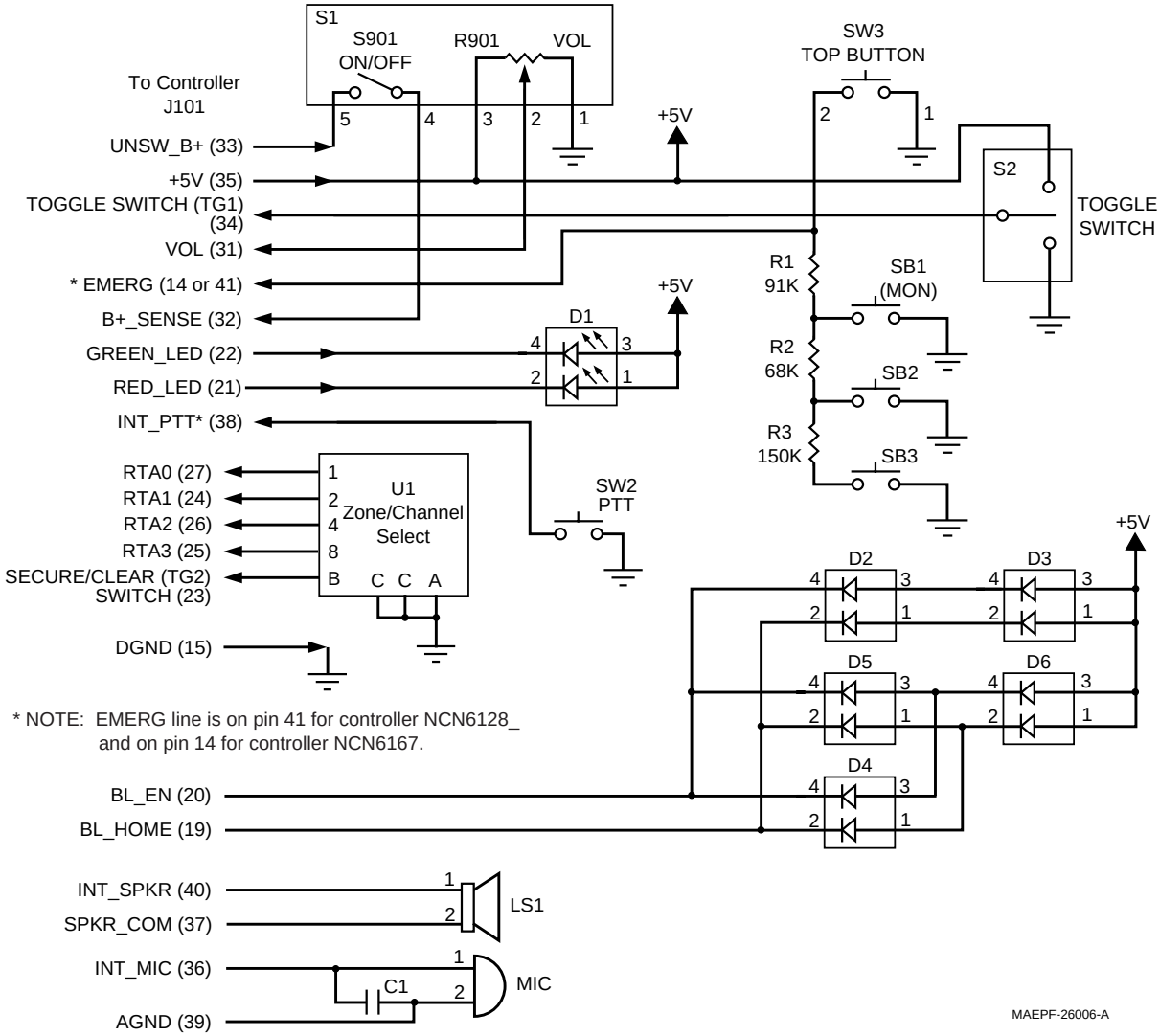


Figure 6-14 Control Top Flex

Volume control is also provided by S1, which contains a potentiometer biased between +5Vdc and ground. The VOL signal is a voltage level between +5Vdc and 0Vdc, dependent on the position of the rotary knob. VOL is an input to an A/D port on the MCU (U701). The MCU sends the appropriate message to the DSP to adjust speaker volume based on this setting.

Switch S2 is the three-position, programmable toggle switch typically used for expanded zone/channel selection. It is an input to an MCU A/D port with levels of 0Vdc, 2.5Vdc, and 5Vdc.

Programmable top (orange) button SW3 is typically used for emergency. This button, along with programmable side buttons SB1 through SB3, is connected to a resistor divider network, biased between +5Vdc and ground. This network, made up of R1, R2, and R3, provides a voltage level, controlled by which button is pressed, to an A/D port on the MCU. The MCU determines which button has been pressed based on the value at the A/D port.

LED D1 is the TX/RX indicator. LEDs D2 through D6 are used for backlighting the frequency knob.

U1 is a binary-coded switch. The output pins from U1 are connected to I/O ports on the controller, which provides a four-bit binary word to the MCU, indicating which of the 16 positions the rotary is set to. This switch provides an additional output, TG2, which is typically used for coded or clear mode selection. It is an input to a control I/O with a pull-up resistor. Selecting clear mode pulls this signal to logic low.

Controller Memory Map

Figure 6-15 depicts the controller section memory map for the parallel data bus as used in normal modes of operation. There are three maps available for normal operation, but map 2 is the only one used. In bootstrap mode, the mapping is slightly different and will be addressed later.

The external bus for the host controller (U701) consists of one 32k x 8 SRAM (U705), one 32k x 8 EEPROM (U706), one 1M x 8 FLASH ROM (U727), and SLIC (U702) configuration registers. In addition, the DSP host port is mapped into this bus through the SLIC address space. The purpose of this bus is to interface the MCU (U701) to these devices.

The MCU executes program code stored in the FLASH ROM. On a power-up reset, it fetches a vector from $FFFE, $FFFF in the ROM and begins to execute code stored at this location. The external SRAM, along with the internal 1k x 8 SRAM, is used for temporary variable storage and stack space. The internal 512 bytes of EEPROM, along with the external EEPROM, are used for non-volatile storage of customer-specific information. More specifically, the internal EEPROM space contains transceiver board tuning information and, on power-down, some radio-state information is stored in the external EEPROM.

The SLIC is controlled through sixteen registers mapped into the MCU memory at $1400-$14FF. This mapping is achieved by the following signals from the MCU: R/W*, CSIO1*, HA0-HA4, HA8, and HA9. Upon power-up, the MCU configures the SLIC including the memory map by writing to these registers.

The SLIC memory management functions, in conjunction with the chip selects provided by the MCU, provide the decoding logic for the memory map that is dependent upon the “map” selected in the SLIC. The MCU provides a chip select, CSGEN*, which decodes the valid range for the external SRAM. In addition, CSI01* and CSPROG* are provided to the SLIC decoding logic for the external EEPROM and FLASH ROM respectively. The SLIC provides a chip select and banking scheme for the EEPROM and FLASH ROM. The FLASH ROM is banked into the map in 16kB blocks, with one 32kB common ROM block. The external EEPROM may be swapped into one of the banked ROM areas. This is all controlled by EE1CS*, ROM1CS*, ROM2CS*, HA14_OUT, HA15_OUT, HA16, and HA17 from the SLIC (U702), and D0-D8 and A0-A16 from the MCU (U701).

The SLIC provides three peripheral chip selects: XTSC1B, XTCS2B, and XTCS3B. These can be configured to drive an external chip select when its range of memory is addressed. XTSC1B is used to address the host port interface to the DSP; XTSC2B is used to address a small portion of external SRAM through gate U708; and XTSCB3 is used as general purpose I/O for interrupting the secure module.

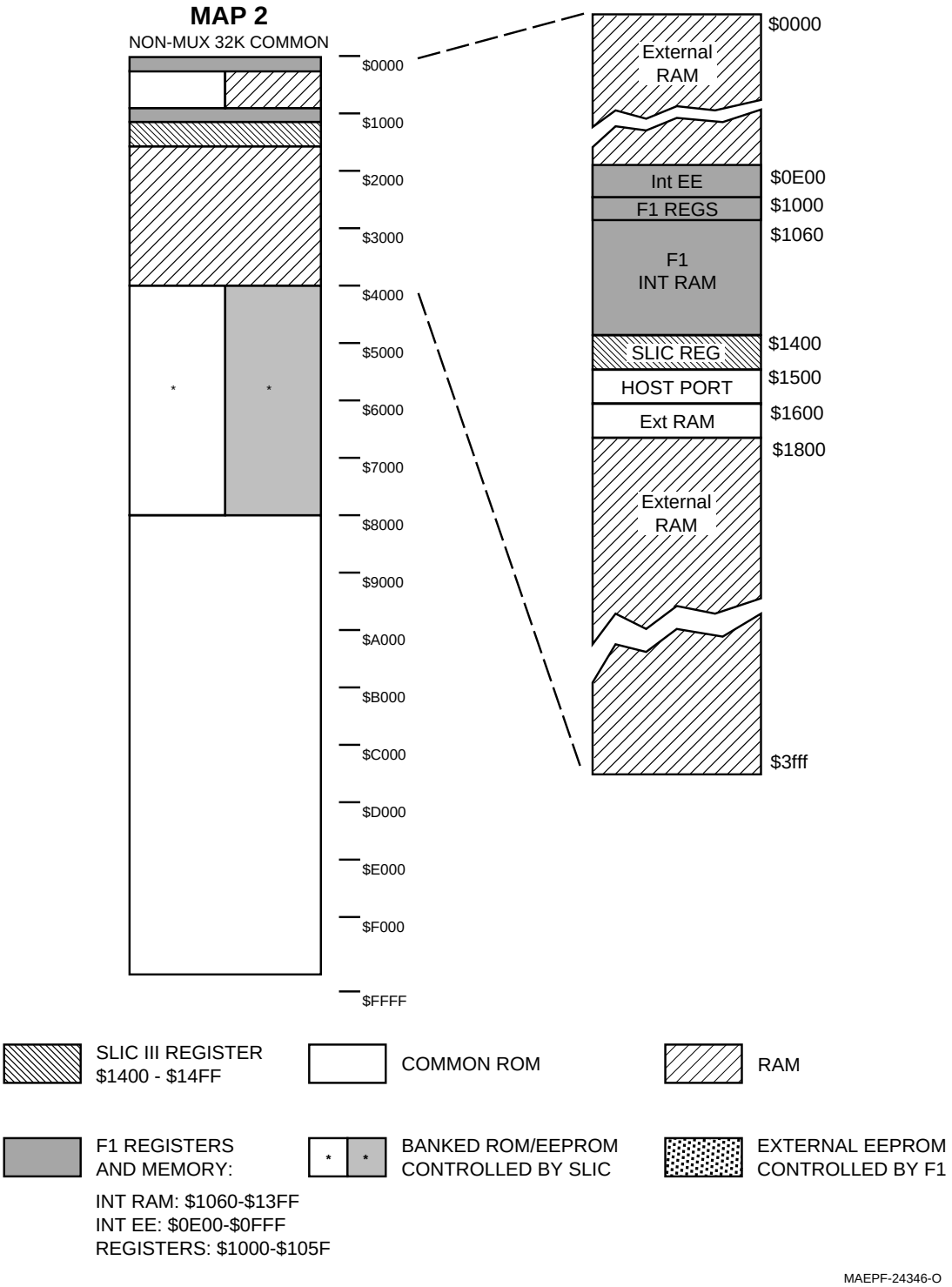


Figure 6-15 Controller Memory Mapping

In bootstrap mode, the memory map is slightly different. Internal EEPROM is mapped at $FE00-$FFFF and F1 internal SRAM starts at $0000-$03FF. In addition, a special bootstrap ROM appears in the ROM space from $B600-$BFFF. For additional information on bootstrap mode, refer to the section “Controller Bootstrap and Asynchronous Buses” on page 3-10.

Vocoder Memory Map

The vocoder (DSP) external bus consists of three 32k x 8 SRAMs (U401, U402, and U403), one 256k x 8 FLASH ROM (U404), and ADSIC (U406) configuration registers. Refer to Figure 6-16.

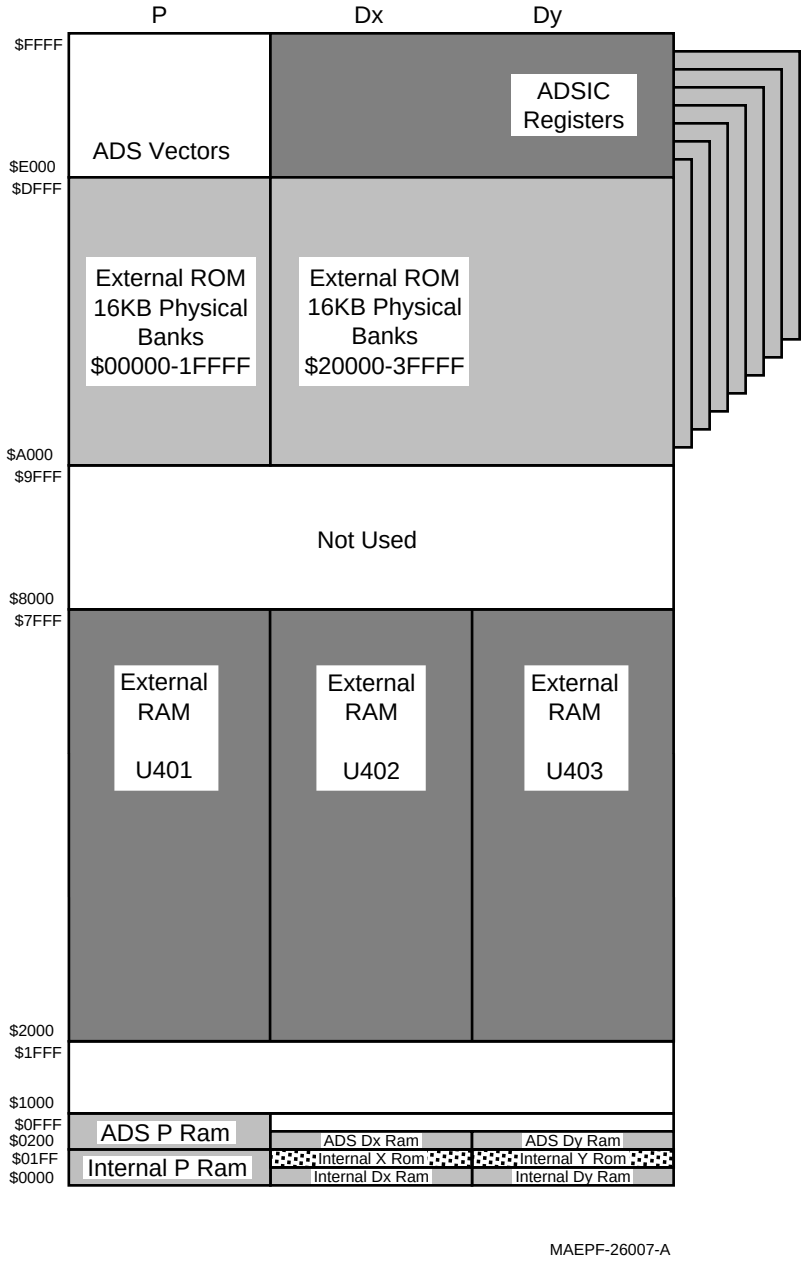


Figure 6-16 Vocoder Memory Mapping

The DSP56001A (U405) has a 24 bit wide data bus (D0-D23) and a 16 bit wide address bus (A0 - A15). The DSP can address three 64k x 24 memory spaces: P (Program), Dx (Data X), and Dy (Data Y). These additional RAM spaces are decoded using PS* (Program Strobe), DS* (Data Strobe), and X/Y*. RD* and WR* are separate read and write strobes.

The ADSIC provides memory decoding for the FLASH ROM (U404). EPS* provides the logic $\overline{A15}$ x ($\overline{A14} \oplus \overline{A13}$) and is used as a select for the ROM. The ADSIC provide three bank lines for selecting 16k byte

banks from the ROM. This provides decoding for 128k bytes from the ROM in the P: memory space. PS* is used to select A17 to provide an additional 128k bytes of space in Dx: memory space for the ROM.

The ADSIC internal registers are decoded internally and start at $E000 in Dy:. These registers are decoded using A0-A2, A13-A15, and PS* from the DSP. The ADSIC internal registers are 16 bits wide, so only D8-D23 are used.

The DSP program code is stored in the FLASH ROM, U404. During normal modes of operation, the DSP moves the appropriate program code into the three SRAMs (U401, U402, and U403) and internal RAM for execution. The DSP never executes program code from the FLASH ROM itself. At power-up after reset, the DSP downloads 512 words (1536 bytes) from the ROM, starting at $C000, and puts it into the internal RAM, starting at $0000, where it is executed. This segment of program code contains the interrupt vectors and the reset vector, and is basically an expanded bootstrap code. When the MCU messages the DSP that the ADSIC has been configured, the DSP overlays more code from the ROM into external SRAM and begins to execute it. Overlays occur at different times when the DSP moves code from the ROM into external SRAM, depending on immediate mode of operation, such as changing from transmit to receive.

MCU System Clock

The MCU (U701) system clock is provided by circuitry internal to the MCU and is based on the crystal reference, Y100. The nominal operating frequency is 7.3728MHz. This signal is available as a clock at 4XECLK on U701 and is provided to the SLIC (U702) for internal clock timing. The MCU actually operates at a clock rate of 1/4 the crystal reference frequency or 1.8432MHz. This clock is available at ECLK on U701.

The MCU clock contains a crystal warp circuit comprised of L120, Q102, and C162. This circuit is controlled by an I/O port (PA6) on the MCU. This circuit moves the operating frequency of the oscillator about 250ppM on certain receive channels to prevent interference from the MCU bus noise.

DSP System Clock

The DSP (U405) system clock, DCLK, is provided by the ADSIC (U406). It is based off the crystal reference, Y401, with a nominal operating frequency of 33.0000 MHz. The ADSIC contains an internal clock-divider circuit that can divide the system clock from 33MHz to 16.5MHz or 8.25MHz operation. The DSP controls this divider by writing to the ADSIC parallel registers. The frequency is determined by the processes the DSP is running and, to reduce system power consumption, is generally configured to the slowest operating speed possible.

The additional circuitry of CR402, L401, C416, C417, C419, and C422 make up a crystal warp circuit. This circuit is controlled by the OSCw signal from ADSIC, which is configured by the host through the SPI bus. The crystal warp circuit moves the operating frequency of the oscillator about 400ppM on certain receive channels to prevent interference from the DSP bus noise.

Radio Power-Up/ Power-Down Sequence

Radio power-up begins when the user closes the radio on/off switch on the control top, placing 7.5Vdc on the B+_SENSE line. This signal enables the pass element Q106 through Q105, enabling SW_B+ to the controller board and the transceiver board. B+_SENSE also enables the +5Vdc regulator, U709. When +5Vdc has been established, it is sensed by the supervisory IC, U726, which disables the system reset through the delay circuit R208 and C214.

When the MCU comes out of reset, it fetches the reset vector in ROM at $FFFE, $FFFF and begins to execute the code this vector points to. It configures the SLIC through the parallel bus registers. Among other things it enables the correct memory map for the MCU. It configures all the transceiver devices on the SPI bus. The MCU then pulls the ADSIC out of reset and, after a minimal delay, the DSP also. It then configures the ADSIC via the SPI bus, configuring, among other things, the DSP memory map. While this is happening, the DSP is fetching code from ROM U404 into internal RAM and beginning to execute it. It then waits for a message from the MCU that the ADSIC has been configured, before going on.

During this process, the MCU does power diagnostics. These diagnostics include verifying the MCU system RAM, and verifying the data stored in the internal EEPROM, external EEPROM, and FLASH ROMs. The MCU queries the DSP for proper status and the results of DSP self tests. The DSP self tests include testing the system RAM, verifying the program code in ROM U404, and returning the ADSIC configuration register checksum. Any failures cause the appropriate error codes to be sent to the display. If everything is OK, the appropriate radio state is configured and the unit waits for user input.

On power-down, the user opens the radio on/off switch, removing the B+_SENSE signal from the controller board. This does not immediately remove power, as the MCU holds this line active through B+_CNTL. The MCU then saves pertinent radio status data to the external EEPROM. Once this is done, B+_CNTL is released, shutting off SW_B+ at Q106 and shutting down the 5Vdc regulator U709. When the regulator slumps to about 4.7Vdc, supervisory IC U726 activates a system reset to the SLIC, which in turn resets the MCU.

Notes

Secure Modules

7

Introduction

The secure modules are designed to digitally encrypt and decrypt voice and ASTRO data in ASTRO Digital XTS 3000 radios. This section covers the following secure modules:

- NTN8253
- NTN8254
- NTN8255
- NTN8256
- NTN8257
- NTN8258
- NTN8259
- NTN8260
- NTN8261
- NTN8326
- NTN8418
- NTN8328
- NTN8329
- NTN8330
- NTN8331
- NTN8705
- 0105956V67

NOTE: The secure modules are NOT serviceable. The information contained in this chapter is only meant to help determine whether a problem is due to a secure module or the radio itself.

The secure module uses a custom encryption integrated circuit (IC) and an encryption key variable to perform its encode/decode function. The encryption key variable is loaded into the secure module, via the radio's universal (side) connector, from a hand-held, key variable loader (KVL). The encryption IC corresponds to the particular encryption algorithm purchased. The encryption algorithms and their corresponding kit numbers are:

DES	NTN8253
DES-XL	NTN8254
DES-OFB	NTN8255
DVI-XL	NTN8256
DVP-XL	NTN8257
DES-XL and DES-OFB	NTN8258
DVP-XL and DES-OFB	NTN8259
DES-XL and DVP-XL	NTN8260
DVP-XL and DVI-XL	NTN8261
DVI-XL and DES-OFB	NTN8326
DES and DES-OFB	NTN8418

DVP	NTN8328
DVI-XL and DVP	NTN8329
DES-XL and DVP	NTN8330
DVP-XL and DVP	NTN8331
DES-OFB and DVP	NTN8705
All, except DVP	0105956V67

Circuit Description

The secure module operates from three power supplies (UNSW_B+, SW_B+, and +5V). The +5V and the SW_B+ are turned on and off by the radio's on/off switch. The UNSW_B+ provides power to the secure module as long as the radio battery is in place.

Key variables are loaded into the secure module through connector J601, pin 15. Up to 16 keys (depending on the type of encryption module) can be stored in the module at a time. The key can be infinite key retention or 30-seconds key retention, depending on how the code plug is setup.

The radio' s host processor communicates with the Secure Module on the Serial Peripheral Interface (SPI) bus. The host processor is the master on this bus, while the secure module is a slave on the bus. The SPI bus consists of five signal lines. Refer to Table 1 for signal information. A communications failure between the host processor and the secure module will be indicated as an "ERROR 09/10" message on the radio display.

Troubleshooting Secure Operations

Refer to "Disassembly/Reassembly Procedures" on page 8-1. A key variable loader (KVL) and oscilloscope are needed to troubleshoot the secure module.

NOTE: The secure module itself is not serviceable. If the secure module is found to be defective, it must be replaced.

Error 09/10, Error 09/90

The ASTRO Digital XTS 3000 radio automatically performs a self test on every power-up. Should the radio fail the self tests, the display will show "ERROR 09/10" or "ERROR 09/90" accompanied by a short beep. If the display shows "**ERROR 09/10**" or "ERROR 09/90," the radio failed the secure power-up tests and the host microcontroller was unable to communicate with the secure module via the SPI bus. Turn the radio off and back on. If the radio still does not pass the self tests, then a problem exists with the secure operations of the radio.

Troubleshooting information for "ERROR 09/10" is found in Troubleshooting Chart, "09/10 Secure Hardware Failure." For "ERROR 09/90," see Troubleshooting Chart, "09/90 Secure Hardware Failure."

Keyload

When the keyloading cable is attached to the ASTRO Digital XTS 3000 radio and "KEYLOADING" is not displayed on the radio's display, then the radio has not gone into KEYLOAD mode. For troubleshooting "KEYLOAD" failure, refer to Troubleshooting Chart, "Key Load Fail."

NOTE: ASTRO Digital XTS 3000 radios need a keyloader that has the ability to keyload an ASTRO Digital XTS 3000 radio. The keyloader must be either a "T - - - - CX" or a "T - - - - DX" keyloader.

Disassembly/Reassembly Procedures

8

Introduction to this Section

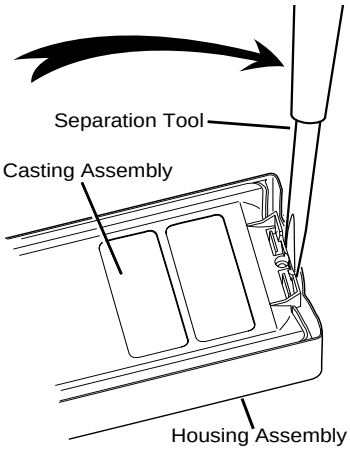
This section gives detailed procedures for disassembling and reassembling the radio. Refer to the diagrams that accompany the text, the exploded view diagrams and parts lists located in the back of this manual, and the ASTRO Digital XTS 3000 Basic Service Manual, Motorola publication 68P81083C85. Items in parentheses ( ) refer to item numbers in the exploded view.

Disassembly

1. Turn off the radio by rotating the on/off/volume control fully counterclockwise until you hear a click.
2. Referring to the Basic Service Manual (68P81083C85), Chapter 6, remove the universal connector cover or any accessory connected to the radio, the antenna, and the battery.

   NOTE: It is not necessary to remove the volume knob (6) and insert (7) or frequency knob (13) and insert (11) to service the main chassis. However, if any top control is suspected, then the knobs and inserts should be removed prior to removing the chassis from the front cover. Refer to Chapter 6 in the Basic Service Manual.

3. With the back of the radio facing upward, insert the 6680334E07 special tool at the bottom of the radio between the housing assembly (2) and the two tabs on the casting assembly (54). Gently pry upward to free the housing assembly from the casting. Making sure that the antenna bushing has cleared the hole in the control top, carefully lift the casting assembly clear of the housing assembly.



4. While holding the casting assembly (54) in one hand and the housing assembly (2) in the other, unplug the 41-pin connector on the controls flex assembly (18) from the controller board (44).

   NOTE: This can easily be done using the thumb of the hand holding the housing assembly.

   Put the housing assembly aside.

5. Remove the main seal (58) from around the casting assembly (54).
6. If you are disassembling a model II or III radio, continue with step 7; if you are disassembling a model I radio, skip to step 10.
7. With the front of the radio facing upward, lift the LCD module (38), with display locator pad (39), up and off of the four locator posts on the casting (54). Then, flip the LCD module up toward the top of the radio, revealing the display flex attachment bracket (42) and the keypad flex attachment bracket (43).
8. Disengage the display flex attachment bracket (42) by prying it up from the side, releasing the two chassis snaps; note the positioning of the bracket over the flex's "finger." Remove the LCD module (38) and display flex connector bracket (42) and put them aside.
9. Disengage the keypad flex attachment bracket (43) by prying it up from the side, releasing the two chassis snaps.
10. Pry all four controller front shield clips (40) upward, alternating diagonally across the chassis. Remove the controller front shield (41), with keypad flex assembly (37) (models II and III only) and clips still attached, from the chassis.
11. Lift the controller board (44) up and away from the chassis.

    NOTE: If the radio is equipped with hardware encryption, insert a small (1/8" wide maximum), flat-bladed screwdriver between the lower left portion of the chassis and controller board and gently pry upward on the controller board. This will free the controller board/encryption board (45) connection.

12. Lift out the 50-pin (48) and 20-pin (47) compression connectors.
13. Remove the vocoder board shield (46) by inserting a small (1/8" wide maximum), flat-bladed screwdriver in the removal slot on the right side of the shield, and prying in a counterclockwise direction. Once the shield's retention tab is free of the casting window, lift the shield out. If the encryption board (45) is equipped, it will come out with the shield.
14. Turn the casting assembly over and allow the vocoder board (50) to drop out into the palm of your hand.
15. With the front of the radio facing upward, use your thumb to hold down the clip (40) that secures the upper left portion of the RF shield (49), and pry the clip free. Then, release the two snaps on the right side of the RF shield. Lift the shield out, rotating it around its top edge.
16. Using the RF board coax disengagement tool or needle-nosed pliers, carefully unplug the coaxial cable's connector (55) from the RF board's (51) surface-mount connector.
17. Lift the RF board (51) out of the casting assembly. Inspect the casting to make sure the thermal pad (61) is attached to the casting. If the pad is attached to the RF board, remove it from the board. If the pad is in good condition, reattach it to the casting; if it is not, attach a new pad to the casting and discard the old one.
18. Lift the B+ assembly (52) and B+ seal (53) out of the casting assembly.

Reassembly

1. Reinstall the B+ assembly (52) and B+ seal (53), making sure that the seal seats properly in the casting assembly. Inspect the B+ assembly from the back of the casting to ensure that the seal shows evenly around the B+ assembly.
2. Make sure that a thermal pad (61) is attached to the casting. If it is not, attach a new thermal pad to the casting as indicated in the exploded view.
3. With the front of the radio facing upward, drop the RF board (51) in place, tucking the right side of the board in first — under the casting ledge.
4. Plug the coaxial cable's connector (55) into the RF board's (51) surface-mount connector, making sure to lead the coax's connector in on an axis straight into the surface-mount connector. An angled lead-in can damage the surface-mount connector or the center of the coax.
5. Reinstall the RF shield (49). Insert the shield's top edge in first, aligning the two tabs on the shield's top edge with the two slots in the casting, then pivot the shield down into position. Engage the two snaps on the right side first, then insert and snap down the single left side clip (40).
6. Reinstall the vocoder board (50) with the component side of the board facing downward.
7. Reinstall the vocoder board shield (46), engaging the two tabs on the left side first, then snapping down the single right side snap.

   If the encryption board (45) is equipped, reinstall it with the shield:

   a. Align the notches on the encryption board's edge with the internal tabs on the vocoder board shield.
   b. Drop the board in place.
   c. Slide the board upward until it stops, nested in the shield.
8. Reinstall the 50-pin (48) and 20-pin (47) compression connectors; they can only be inserted in one way. Insert the 50-pin connector with the smallest diameter peg pointing downward on the left side. Insert the 20-pin connector with the two-peg edge pointing downward on the left side.
9. Reinstall the controller board (44). Tuck the controller board's upper peninsula into the retention slot on the casting, rotate the board into position, and engage the 20- and 50-pin connectors. If the radio is equipped with hardware encryption, make sure that the controller board's connector mates fully with the encryption board's (45) connector.
10. Reinstall the controller front shield (41), with keypad (models II and III only) and four clips (40) still attached, into the chassis. Snap the controller front shield clips down, alternating diagonally across the shield.
11. If you are reassembling a model II or III radio, continue with step 11; if you are resassembling a model I radio, skip to step 13.

12. Reinstall the keypad flex attachment bracket (43). Insert the two tabs on the bracket through the two slots in the keypad flex (37) and into the two slots in the controller board (44), then snap down the two casting snaps.

13. Reinstall the LCD module (38), display locator pad (39), and display flex attachment bracket (42). Position the LCD module, with display locator pad, so that the back of the module faces upward, the flex points toward the bottom of the radio, and the locating "finger" on the flex passes through the opening between the middle compression fingers on the bracket. Insert the tab on the bracket through the slot in the flex and into the slot in the controller board (44), then snap down the two chassis snaps. Flip the LCD module down to cover the display flex connector and keypad flex connector brackets. Press the display locator pad (39) down over the three locator tabs on the casting.

14. Reinstall the main seal (58) around the casting assembly (54). Start at the top of the casting and work the seal around the perimeter of the casting until it is completely in place.

15. While holding the casting assembly (54) in one hand and the housing assembly (2) in the other, plug the 41-pin connector on the controls flex assembly (18) into the connector on the controller board (44).

    NOTE: This can easily be done using the thumb of the hand holding the chassis.

16. With the fronts of both the casting assembly (54) and housing assembly (2) facing upward, carefully insert the top of the casting into the top of the housing assembly. Making sure that the antenna bushing is inside the antenna hole in the control top, pivot the bottom of the housing downward toward the bottom of the casting until they meet. Snap the housing assembly and casting assembly together.

17. Referring to the Basic Service Manual (68P81083C85), Chapter 6, reinstall: the universal connector cover or any accessory connected to the radio, the antenna, and the battery.

    NOTE: If the volume knob (6) or frequency knob (13) were removed prior to servicing the main chassis, reinstall them.

Ensuring Radio Submersibility

Introduction

ASTRO XTS 3000 R radio models meet the stringent requirements of U. S. MIL-STD-810C, Method 512.1, Procedure I, MIL-STD-810D, Method 512.2, Procedure I, and MIL-STD-810E, Method 512.3, Procedure I, which require the radio to maintain watertight integrity when immersed in three feet of water for two hours @ 27° ΔT. Radios shipped from the Motorola factory have passed the water immersion test and should not be disassembled. If disassembly is necessary, refer to qualified service personnel and service shops capable of restoring the watertight integrity of the radio.

Caution It is strongly recommended that maintenance of the radio be deferred to qualified service personnel and service shops. This is of paramount importance as irreparable damage to the radio can result from service by unauthorized persons. If disassembly is necessary, unauthorized attempts to repair the radio may void any existing warranties or extended performance agreements with Motorola. It is also recommended that submersibility be checked annually by qualified service personnel.

If the radio has been submersed in water, shake the radio well to remove any water that may be trapped inside the speaker grille and microphone port. Otherwise, the water will decrease the audio quality of the radio. Dry the radio and battery.

If the radio's battery contact area has been exposed to water, dry the battery contacts (both on the radio and the battery) before attaching the battery to the radio. Otherwise, the water could short-circuit the radio.

If the radio has been submersed in corrosive medium (such as salt water), rinse the radio and battery in fresh water, and dry the radio and battery.

If cleaning is desired, use a diluted solution of mild dishwashing detergent and fresh water (one teaspoon of detergent to one gallon of water).

General Information

To ensure that the radio is truly a watertight unit, special testing, test procedures, and specialized test equipment are required. The special testing involves a vacuum check of the radio and pressure testing (troubleshooting) for water leaks if the vacuum check fails. The specialized test equipment is needed to perform the vacuum check and pressure testing, if required.

Specialized Test Equipment

Vacuum Pump Kit, NLN9839

The vacuum pump kit includes a vacuum pump with gauge, and a vacuum hose. An adapter with gasket (NTN9279A), which must be

ordered separately, connects the vacuum hose to the radio's casting. The vacuum pump kit is also used on Motorola ASTRO SABER R radios. The adapter with gasket is new to the ASTRO XTS 3000 R.

Pressure Pump Kit, NTN4265

The pressure pump kit includes a pressure pump with gauge, and a pressure hose; the pressure pump kit is also used on Motorola ASTRO SABER R radios. As with the vacuum pump kit above, the NTN9279A adapter connects the pressure hose to the radio's casting.

Miscellaneous Hardware

Other items needed for testing the submersible radio include:

- Large water container.
- Deionized (DI) water
- A supply of replacement seals, o-rings, and gaskets (refer to the ASTRO XTS 3000 R exploded view parts list).

Disassembly and Reassembly

If disassembly and reassembly of the radio is required, refer to the "Disassembly/Reassembly Procedures" in this manual.

Disassembly

Disassemble the radio according to the "Disassembly" section of this manual.

Reassembly

Reassemble the radio according to the "Reassembly" section of this manual. Tighten all hardware that was loosened or removed. *DO NOT REASSEMBLE THE RADIO WITHOUT FIRST PERFORMING THE FOLLOWING PRELIMINARY INSPECTION PROCEDURE:*

1. Remove the main seal o-ring from the casting.
2. Inspect the seal area around the casting for foreign material that might prevent the main seal o-ring from sealing properly.
3. Install a new, well lubricated, main seal o-ring. Replacement main seal o-rings are pre-lubricated with Nye Fluorocarbon Gel 865.
4. Reassemble the housing.

Caution

The main seal o-ring should not be visible when looking at the back side of the radio. If the seal is visible, it is improperly installed.

Vacuum Test

Refer to the exploded view diagrams and parts lists in this manual.

General

The vacuum test uses a vacuum pump and gauge. The pump creates a vacuum condition inside the radio, and the gauge monitors the radio for a stable vacuum reading; that is, checking for a properly sealed, watertight unit. Before starting the vacuum test:

- Remove the battery.
- Remove the universal connector cover to expose the universal connector.

Conducting the Test

1. Attach the vacuum hose to the vacuum pump. Check the pump and hose for leaks by blocking off the open end of the hose and operating the pump a few times. The actual reading of the gauge at this point is not important; it is important that the gauge pointer remains steady, indicating no vacuum leaks in the pump.
2. Remove the vacuum test port (see Section 13, page 13-94, item 62) using a 7/64" Allen key. Remove the O-Ring; item 63.
3. Ensure that a rubber gasket is attached to the hose-to-casting adapter. Screw the adapter into the tapped hole in the casting.
4. Attach the open end of the hose to the adapter.
5. Place the radio on a flat surface with the casting facing upward. Place two or three drops of water on each slot of the label (66) that protects the vent port seal (65) on the casting. This will ensure that no air goes through the seal.
6. Operate the pump a few times until the gauge indicates 5 in. Hg; do not pull more than 7 in. Hg of vacuum on the radio.

   Operate the pump again until the gauge indicates 6 in. Hg.

7. Observe the gauge for approximately 1 minute.
   - If the needle falls 1 in. Hg or less (for example, from 6 in. Hg to 5 in. Hg), then the radio has passed the vacuum test and is approved for submersibility. No additional testing will be required.
   - If the needle falls more than 1 in. Hg (for example, from 6 in. Hg to less than 5 in. Hg), then the radio has failed the vacuum test and the radio might leak if submersed. Additional troubleshooting of the radio will be required; complete this procedure, then go to the "Pressure Test" section of this manual.
8. Dry the water from the slots on the label (66) that protects the vent port seal to allow the radio to equalize. The pressure should drop slowly to "0."
9. Remove the vacuum hose and adapter from the radio.
10. Install the o-ring and the vacuum test port plug. Torque the plug to 6 in-lb.

Pressure Test

Refer to the exploded view diagrams and parts lists in this manual.

General

Pressure testing the radio is necessary only if the radio has failed the vacuum test. Do not perform the pressure test until the vacuum test has been completed. Pressure testing involves creating a positive pressure condition inside the radio, submersing the radio in water, and observing the radio for a stream of bubbles (leak). Since all areas of the radio are being checked, observe the entire unit carefully for the possibility of multiple leaks before completing this test.

Conducting the Test

1. Remove the vacuum test port (see Section 13, page 13-94, item 62) using a 7/64" Allen key. Remove the O-Ring; item 63.
2. Screw the adapter (with gasket) into the tapped hole in the casting.
3. Attach one end of the pressure hose to the adapter and the other end to the pressure pump.
4. Cover the vent port seal (65) and label (66) on the back of the casting with your thumb. This will prevent air from going through the seal. Keep the vent port covered with your thumb until the test is complete (through step 8).
5. Operate the pump until the gauge reads approximately 1 psig.

Caution

Pressure any greater than 1 psig may push air around the main seal.

6. Maintain the pressure at 1 psig and submerse the radio into a water-filled container. Keep the vent port covered with your thumb while the radio is submersed.
7. Watch for any continuous series of bubbles. A stream of bubbles indicates a sign of leakage.

   NOTE: Some air entrapment may cause the accumulation of bubbles, especially in the grille area, but the bubbles should not be continuous.

8. Note all of the seal areas that show signs of leakage. Pinpoint the problem(s) to one (or more) of the following areas:
   - housing
   - antenna bushing seal
   - controls seal
   - frequency switch, toggle, and on/off/volume control switch
   - main seal
   - battery contact and battery contact seal
   - keypad
9. Remove the radio from the water container, remove your thumb from the vent port seal, and dry the radio thoroughly. Be especially careful to dry the area around the main seal to prevent contamination of the internal electronics while the unit is open.

To avoid equipment damage, keep the area around the port seal dry by ensuring that there is no water around the casting's vacuum port.

10. Remove the adapter and pressure hose added in steps 1 and 2, above.
11. Install the o-ring and the vacuum test port plug. Torque the plug to 6 in-lb.
12. Inspect the vent port seal (65) to ensure that the seal behind the label's (66) two slots has not been punctured. If it has been punctured, the seal and the label must be replaced.

Troubleshooting Leak Areas

Before repairing any leak, read all applicable area repair paragraphs. This will help to eliminate unnecessary disassembly and reassembly of a radio with multiple leaks. Troubleshoot only the faulty seal areas listed in the "Pressure Test" section, and, when multiple leaks exist, in the order listed.

NOTE: Before reassembling the radio, always install a new main seal o-ring, and new seals in the defective area.

Housing

1. If a leak occurs at the lens, universal connector, casting/housing interface, or PTT/Ratt button area of the housing, replace the housing. Referring to the Disassembly/Reassembly Procedures:
   a. Remove the housing assembly from the radio.
   b. Discard the housing assembly and main seal o-ring.
   c. Install a new main seal o-ring around the casting assembly.
   d. Install a new housing assembly to the radio.
   e. Inspect the main seal for proper seating.
   f. Observe carefully to ensure that the main seal o-ring is not pinched between the housing and the casting.
2. If the leak occurs at the control top area, remove the knobs, knob inserts and antenna in order to determine the leak location:
   a. Conduct the Pressure Test.
   b. Identify the leak location.

Antenna Bushing Seal

1. Referring to the Disassembly/Reassembly Procedures, remove the housing assembly from the radio.
2. Remove and discard the antenna bushing seal.
3. Inspect the housing seal surface for debris or damage. Remove any debris and replace housing if damaged.
4. Install a new, well lubricated, antenna seal o-ring. Replacement antenna seal o-rings are pre-lubricated with Nye Fluorocarbon Gel 865.
5. Install a new, well lubricated, main seal o-ring around the casting assembly. Replacement main seal o-rings are pre-lubricated with Nye Fluorocarbon Gel 865.
6. Reassemble the housing assembly to the radio.
7. Inspect the main seal for proper seating. Observe carefully to ensure that the main seal o-ring is not pinched between the housing and the casting.

Controls Seal

1. Referring to the Disassembly/Reassembly Procedures, remove the housing assembly from the radio.
2. Remove the speaker bracket screw.
3. Remove the speaker bracket.
4. Before continuing, install the universal connector cover (5).For installation instructions refer to Chapter 6 of the XTS 3000 Basic Service Manual. This will hold the universal connector in place when the control flex is removed.

Caution

Removing the control flex without installing the universal connector cover (5) may compromise the universal connector seal.

5. Disconnect the controls flex from the universal connector.
6. Disconnect the controls flex and backer from PTT area of the housing assembly.
7. Referring to the Basic Service Manual (68P81083C85), Chapter 6, remove the frequency knob, frequency insert, secure lever, lightpipe, volume knob, volume insert, and o-ring.
8. Using a pair of needlenose pliers, unsnap the left snap of the controls bracket assembly.
9. Remove the controls bracket assembly.
10. Remove and discard the controls seal.
11. Inspect the housing seal surfaces for debris. Remove any debris.
12. Install a new controls seal.
13. Install a new main seal o-ring around the casting assembly.
14. Reassemble the controls bracket assembly.
15. Referring to the Basic Service Manual (68P81083C85), Chapter 6, install the frequency knob, new frequency escutcheon, new frequency insert, secure lever, lightpipe, volume knob, new volume insert, and o-ring.
16. Reconnect the controls flex to the universal connector and the PTT area of the housing assembly.
17. Reassemble the housing assembly to the radio.
18. Inspect the main seal for proper seating. Observe carefully to ensure that the main seal o-ring is not pinched between the housing and the casting.

Frequency Switch, Toggle, and On/Off/ Volume Control Switch

1. Referring to the Disassembly/Reassembly Procedures, remove the housing assembly from the radio.
2. Remove the speaker bracket screw.
3. Remove the speaker bracket.
4. Disconnect the controls flex from the universal connector.
5. Disconnect the controls flex and backer from the PTT area of the housing assembly.
6. Referring to the Basic Service Manual (68P81083C85), Chapter 6, remove the frequency knob, frequency insert, secure lever, lightpipe, volume knob, volume insert, and o-ring.
7. Using a pair of needle nose pliers, unsnap the left snap of the controls bracket assembly.
8. Remove the controls bracket assembly.
9. Replace the switch that leaks by following the unsoldering and replacement instructions contained in the new switch's instruction sheet.

10. Reassemble the controls bracket assembly.
11. Referring to the Basic Service Manual (68P81083C85), Chapter 6, install the frequency knob, new frequency escutcheon, new frequency insert, secure lever, lightpipe, volume knob, new volume insert, and o-ring.
12. Reconnect the controls flex to the universal connector and the PTT area of the housing assembly.
13. Install a new main seal o-ring around the casting assembly.
14. Reassemble the housing assembly to the radio.
15. Inspect the main seal for proper seating. Observe carefully to ensure that the main seal o-ring is not pinched between the housing and the casting.

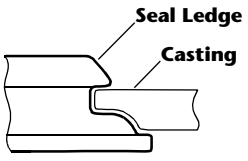
Main Seal

1. Referring to the Disassembly/Reassembly Procedures, remove the housing assembly from the radio.
2. Remove and discard the main seal.
3. Inspect the housing and casting seal surfaces for debris or damage. Remove any debris and replace the housing or casting if damaged.
4. Install a new, well lubricated, main seal o-ring around the casting assembly. Replacement main seal o-rings are pre-lubricated with Nye Fluorocarbon Gel 865.
5. Reassemble the housing assembly to the radio.
6. Inspect the main seal for proper seating. Observe carefully to ensure that the main seal o-ring is not pinched between the housing and the casting.

Battery Contact and Battery Contact Seal

1. Referring to the Disassembly/Reassembly Procedures, remove the housing assembly from the radio.
2. Completely disassemble the casting assembly.
3. Remove and discard the leaking component.
4. Inspect the casting seal surface for debris or damage. Remove any debris and replace casting if damaged.
5. Install a new battery contact and a new battery contact seal if necessary.

Caution When installing the battery contact seal, make sure that the ledge around the outside of the seal completely protrudes through the opening in the casting and sits flush with the outside surface of the casting. Also, make sure that the seal's shape is not distorted.



6. Reassemble the casting assembly.
7. Install a new main seal o-ring around the casting assembly.
8. Reassemble the housing assembly to the radio.
9. Inspect the main seal for proper seating. Observe carefully to ensure that the main seal o-ring is not pinched between the housing and the casting.

Keypad

1. Referring to the Disassembly/Reassembly Procedures, remove the housing assembly from the radio.
2. Remove and discard the keypad.
3. Inspect the housing seal surface for debris or damage. Remove any debris and replace housing if damaged.
4. Install new keypad.
5. Install a new main seal o-ring around the casting assembly.
6. Reassemble the housing assembly to the radio.
7. Inspect the main seal for proper seating. Observe carefully to ensure that the main seal o-ring is not pinched between the housing and the casting.

Vacuum Port Seal

1. Remove the vacuum port plug (see Section 13, page 13-94, item 62), using a 7/64" hex torque bit; remove the o-ring; item 63.
2. Inspect the casting seal surface for debris or damage. Remove any debris and replace the casting if damaged.
3. Install a new o-ring and reinstall the vacuum port plug to the correct torque as specified in Table 8-2.

Table 8-2 Submersible Radio Torque Specifications

Application	Torque (in.-lbs)	Torque (N•m)	Torque Bit Part No.
Speaker Bracket Screw	2	0.23	66-80321B79
Vacuum Port Plug	6	0.68	66-80357B82

Vent Port Seal

1. Remove the seal label (66) that covers the vent port seal (65).
2. Remove the vent port seal.
3. Ensure that the casting's surfaces are clean and free from any adhesive or other foreign materials.
4. Install the appropriate vent port seal (65), covering the vent port holes located in the small recessed area on the front of the casting assembly (54). Ensure that no oily substances come in contact with the seal.

Caution Depending on the ruggedized casting (54) configuration (two or four hole vent port), use the appropriate vent port seal (65) as indicated in the parts list located in the back of this manual.

5. Install a new seal label over the vent port seal in the larger recessed area in the casting. Press down evenly over the label's surface to ensure good adhesion.

Housing Assembly Replacement

When replacing an old housing assembly, which has a housing part number in either the 1505578Z or 1505350Z family of part numbers, with a new housing assembly, which has a housing part number in the 1585920C family, the universal controls flex bracket may need to be replaced (see Figures 8-1 and 8-2). Housing part numbers are molded on the inside of the housing. A new universal controls flex bracket (complete with bracket, liners, adhesive and aligning tool) is supplied with the housing assemblies that have a housing part number in the 1585920C family.

For housing assembly replacement, follow the steps for disassembling the controls seal, as described earlier in this chapter. DO NOT REMOVE the dust cover on the new housing assembly until you have fully read and completed the following instructions. Once the controls flex is removed, DO NOT DISCARD.

Inspect the universal connector bracket. If the current bracket resembles the bracket shown on the left in Figure 8-17 below, you MUST replace this bracket for the one shown on the right in Figure 8-17. Start with step #1 below. If the bracket resembles the one shown on the right in Figure 8-17, no bracket replacement is needed. Skip to step #11. If a new universal connector bracket is needed, use part number 4205582Z07 (universal bracket replacement kit).

Figure 8-17 Universal Connector Bracket

1. Carefully peel the old universal bracket from the controls flex.
2. Thoroughly clean the adhesive from this area using isopropyl alcohol.
3. Peeling the old bracket from the controls flex may cause the flex to curl. Roll the flex in the opposite direction to flatten out as much as possible.
4. Once the controls flex is clean, dry and flat, use the alignment tool supplied to apply a new layer of double-sided adhesive and a new bracket to the controls flex. To hold the alignment tool steady, tape it to a flat work area.
5. Refer to Figure 8-18.

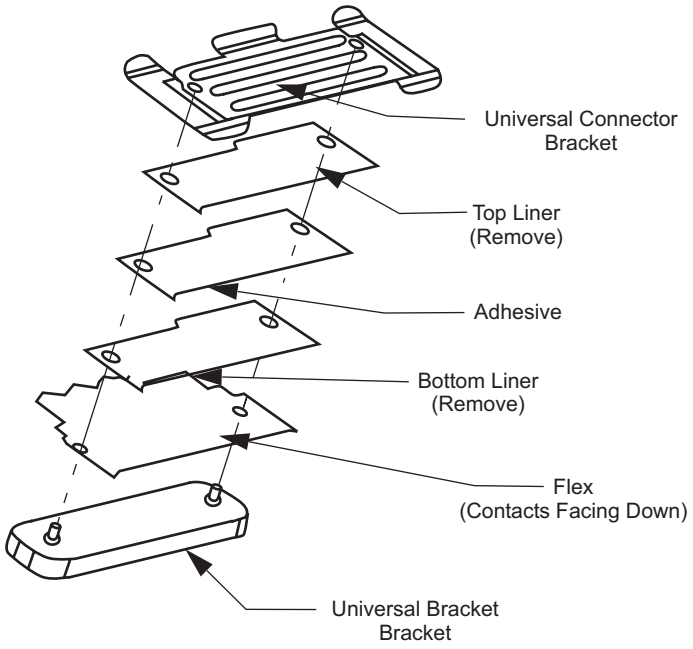


Figure 8-18 Replacing the Universal Controls Flex Bracket

6. With the controls flex universal contacts facing down, align holes in the controls flex to match the pegs on the alignment tool.
7. Peel the bottom liner from the double-sided adhesive and apply to the controls flex using the alignment pegs shown above. The adhesive should align to the outer edges of the flex. Two pieces of adhesive are supplied in case of assembly error.
8. Apply hand pressure to the adhesive.
9. Peel the top liner from the adhesive and apply the new bracket using the alignment pegs. The bracket should be assembled to the adhesive on the non-coated side. The top edge of the bracket should closely align with the edge of the controls flex.
10. Apply pressure to the controls flex and the bracket.
11. Continue with the remaining steps for reassembling the controls seal into the NEW housing assembly, as described earlier in this chapter.
12. Once the assembly is fully completed, the dust cover may be removed.

Troubleshooting Procedures

9

Introduction to This Section

The purpose of this section is to aid in troubleshooting a malfunctioning ASTRO Digital XTS 3000 radio. It is intended to be detailed enough to localize the malfunctioning circuit and isolate the defective component.

Caution

Most of the ICs are static sensitive devices. Do not attempt to troubleshoot or disassemble a board without first referring to the following Handling Precautions section.

Handling Precautions

Complementary metal-oxide semiconductor (CMOS) devices, and other high-technology devices, are used in this family of radios. While the attributes of these devices are many, their characteristics make them susceptible to damage by electrostatic discharge (ESD) or high-voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair. Handling precautions are mandatory for this radio, and are especially important in low-humidity conditions. DO NOT attempt to disassemble the radio without observing the following handling precautions.

1. Eliminate static generators (plastics, Styrofoam, etc.) in the work area.
2. Remove nylon or double-knit polyester jackets, roll up long sleeves, and remove or tie back loose hanging neckties.
3. Store and transport all static-sensitive devices in ESD-protective containers.
4. Disconnect all power from the unit before ESD-sensitive components are removed or inserted unless otherwise noted.
5. Use a static-safeguarded workstation, which can be accomplished through the use of an anti-static kit (Motorola part number 01-80386A82). This kit includes a wrist strap, two ground cords, a static-control table mat and a static-control floor mat. For additional information, refer to Service and Repair Note SRN-F1052, “Static Control Equipment for Servicing ESD Sensitive Products,” available from Literature Distribution.

   Motorola
   Literature Distribution
   2290 Hammond Drive
   Schaumburg, IL 60173
   (708) 576-2826

6. Always wear a conductive wrist strap when servicing this equipment. The Motorola part number for a replacement wrist strap that connects to the table mat is 42-80385A59.

Voltage Measurement and Signal Tracing

It is always a good idea to check the battery voltage under load. This can be done by measuring the OPT_B+ pin at the universal connector on the back of the radio, with the radio keyed. The battery voltage should remain at or above 7.0Vdc. The battery should be recharged or replaced as necessary prior to analyzing the radio.

In most situations, the problem circuit may be identified using a dc voltmeter, RF millivoltmeter, and oscilloscope (preferably with 100MHz bandwidth or more). The “Recommended Test Equipment, Service Aids, and Tools” section in the ASTRO Digital XTS 3000 Portable Radios Basic Service Manual outlines the recommended tools and service aids which would be useful. Of special note is the 8180377E58 Housing Eliminator, which allows the technician to open the radio to probe points while in operation.

In some cases dc voltages at probe points are shown in red on the schematics. In other areas diagrams may be included to show time varying signals which should be present under the indicated circumstances. It is recommended that a thorough check be made prior to replacement of any IC or part. If the probe point does not have a signal reasonably close to the indicated one, a check of the surrounding components should be made prior to replacing any parts.

Caution

When checking a transistor or module, either in or out of circuit, do not use an ohmmeter having more than 1.5 volts dc appearing across test leads or use an ohms scale of less than x100.

Power-Up Self-Check Errors

Each time the radio is turned on the MCU and DSP perform some internal diagnostics. These diagnostics consist of checking the programmable devices such as the FLASH ROMs, internal and external EEPROMs, SRAM devices, and ADSIC configuration bus checksum. At the end of the power-up self-check routines, if an error exists, the appropriate error code is displayed on the display. For non-display radios, the error codes may be read using the Radio Service Software (RSS) from the SB9600 bus on the universal connector. Table 9-3 lists valid checksums, the related failure, and a reference section for investigating the cause of the failure.

Table 9-3 Power-Up Self-Check Error Codes

Error Code	Description	Troubleshooting Chart
01/81	Host ROM Checksum Failure	Chart 6
01/82	External EEPROM Checksum Failure	Chart 7
01/84	SLIC Initialization Failure	Chart 8
01/88	MCU (Host µC) External SRAM Failure	Chart 9
01/92	Internal EEPROM Checksum Failure	Chart 10
02/A0	ADSIC Checksum Failure	Chart 11
02/81	DSP ROM Checksum Failure	Chart 12
02/88	DSP External SRAM Failure	Chart 13
02/90	General DSP Hardware Failure	Chart 14
09/10	Secure Hardware Module Not Installed	Chart 15
09/90	Secure Hardware Failure	Chart 16
001	Synthesizer Out of Lock	Chart 29 & Chart 30
002	Block Checksum Failure for Selected Mode	Chart 7

In the case of multiple errors, the codes are logically ORed and the results displayed. As an example, in the case of an ADSIC checksum failure and a DSP ROM checksum failure, the resultant code would be 02/A1. Following is a series of troubleshooting flowcharts which relate to each of these failure codes.

Power-Up Sequence

Upon RESET* going active, the MCU begins to execute code which is pointed to by the vector stored at $FFFE, $FFFF in the FLASH ROM. The execution of this code is as follows:

1. Initialize the MCU (U701). Green LED on.
2. Initialize the SLIC (U702).
3. CONFIG register check. If the CONFIG register is not correct, the MCU will repair it and loop.
4. Start ADSIC/DSP:
   - Bring the ADSIC reset line high.
   - Wait 2ms.
   - Bring the DSP reset line high.

5. Start EMC:
    - Set the EMC wake-up line low (emc irq line).
    - Wait 5ms.
    - Set the EMC wake-up line high
    - Wait 10ms.
    - Set the EMC wake-up line low (emc irq line).
    - Wait 5ms.
    - Set the EMC wake-up line high.
6. Begin power-up self-tests.
7. Begin RAM tests:
    - External RAM ($1800-$3FFF).
    - Internal RAM ($1060-$1300).
    - External RAM ($0000-$0DFF).
    - Display 01/88 if failure.

The radio will get stuck here if the internal RAM is defective. The radio uses the internal RAM for stack. The RAM routines use subroutines. Thus, if the internal RAM is defective, the radio will get lost testing the external RAM.

8. Display "`Self Test`" (these routines use subroutines too). It is almost impossible to display an error message if the internal RAM is defective.
9. Begin MCU (host µC) ROM checksum test.
    - Fail 01/81 if this routine fails.
10. Begin DSP power-up tests. The MCU will try this five times before it fails the DSP test.
    - Check for HF2.
        - Fail 02/90 if 100ms.
    - Program the ADSIC.
    - Wait for the DSP power-up message.
        - Fail 02/90 if 300ms.
        - Fail 02/90 if wrong message from the DSP.
    - Wait for the DSP status information.
        - Fail 02/90 if 100ms.
        - Fail 02/88 if DSP RAM fails.
    - Wait for the ADSIC checksum.
        - Fail 02/90 if 100ms.

- Fail 02/90 if failure

- Wait for the first part of the DSP version number.

  - Fail 02/90 if 100ms.

- Wait for the second part of the DSP version number.

  - Fail 02/90 if 100ms.

11. Display errors if a fatal error exists at this point.
12. Checksum the codeplug.
    - Test internal codeplug checksums.

      - Fail 01/92 if failure.

    - Test external codeplug checksums.

      - Error 01/82 if non-fatal error; fail 01/82 if fatal error.

13. Power-up the EMC (if it is enabled in the codeplug).
14. Turn off the green LED.
15. Start up operating system.

Standard Bias Table

Table 9-4, below, outlines some standard supply voltages and system clocks which should be present under normal operation. These should be checked as a first step to any troubleshooting procedure.

Table 9-4 Standard Operating Bias

Signal Name	Nominal Value	Tolerance	Source
UNSW_B+	7.5Vdc	6.0-9.0Vdc	J101
SW_B+	7.5Vdc	6.0-9.0Vdc	Q106
+5V	5.0Vdc	±10%	U709
+5VA	5.0Vdc	±10%	U710
RESET	5.0Vdc	+0.7, -1.0Vdc	U702
POR*	5.0Vdc	+0.7, -1.0Vdc	U726
DSP_RST*	5.0Vdc	+0.7, -1.0Vdc	U701
ADSIC_RST*	5.0Vdc	+0.7, -1.0Vdc	
DCLK	33.0000MHz[a]	±500ppM	U406
ODC	2.4MHz	±30ppM	ABACUS
ECLK	1.8432MHz	±500ppM	U701
IRQB*	8kHz[b]	±500ppM	U406
+5V	5.0Vdc	±10%	U202
RX_5V[c]	5.0Vdc	±10%	U106

a. This is number may vary due to the operating mode of the radio when it is measured. The ADSIC contains a divider which may divide the clock by a modulus of 2. Therefore the actual frequency measured may be clock/2^n. The most common frequency will be 16.5000MHz nominal.

b. This 8kHz clock will be present only after the MCU has successfully programmed the ADSIC after power-up. This is a good indication that the ADSIC is at least marginally operational.

c. Receive mode only.

Troubleshooting Charts

10

Introduction to This Section

This section contains detailed troubleshooting flowcharts. These charts should be used as a guide in determining the problem areas. They are not a substitute for knowledge of circuit operation and astute troubleshooting techniques. It is advisable to refer to the related detailed circuit descriptions in the theory section prior to troubleshooting a radio.

List of Troubleshooting Charts

Most troubleshooting charts end up by pointing to an IC to replace. **It is not always noted, but it is good practice to verify supplies and grounds to the affected IC and to trace continuity to the malfunctioning signal and related circuitry before replacing any IC.** For instance, if a clock signal is not available at a destination IC, continuity from the source IC should be checked before replacing the source IC.

NOTE: µC is used in several of the following troubleshooting charts.
µC = MCU

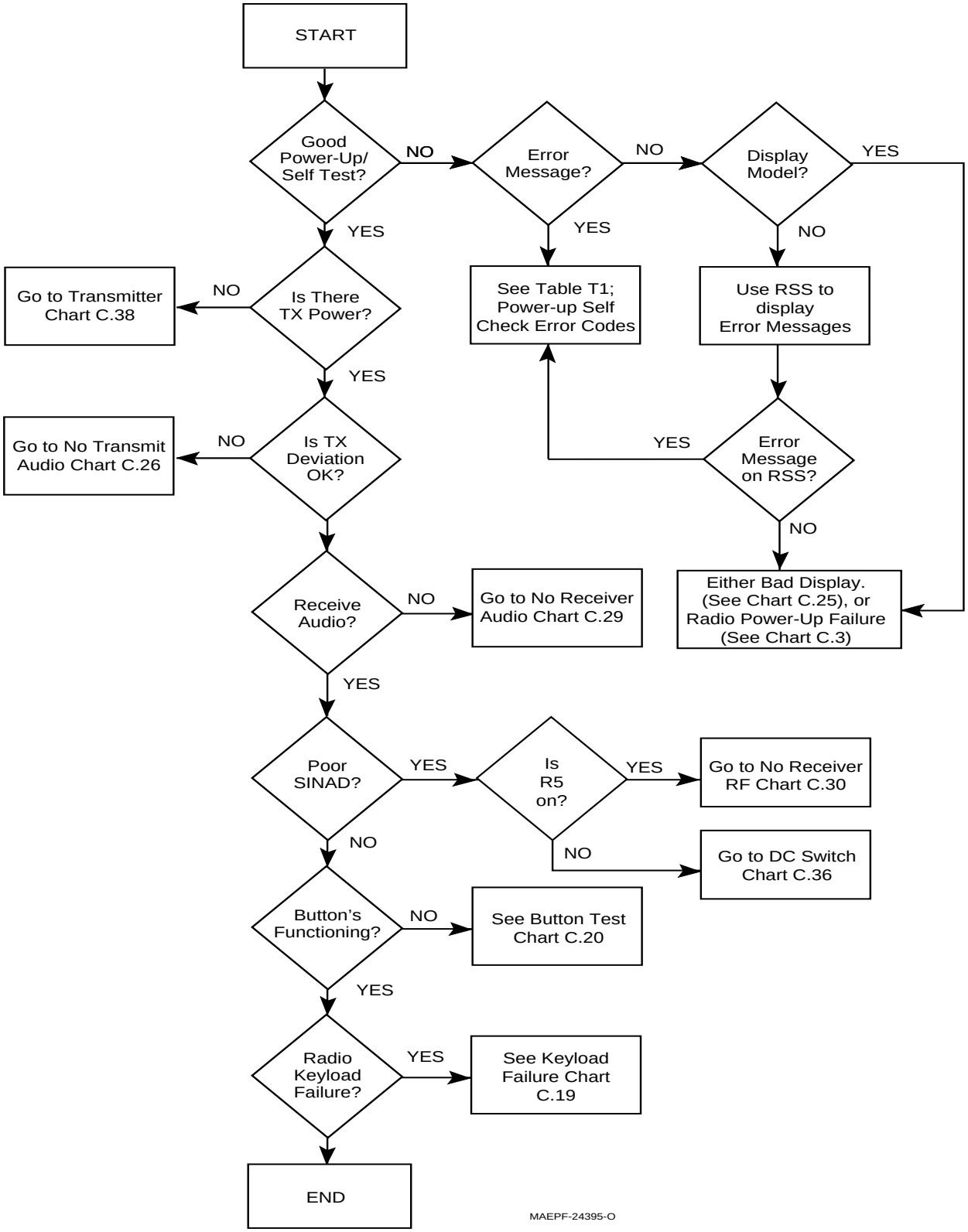


Chart 1. 800 MHz Radio Main

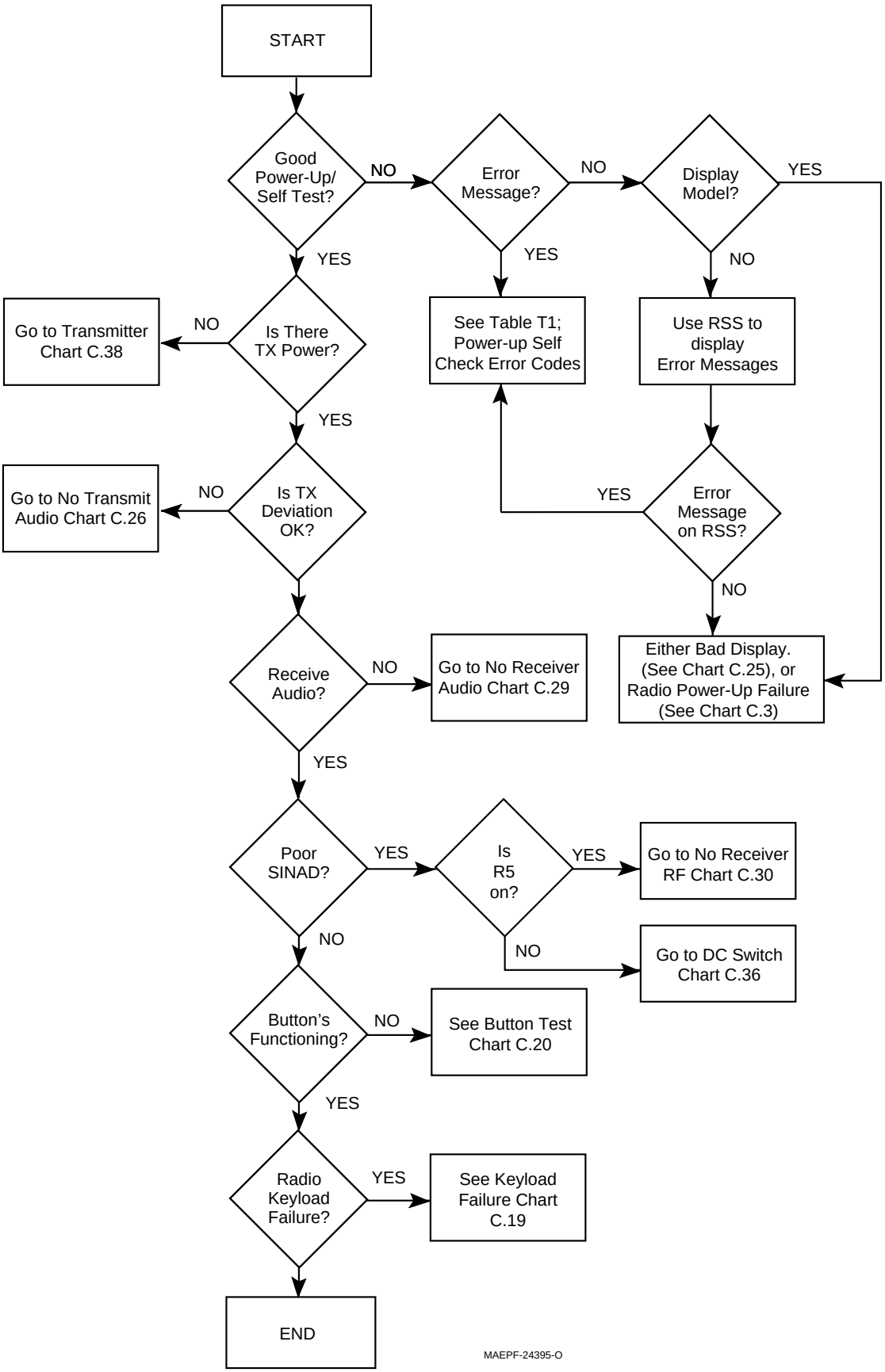


Chart 2. VHF/UHF Radio Main

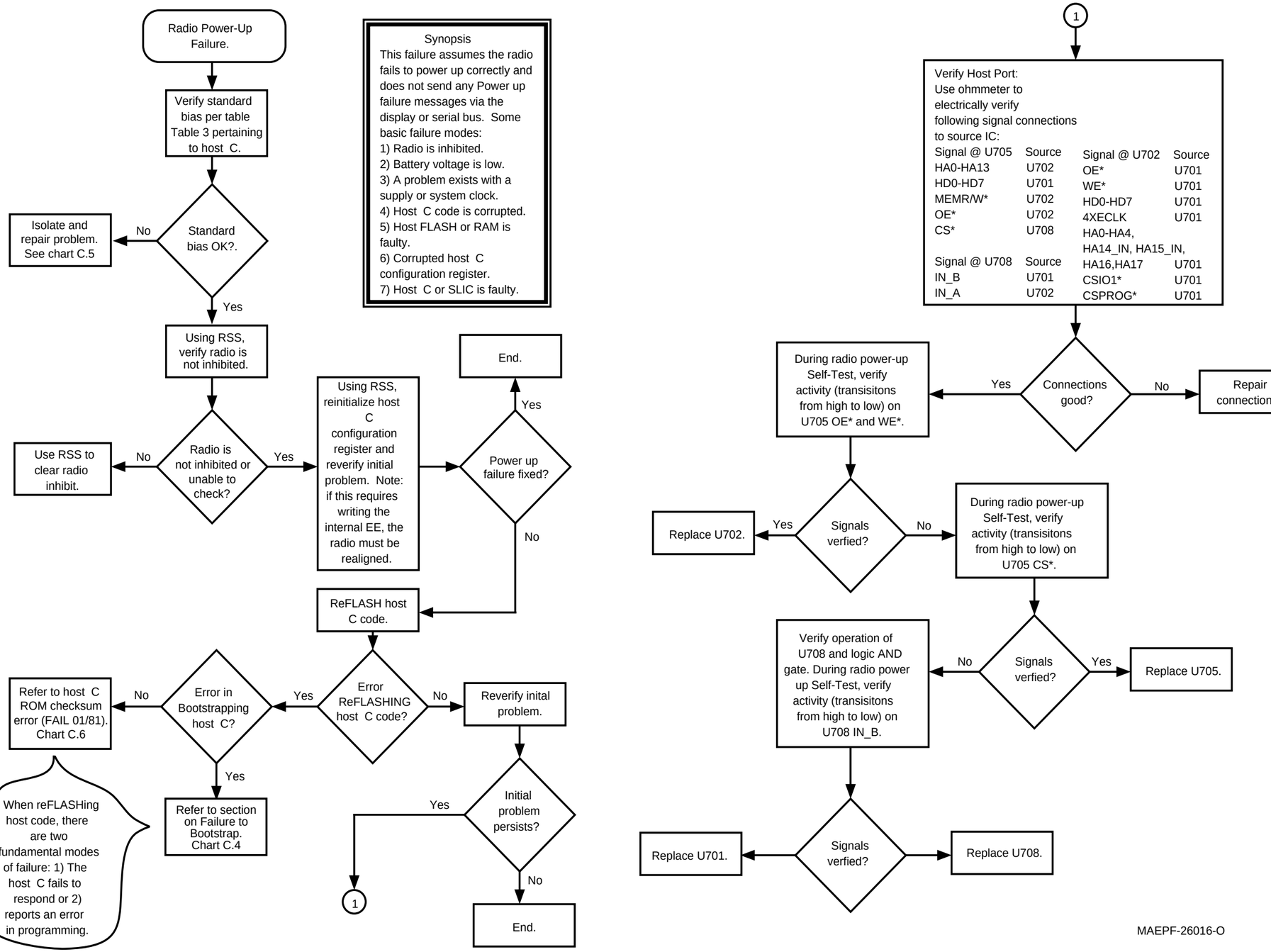
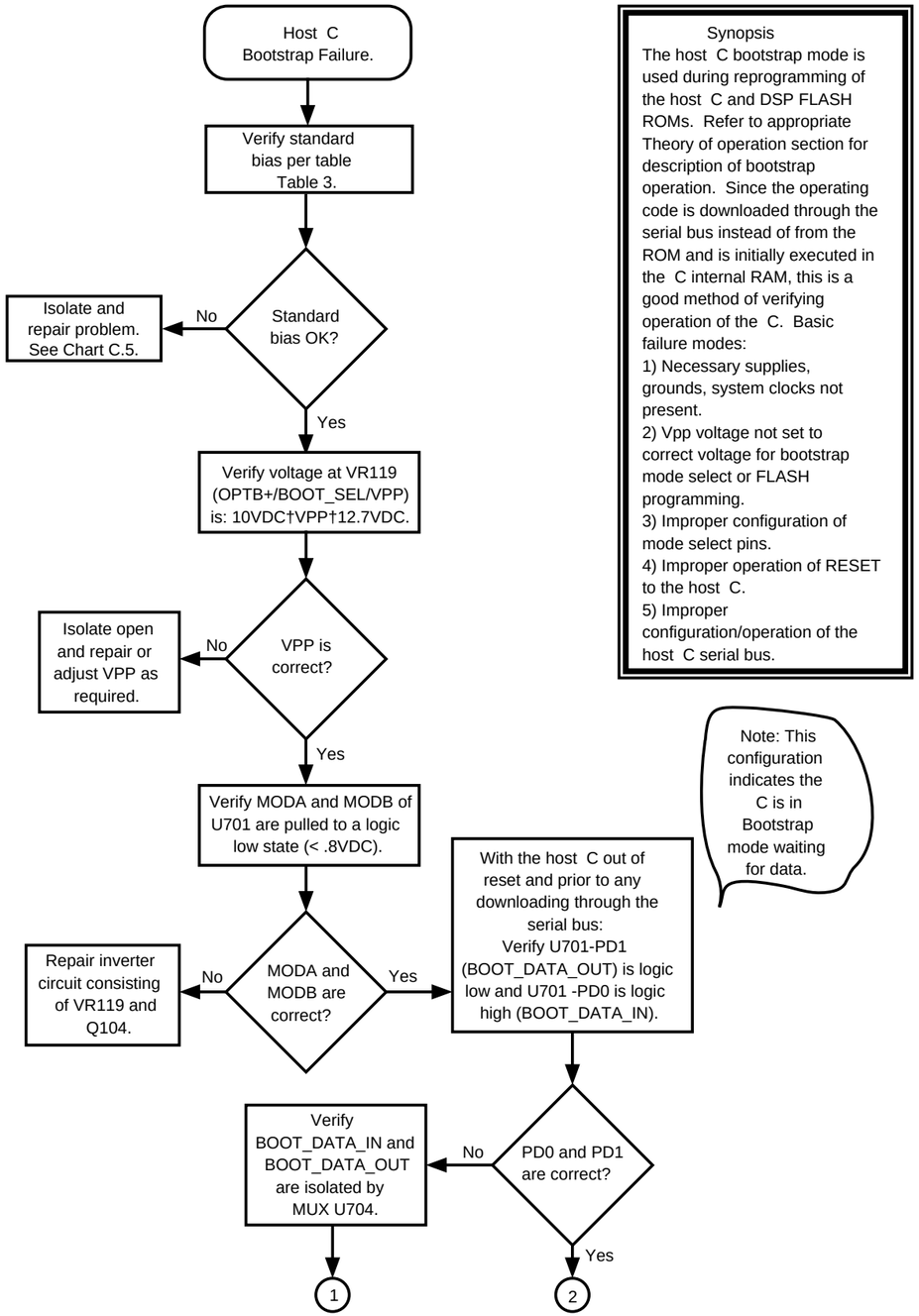


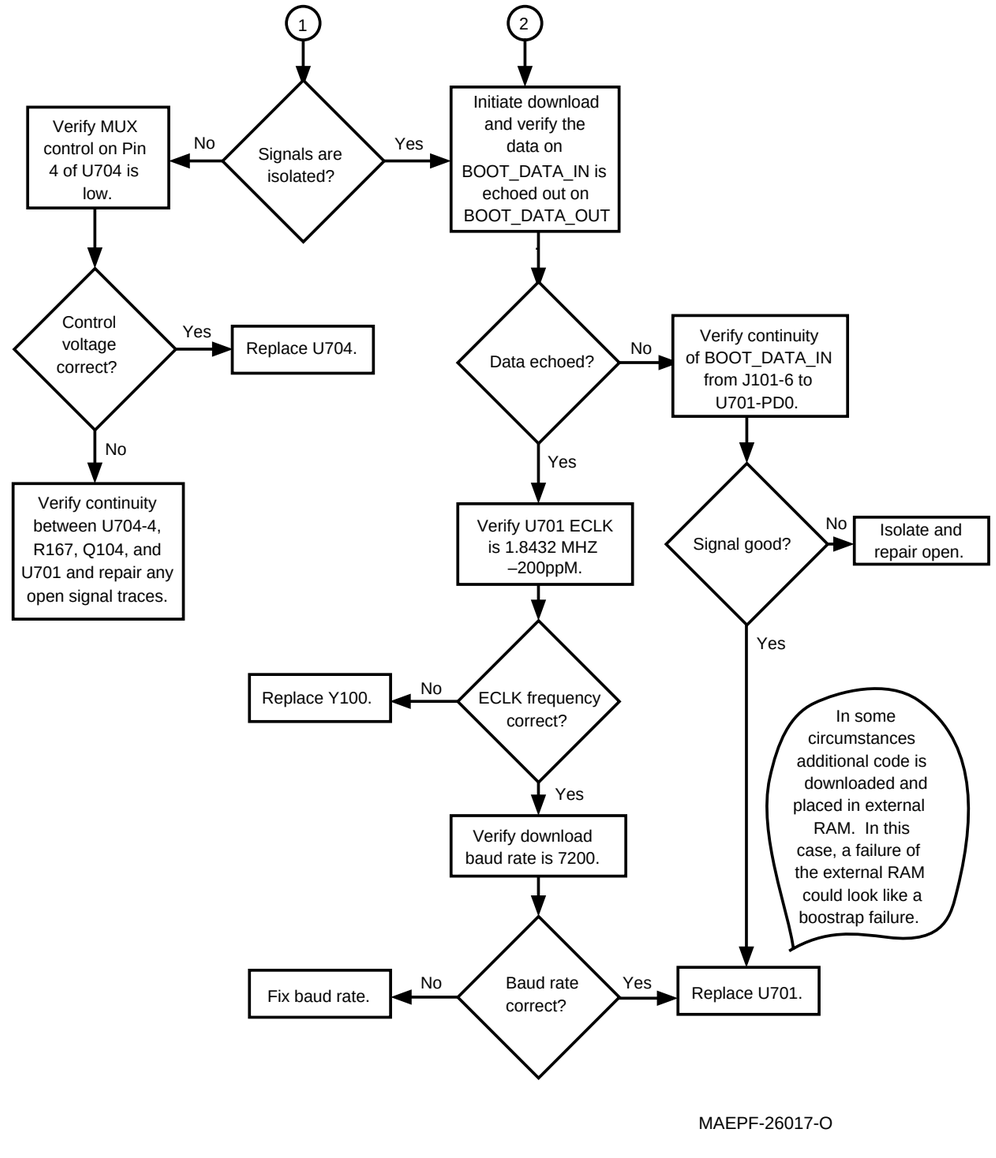
Chart 3. Radio Power-up Fail



Synopsis

The host C bootstrap mode is used during reprogramming of the host C and DSP FLASH ROMs. Refer to appropriate Theory of operation section for description of bootstrap operation. Since the operating code is downloaded through the serial bus instead of from the ROM and is initially executed in the C internal RAM, this is a good method of verifying operation of the C. Basic failure modes:

1) Necessary supplies, grounds, system clocks not present.
2) Vpp voltage not set to correct voltage for bootstrap mode select or FLASH programming.
3) Improper configuration of mode select pins.
4) Improper operation of RESET to the host C.
5) Improper configuration/operation of the host C serial bus.



MAEPF-26017-O

Chart 4. Bootstrap Fail

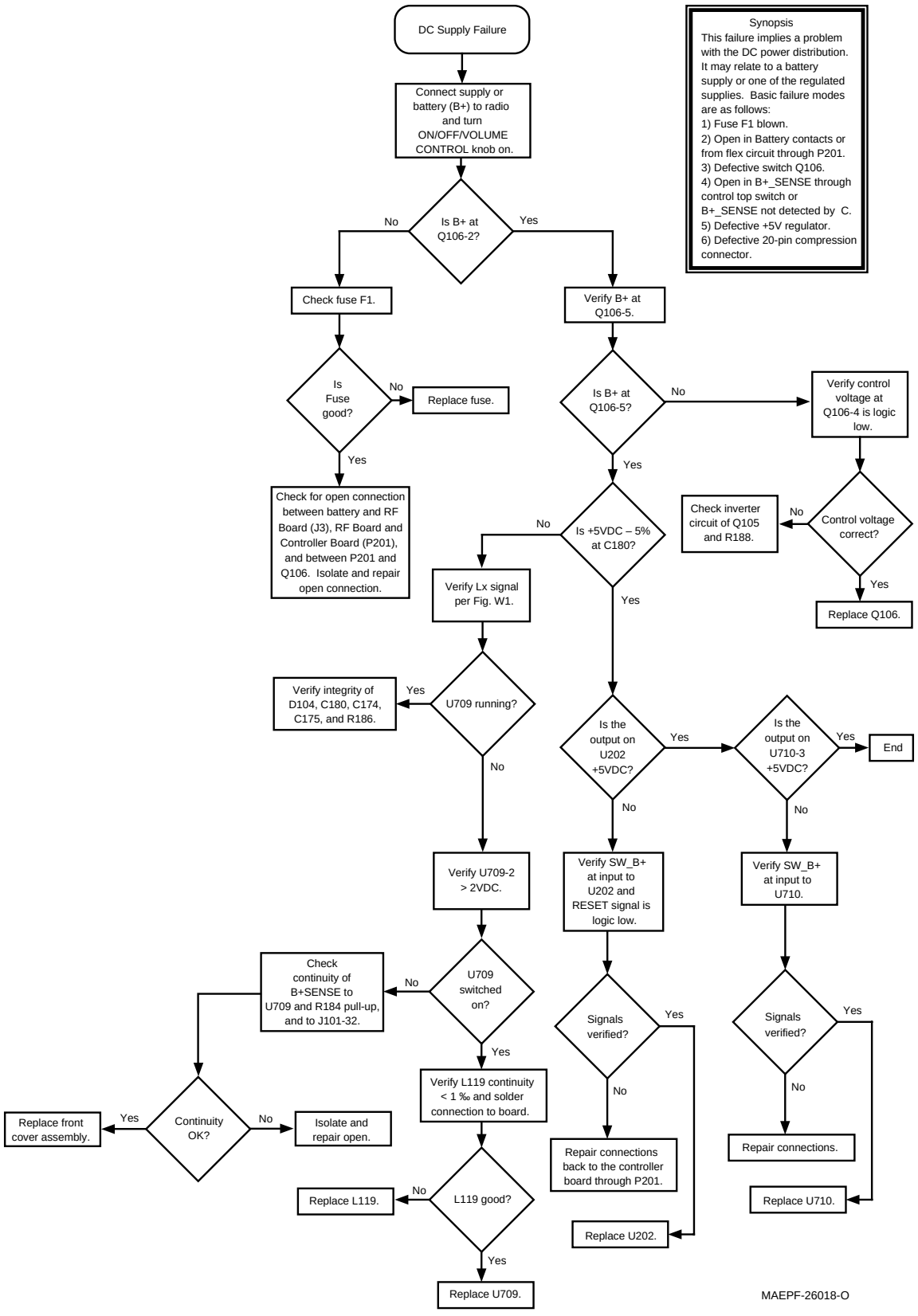


Chart 5. DC Supply Failure

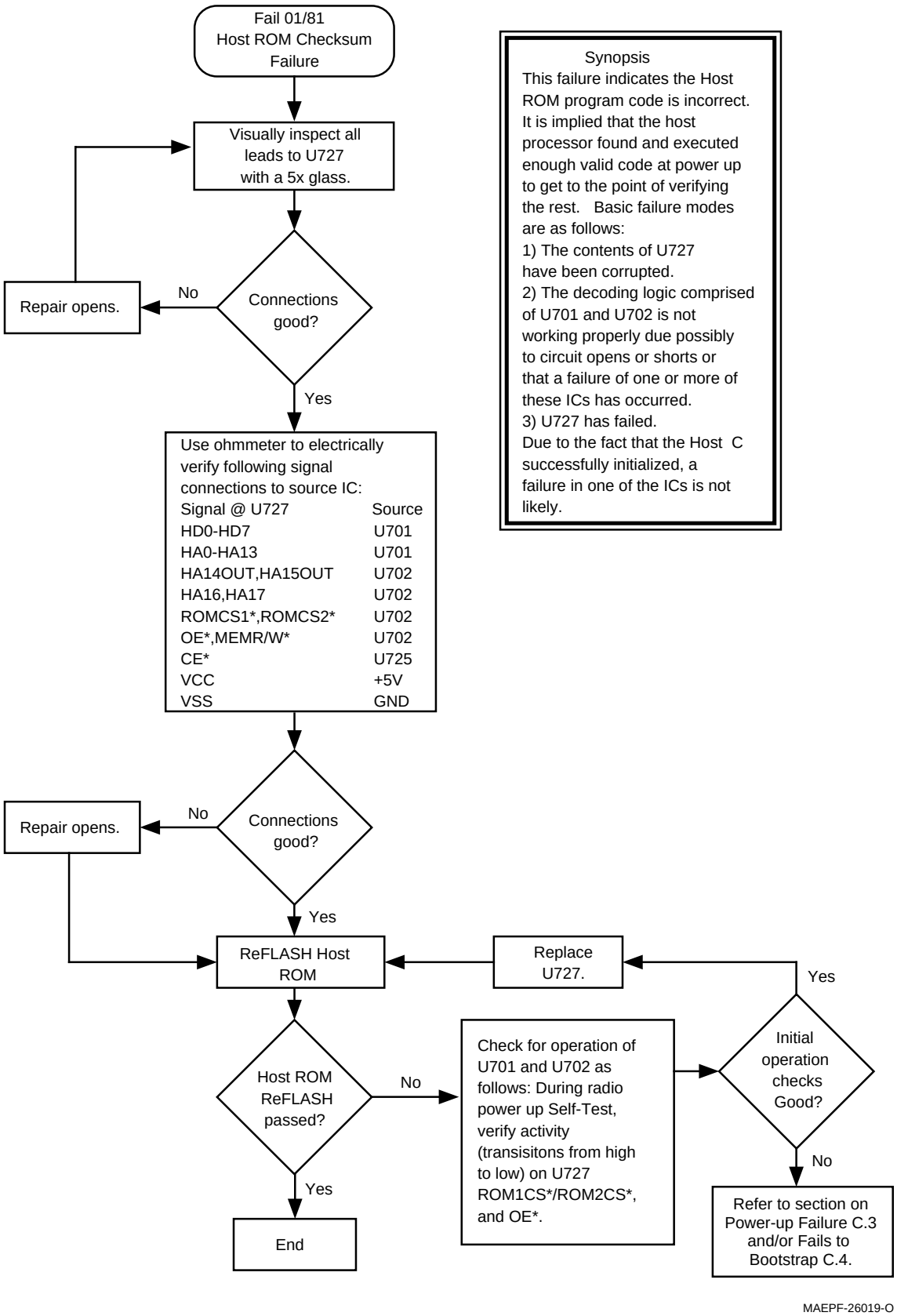


Chart 6. 01/81 Host ROM Checksum Failure

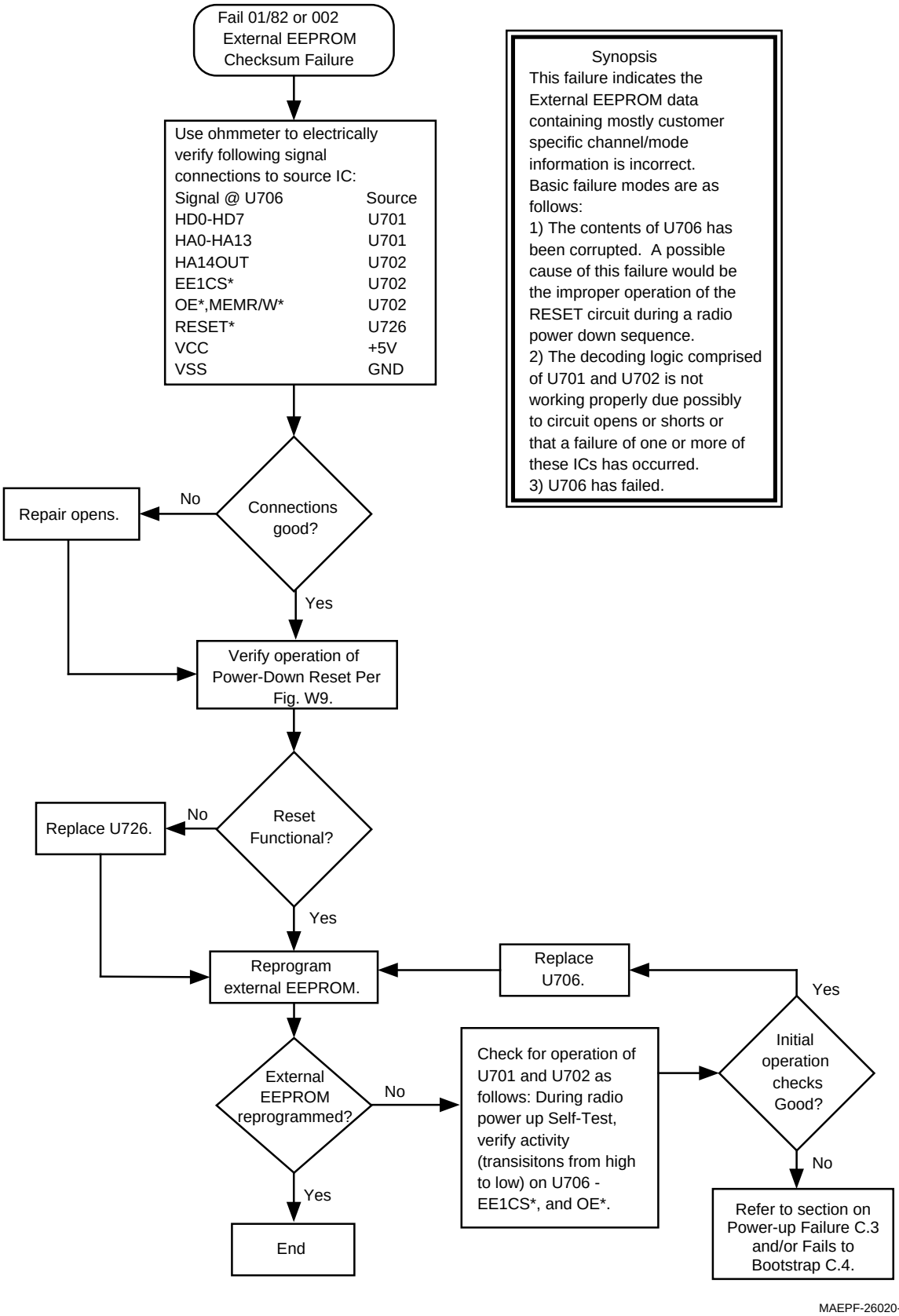


Chart 7. 01/82 or 002, External EEPROM Checksum Failure

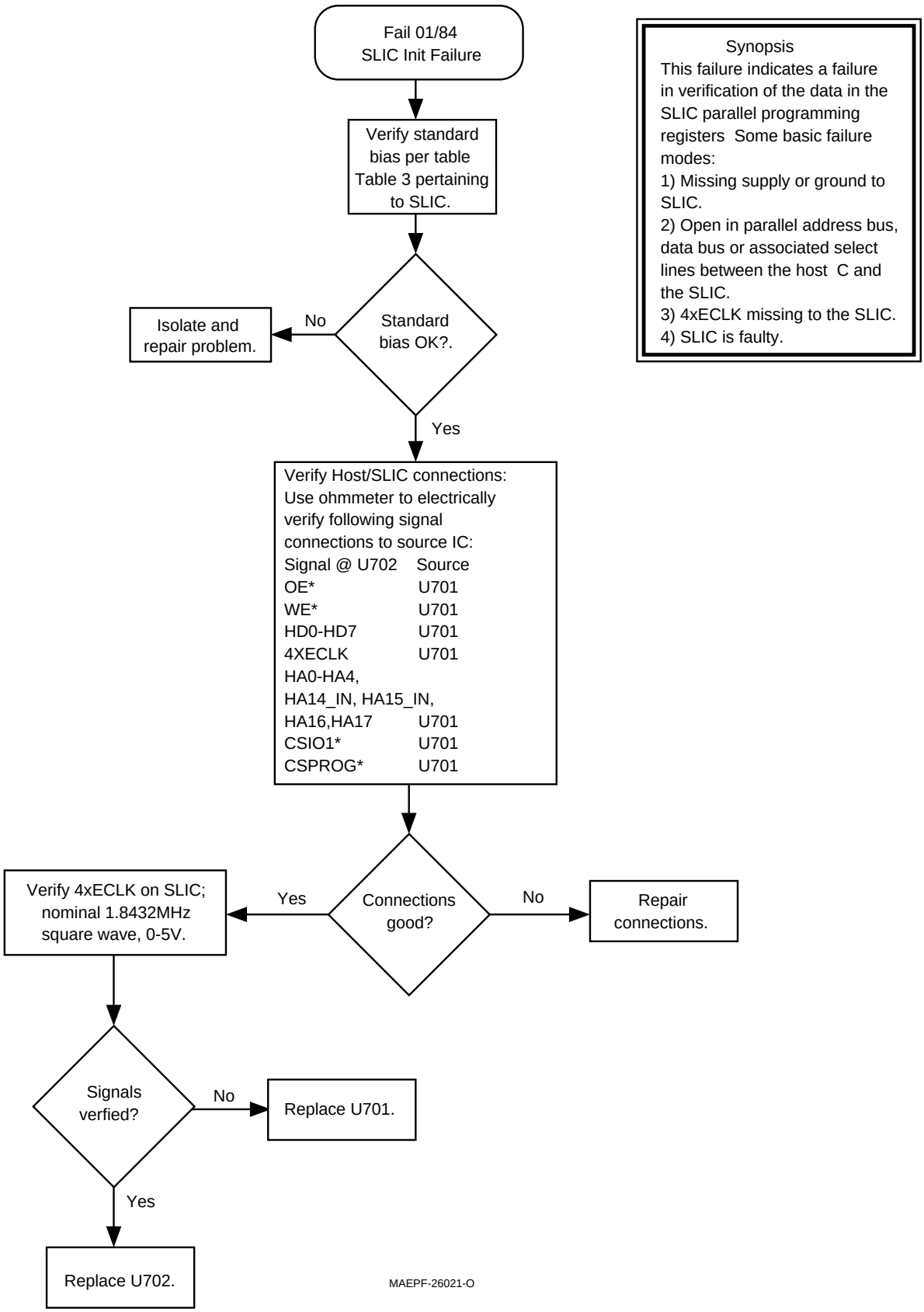


Chart 8. 01/84 SLIC Initialization Failure

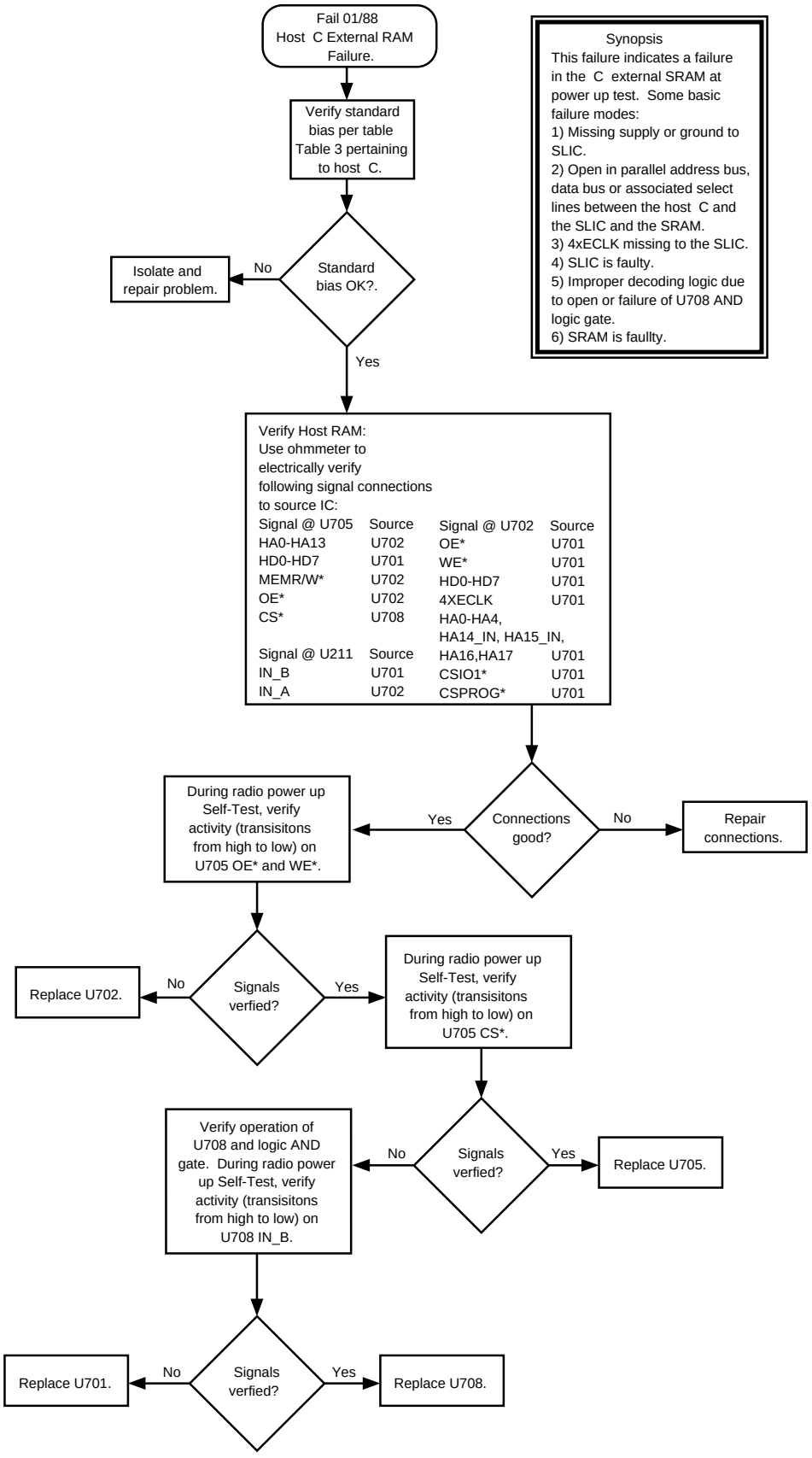


Chart 9. 01/88 MCU (Host µC) External SRAM

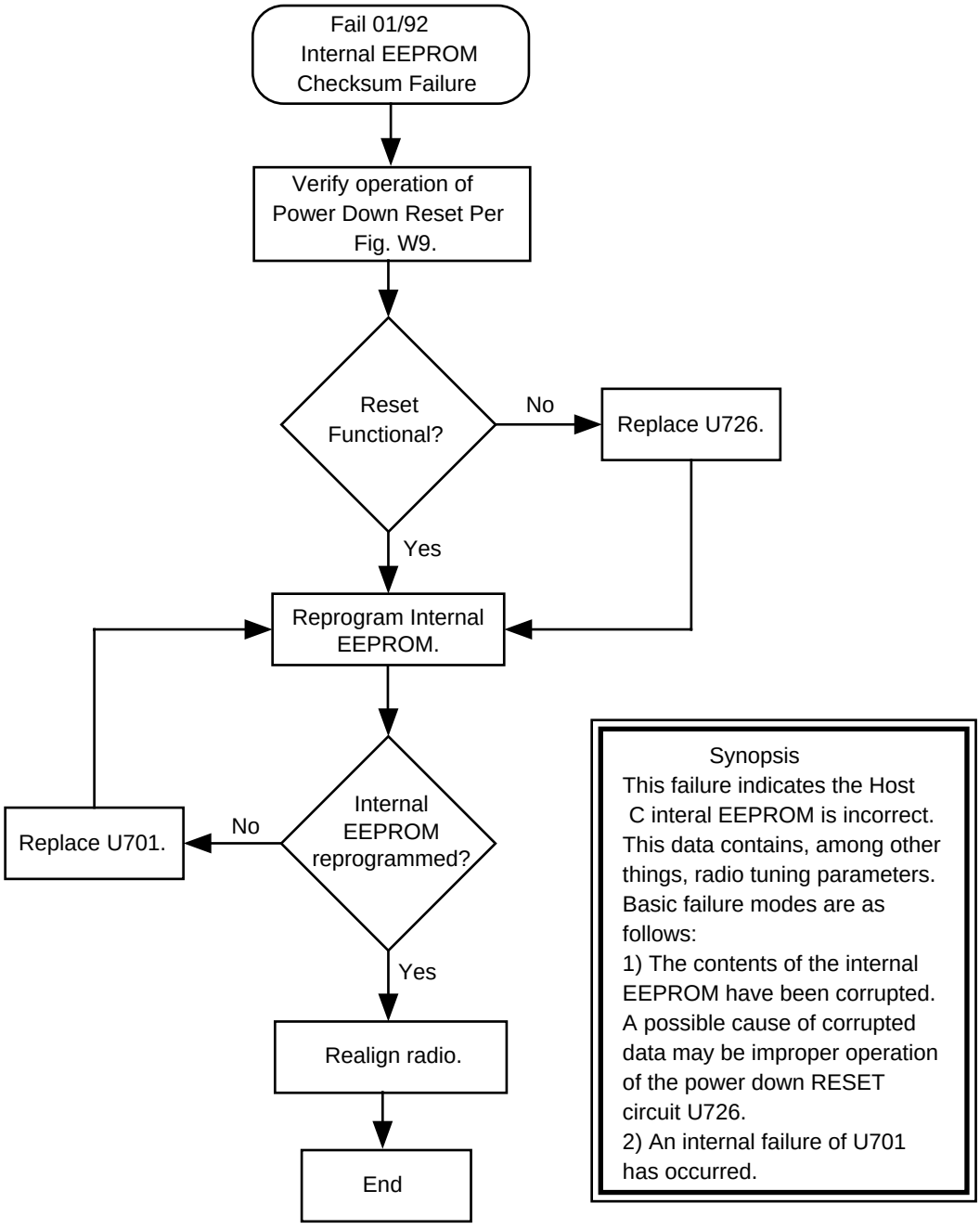


Chart 10. 01/92, Internal EEPROM Checksum Failure

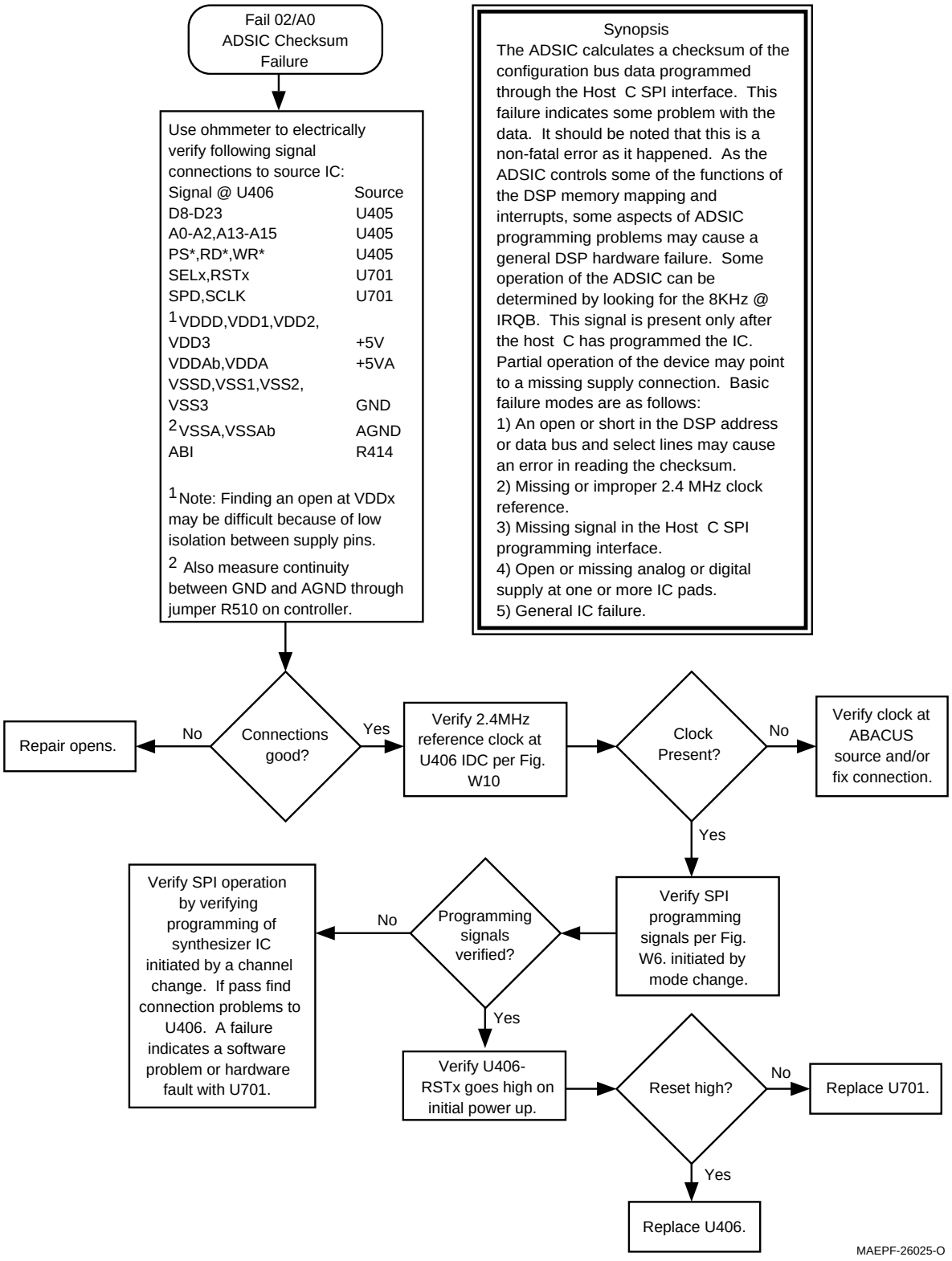


Chart 11. 02/A0, ADSIC Checksum Failure

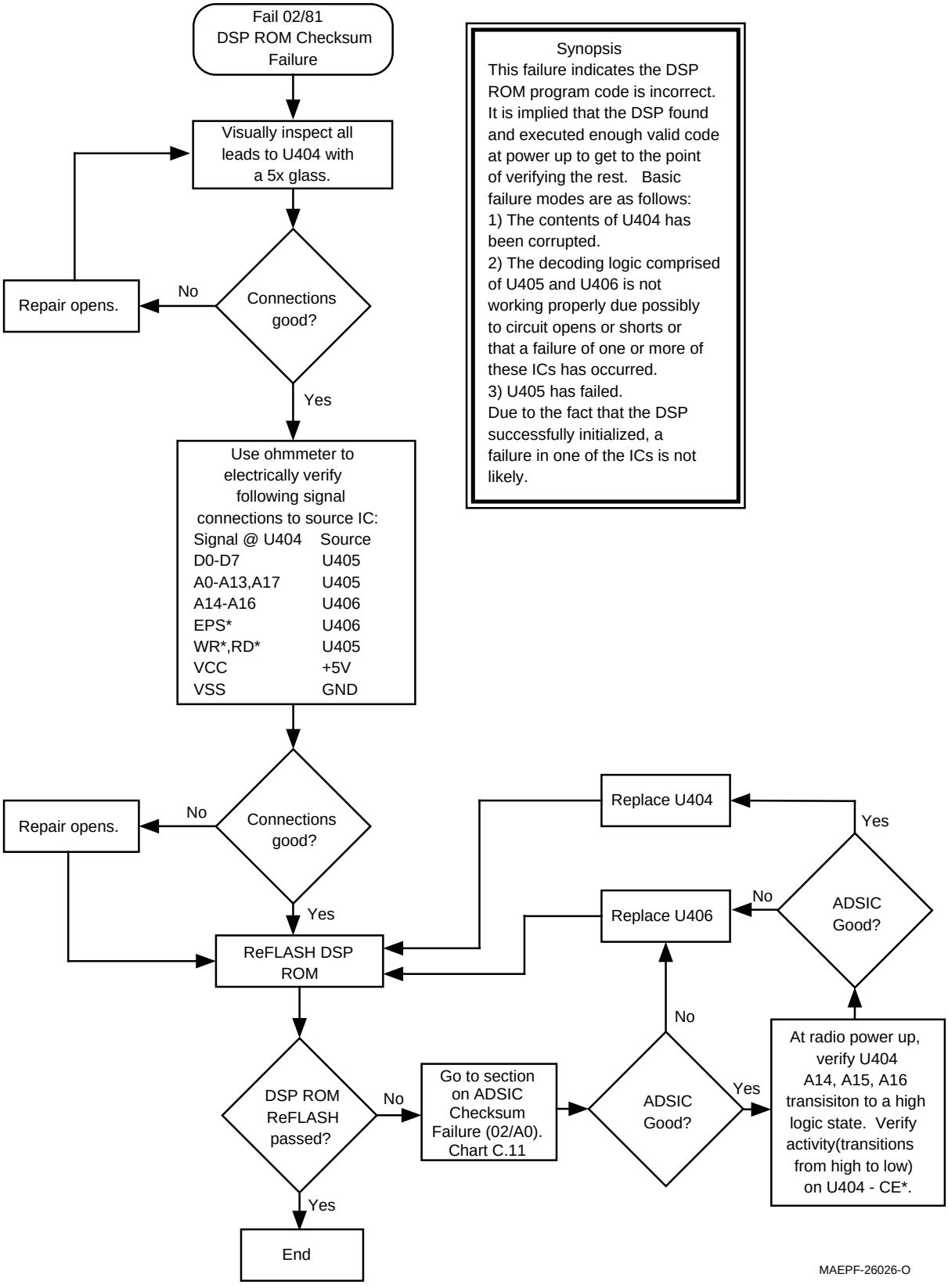


Chart 12. 02/81, DSP ROM Checksum Failure

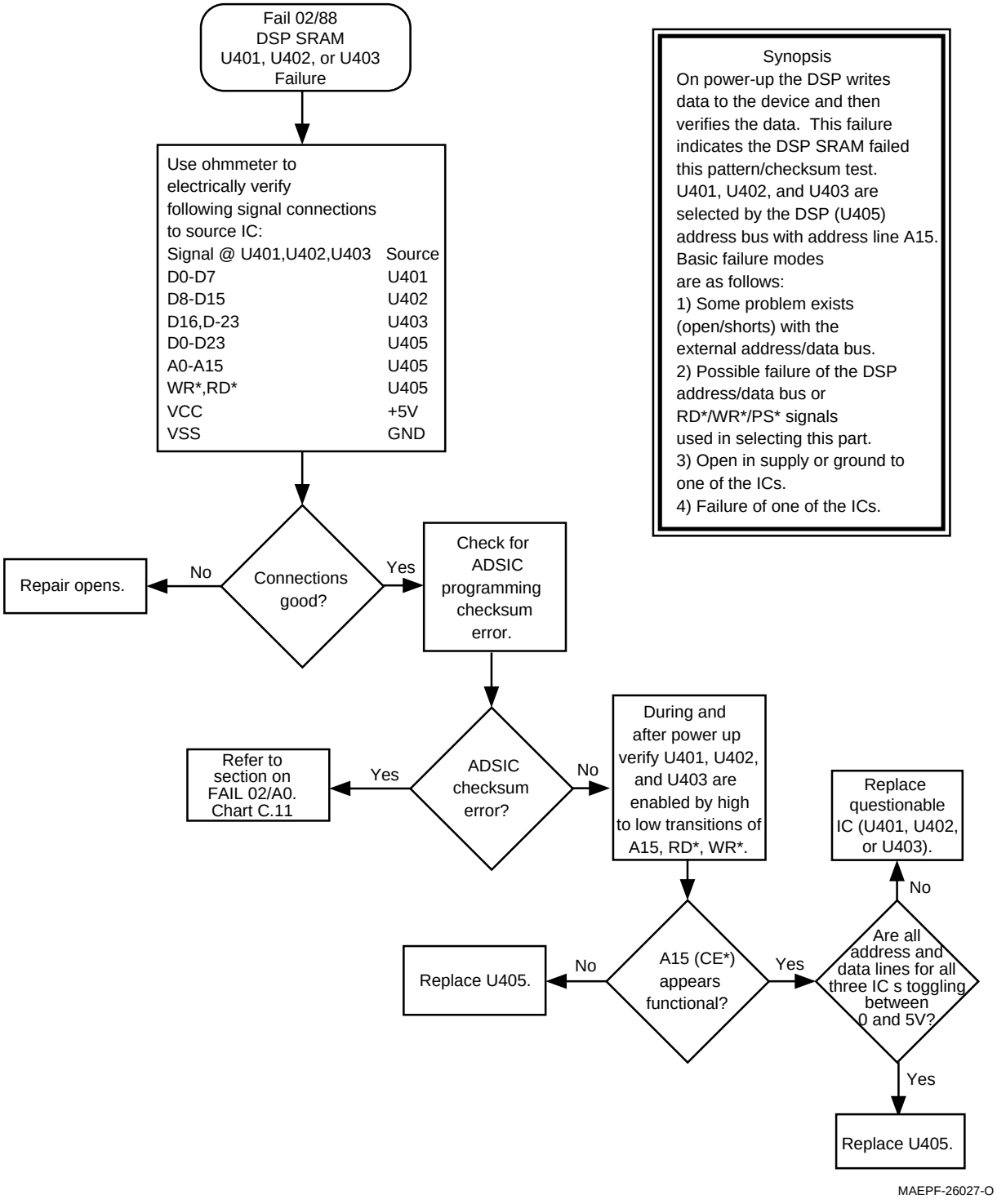


Chart 13. 02/88, DSP External SRAM Failure U414

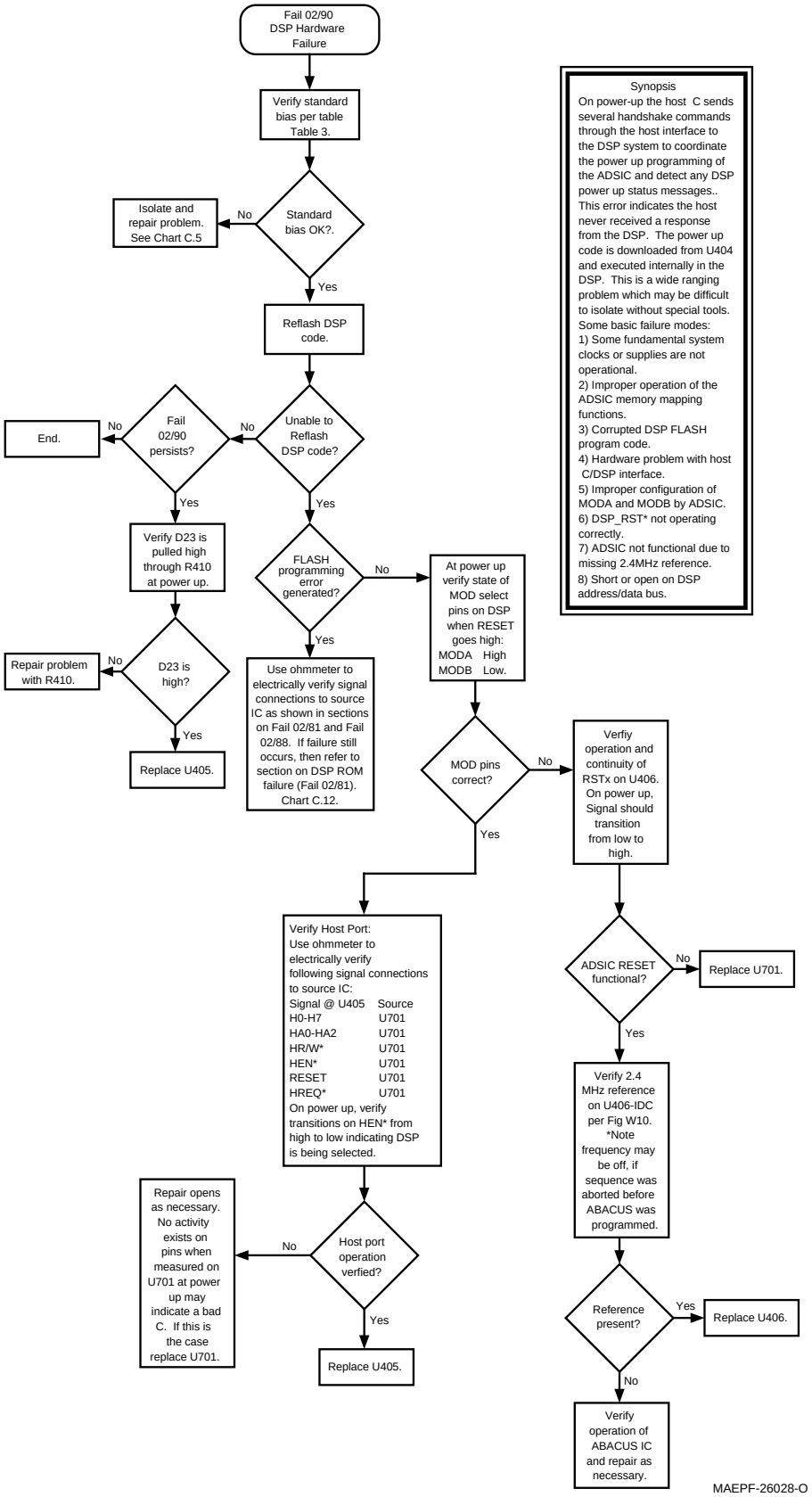


Chart 14. 02/90, General DSP Hardware Failure

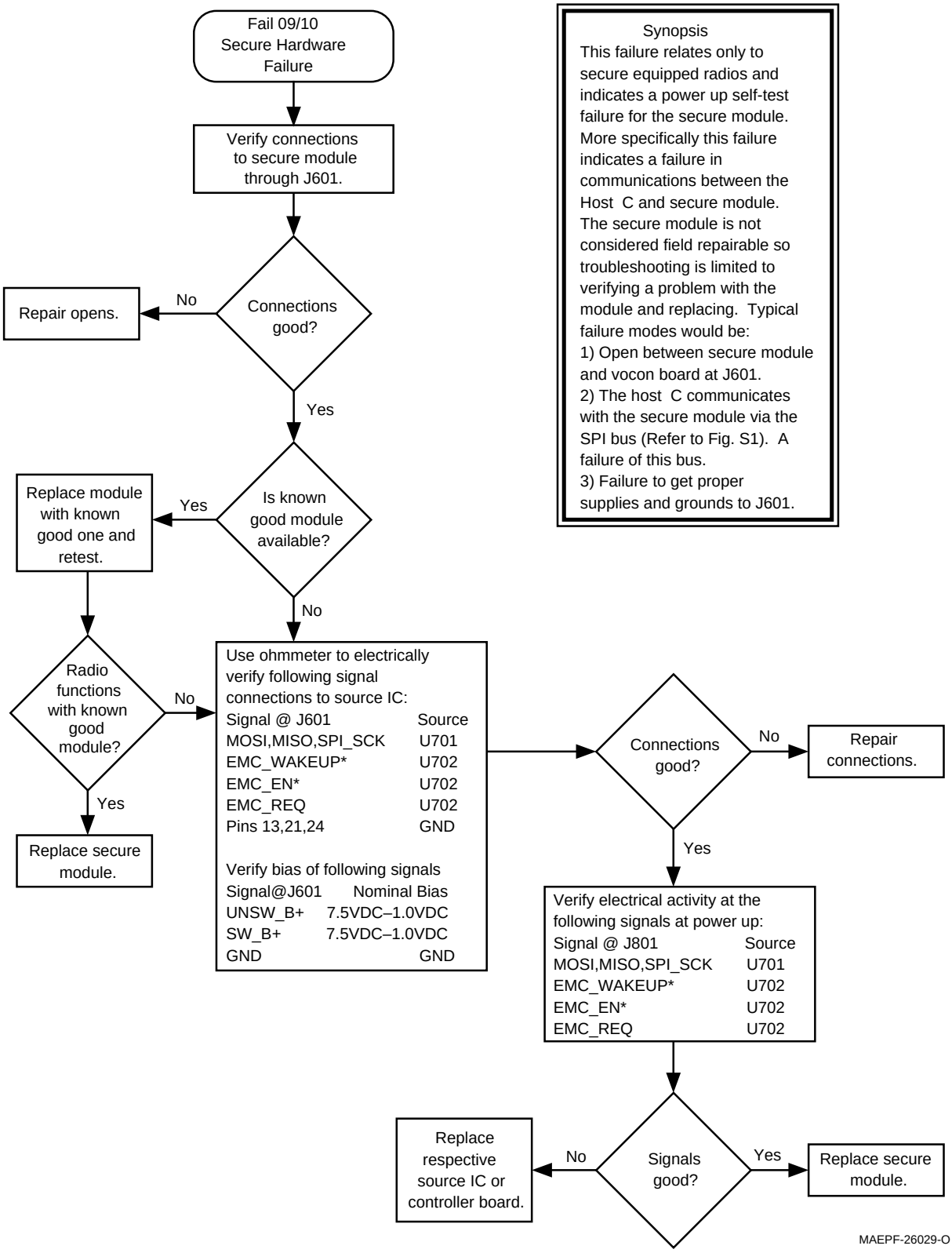


Chart 15. 09/10, Secure Hardware Failure

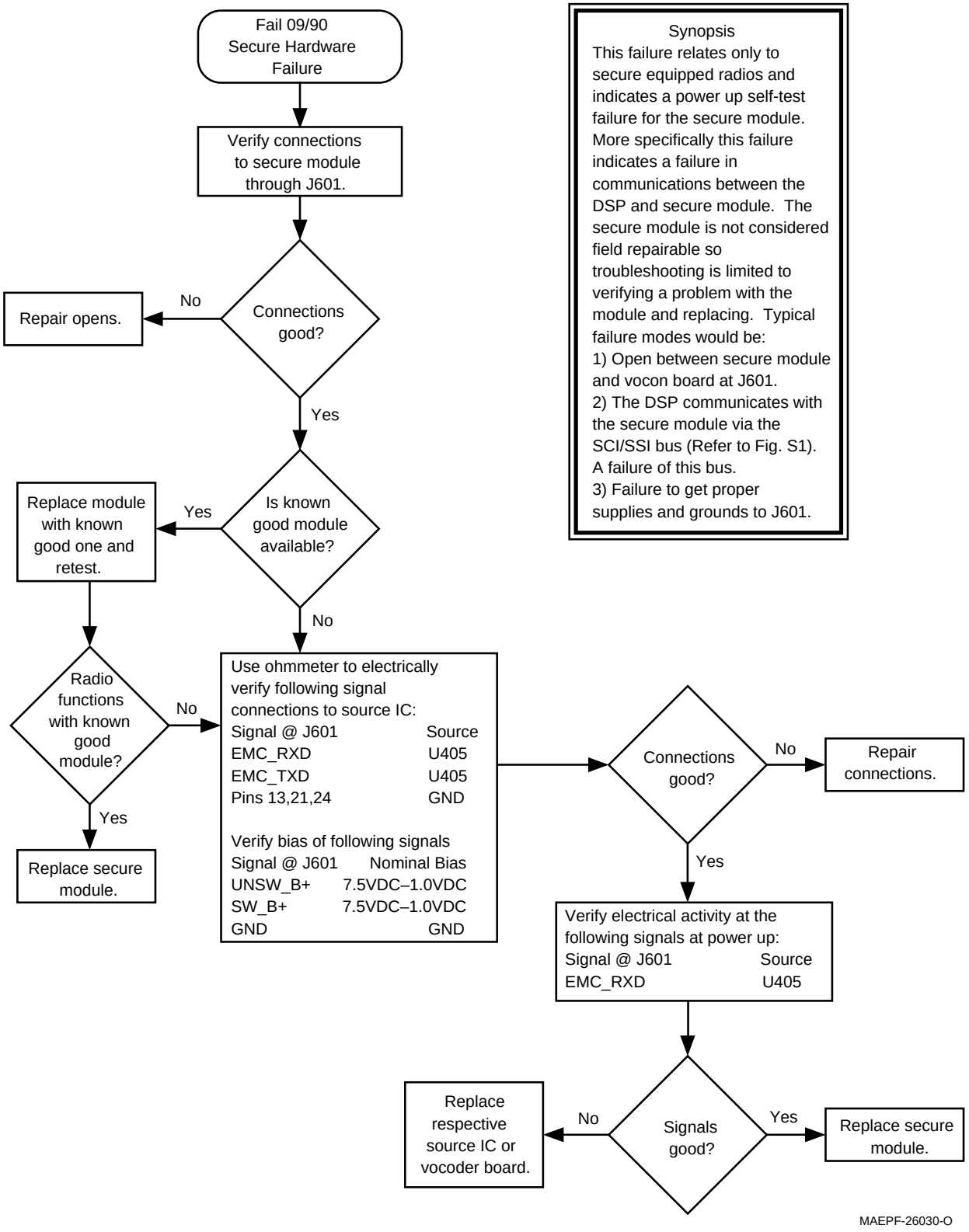


Chart 16. 09/90, Secure Hardware Failure

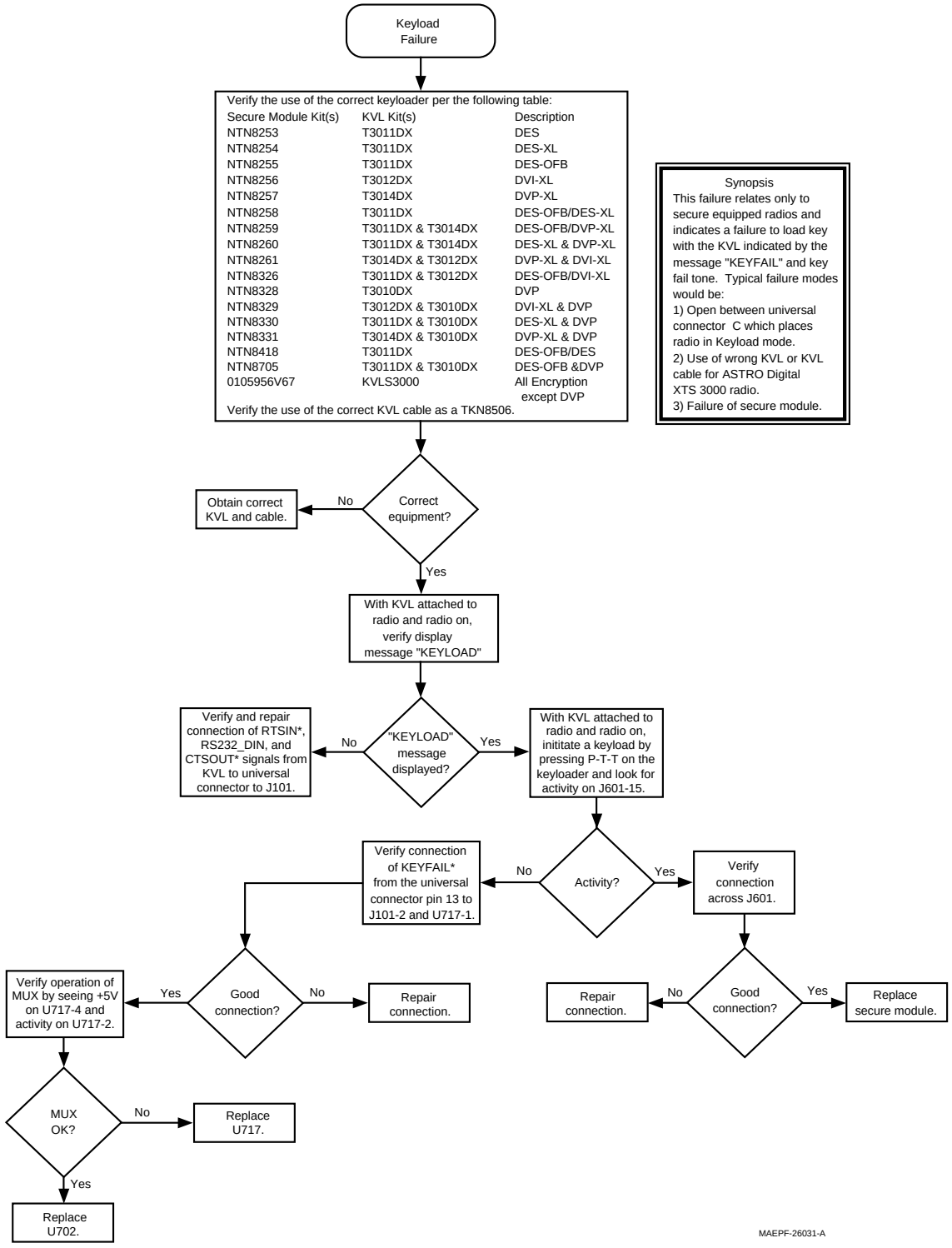
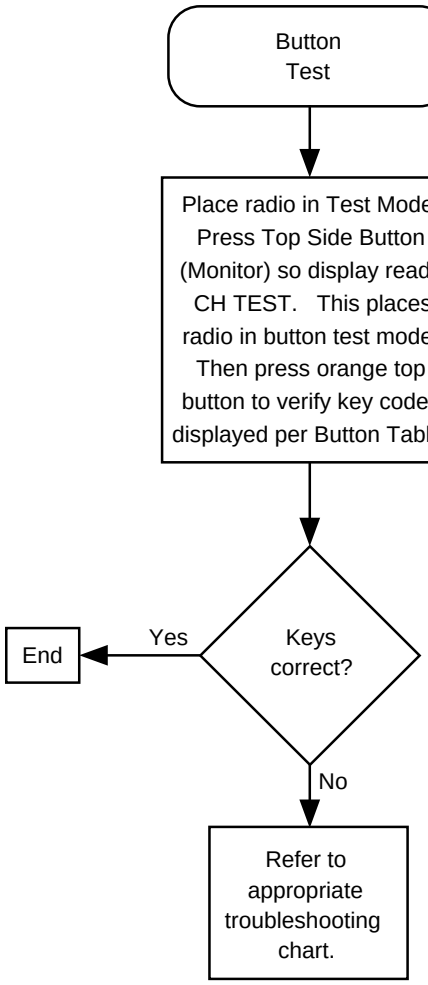


Chart 17. Key Load Fail



Synopsis

This chart relates to a failure in the button functions. Basic Failure modes are as follows:

1) Failure in control top/ptt or keypad flex assembly.
2) Bad connection.
3) Defective switches or pads.
4) Defective A/D port in host C.

Button Table

Button	Code	Chart
PTT	1/ 0-1	C.22
Top Button (Emergency)	3/ 0-1	C.22
Top Side Button (Monitor)	96/ 0-1	C.22
Side Button 1 (RAT 1)	97/ 0-1	C.22
Side Button 2 (RAT 2)	98/ 0-1	C.22
Secure/Clear Switch	65/ 0-1	C.22
Zone/Channel Select (Frequency)	4/ 0-15	C.21
Volume Control Knob	2/ 0-255	C.20
Toggle Switch	67/ A=0, B=1, C=2	

See Chart C.19

Keypad Table

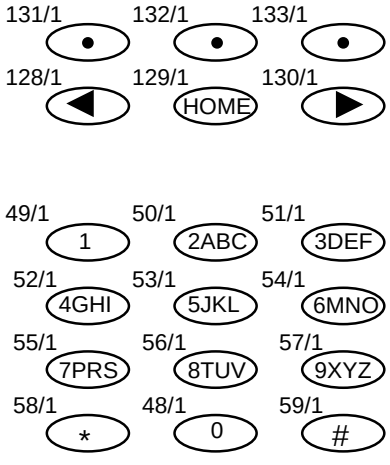


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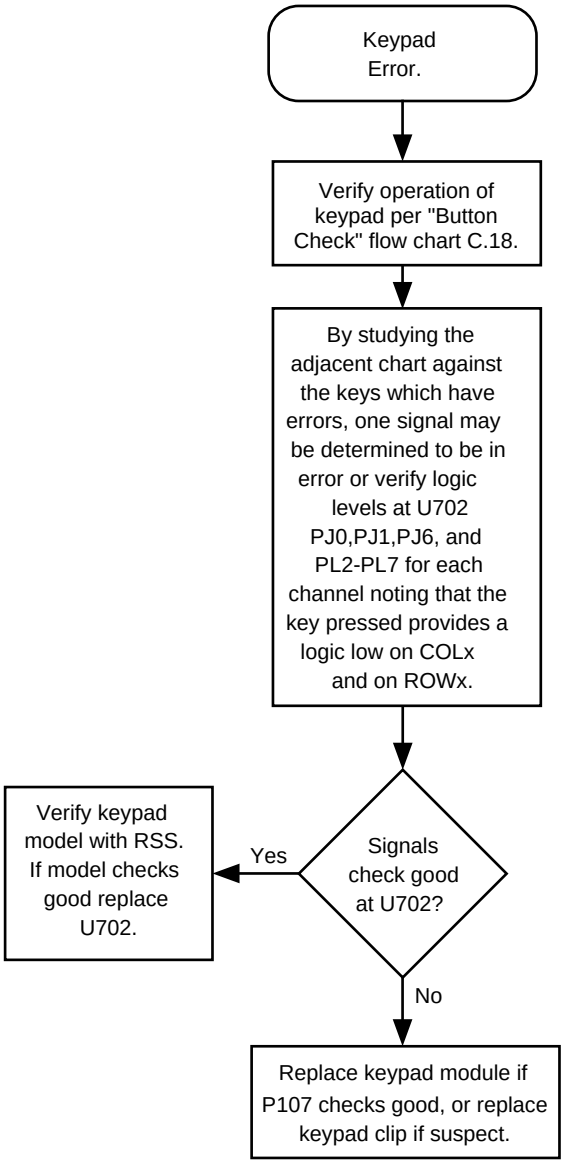
Chart 18. Button Test



Synopsis

This chart relates to a failure in reading the keypad. Basic Failure modes are as follows:

1) Failure in flex circuit.
2) Bad connection.
3) Defective keypad.
4) Defective port in SLIC.

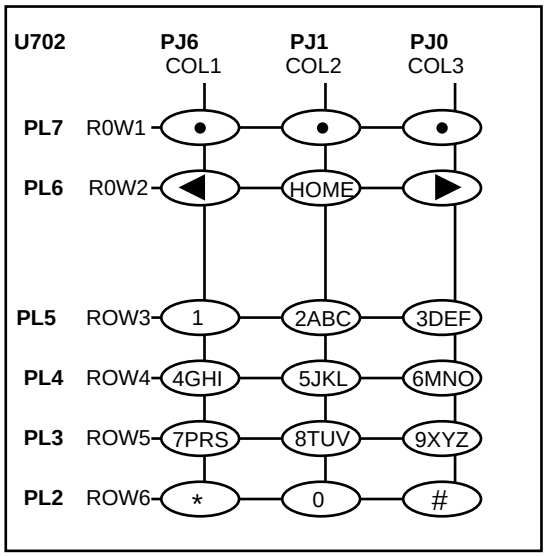


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Chart 19. Keypad Error

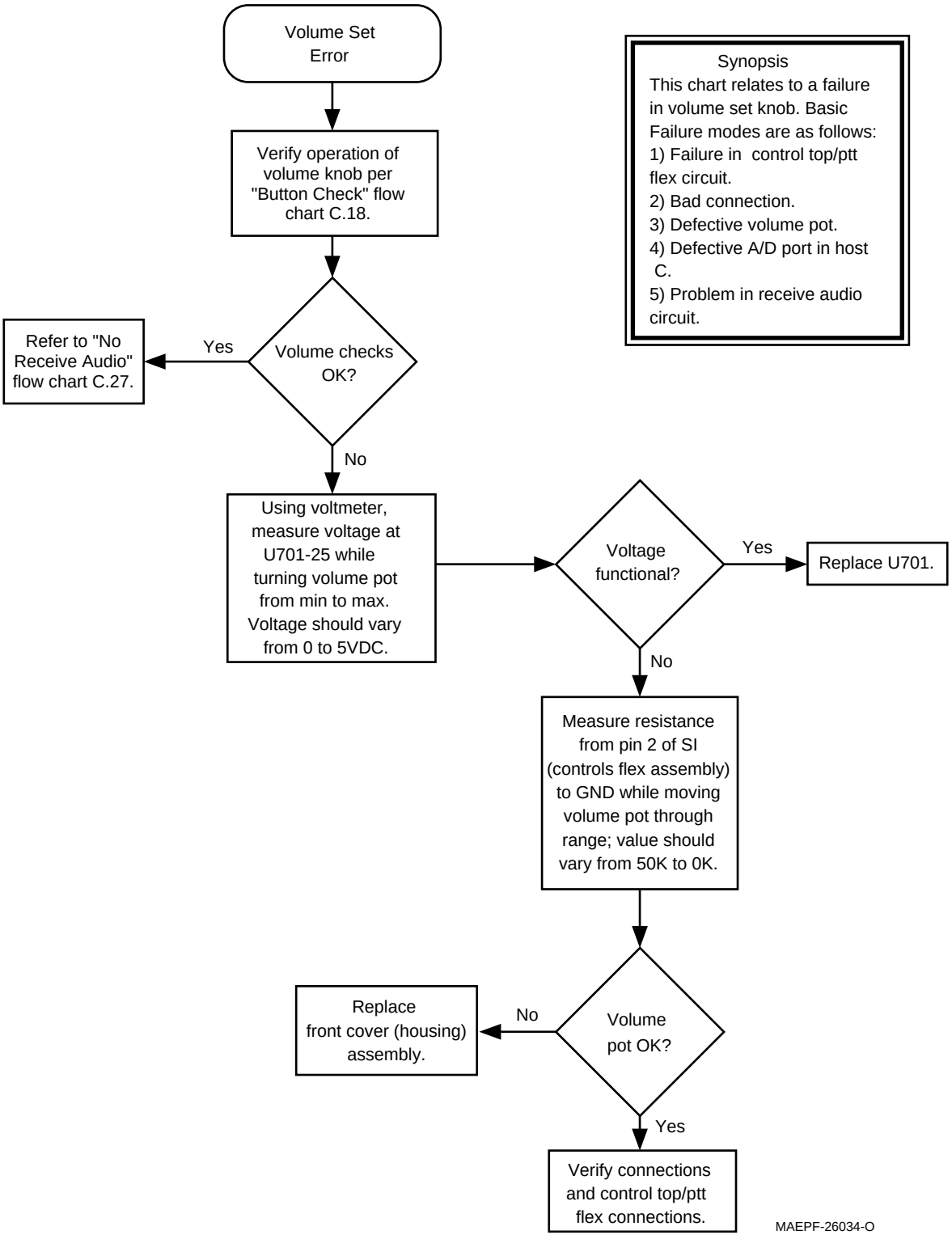
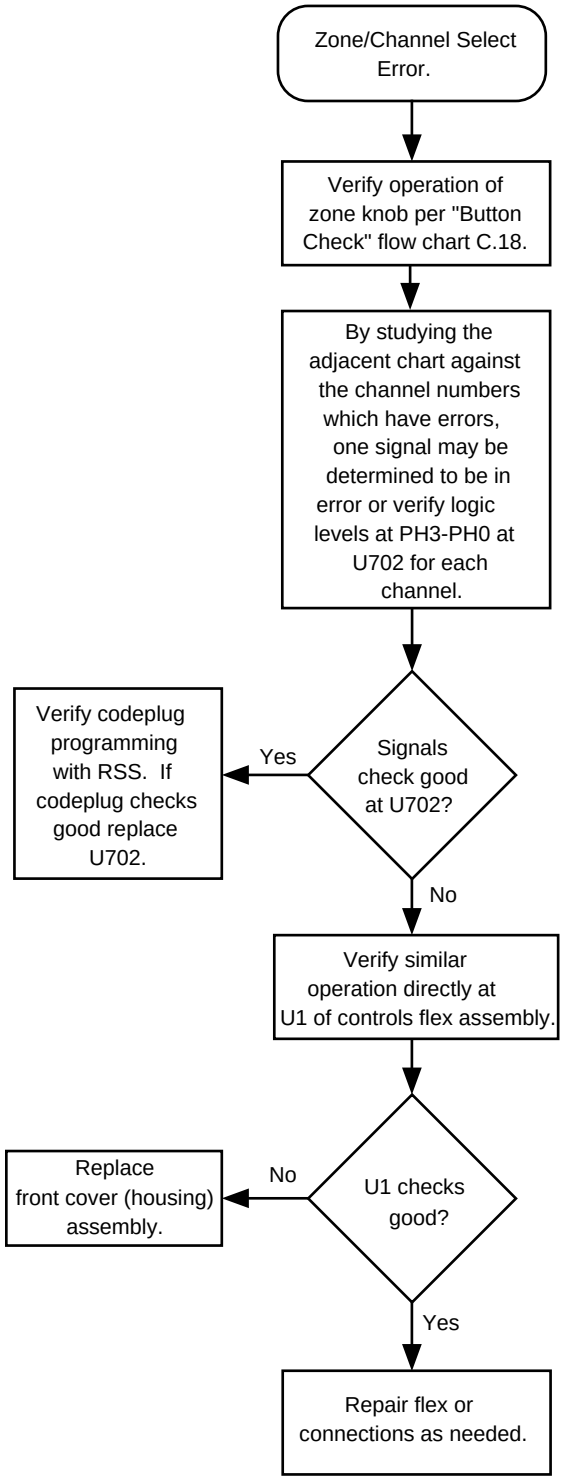


Chart 20. Volume Set Error



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Synopsis

This chart relates to a failure in reading the zone/channel select knob. Basic Failure modes are as follows:
1) Failure in flex circuit.
2) Bad connection.
3) Defective switch.
4) Defective port in SLIC.

Channel	RTA3	RTA2	RTA1	RTA0
1	0	0	0	0
2	0	0	0	1
3	0	0	1	0
4	0	0	1	1
5	0	1	0	0
6	0	1	0	1
7	0	1	1	0
8	0	1	1	1
9	1	0	0	0
10	1	0	0	1
11	1	0	1	0
12	1	0	1	1
13	1	1	0	0
14	1	1	0	1
15	1	1	1	0
16	1	1	1	1

Chart 21. Zone/Channel select Error

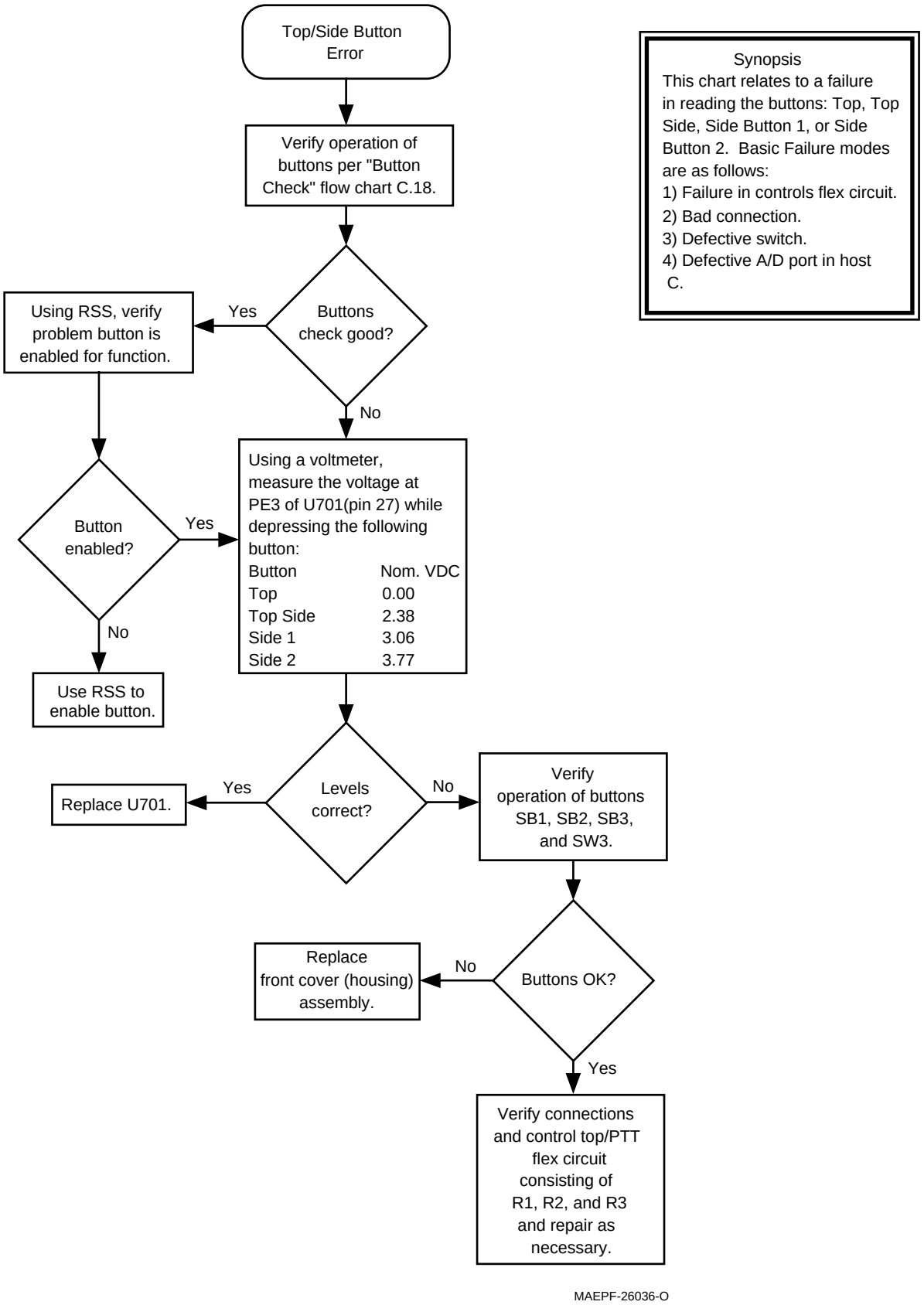
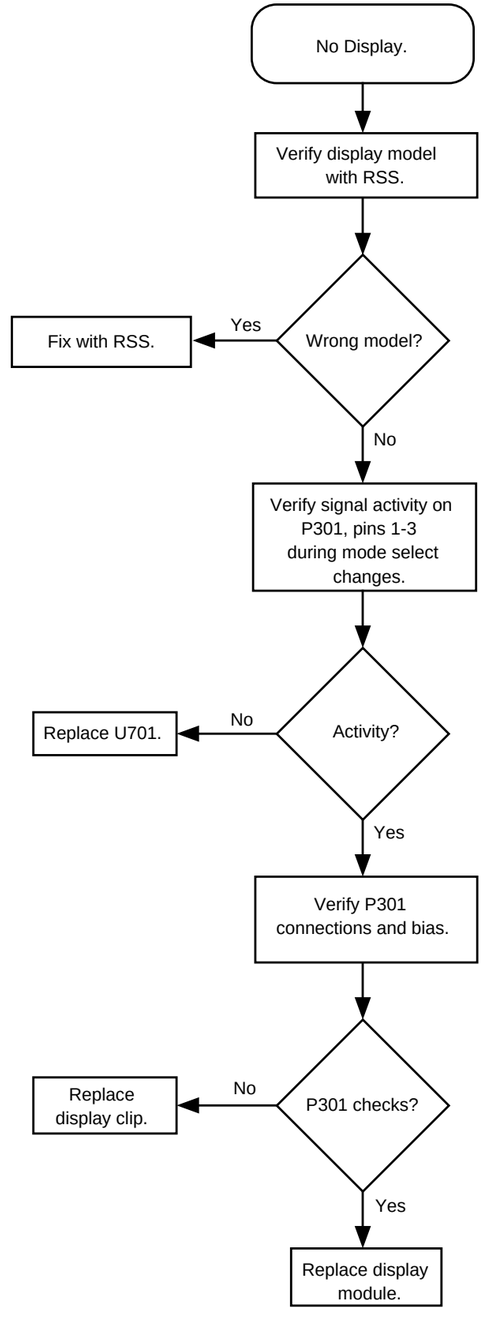


Chart 22. Top/Side Button Error



Synopsis

This chart relates to a failure in the display. The display is considered not field repairable and must be replaced as a uint. Basic Failure modes are as follows:

1) Non-display model radio.
2) Bad connection.
3) Defective C.

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Chart 23. Radio Power-up Fail

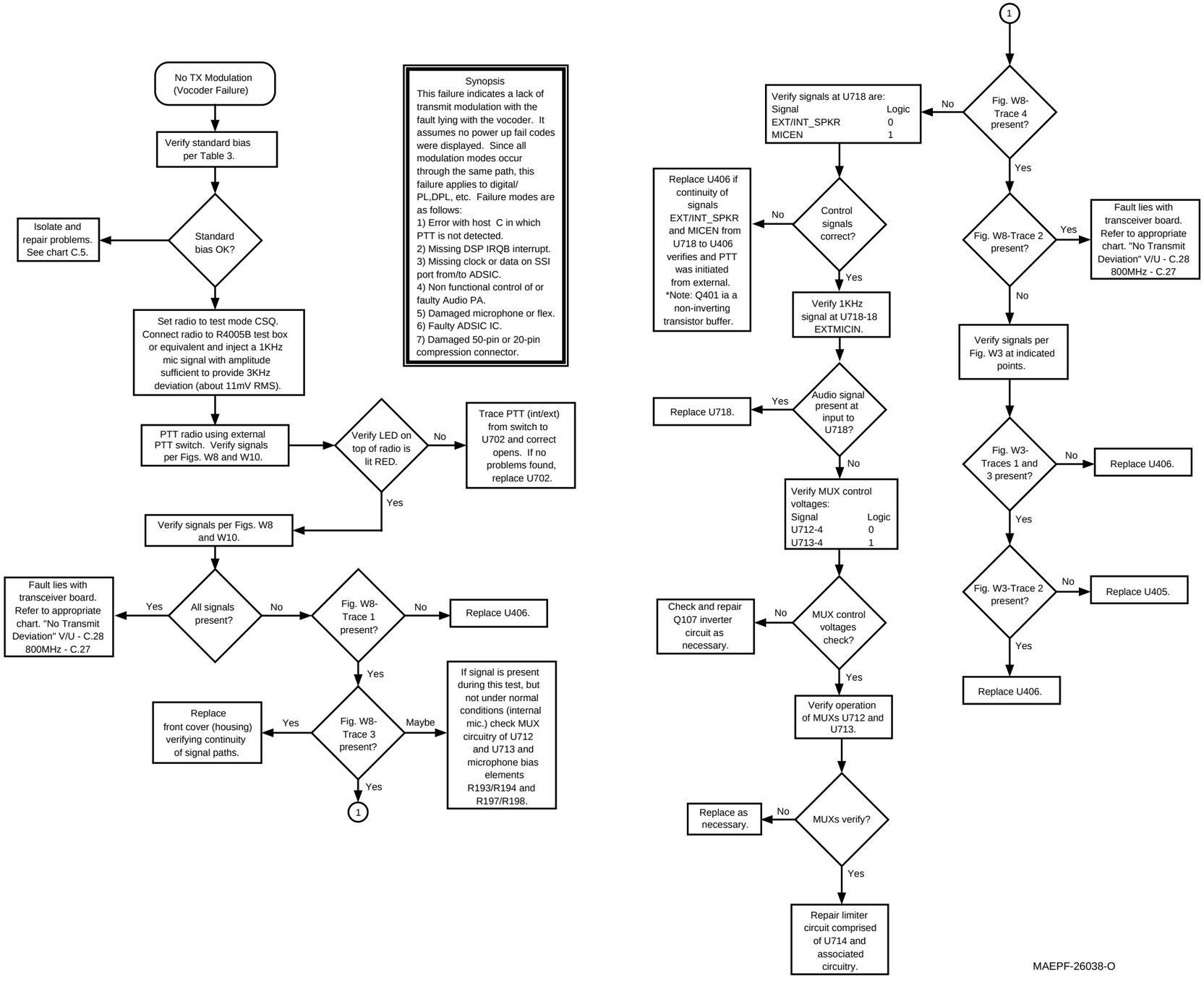

Chart 24. Bootstrap Fail

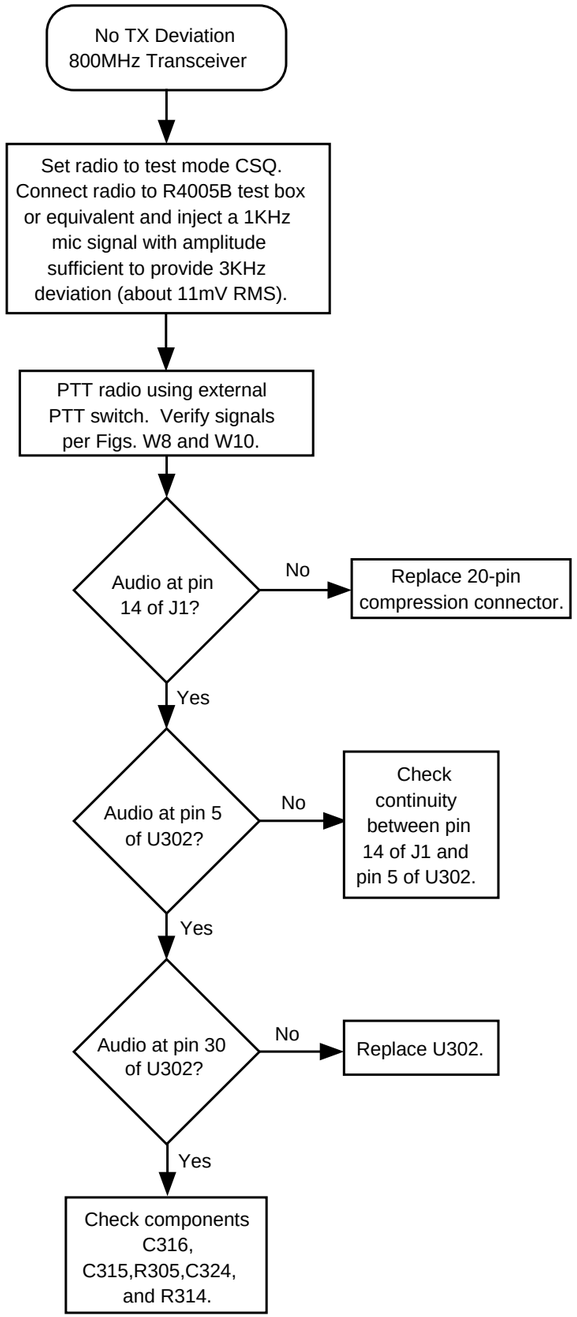

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Chart 25. 800 MHz No TX Deviation

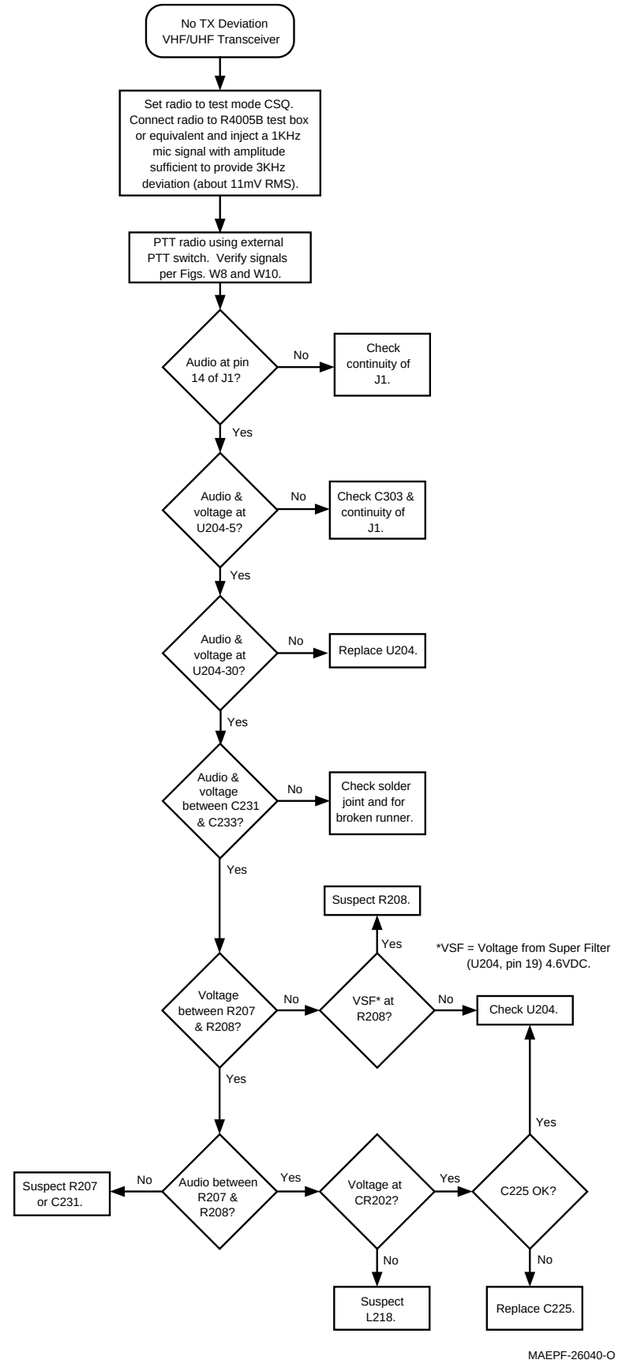

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Chart 26. VHF/UHF No TX Deviation

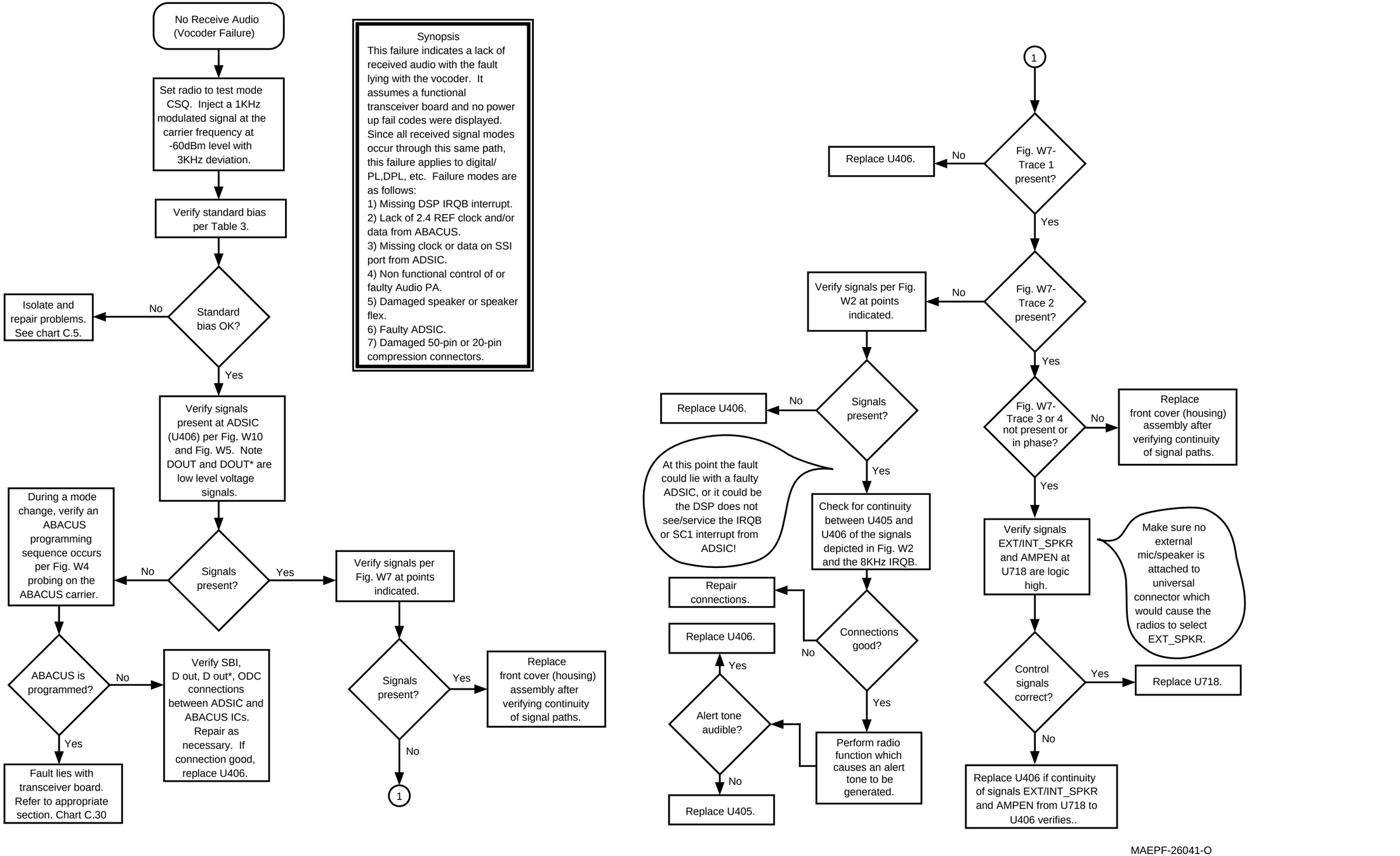


Chart 27. No RX Audio

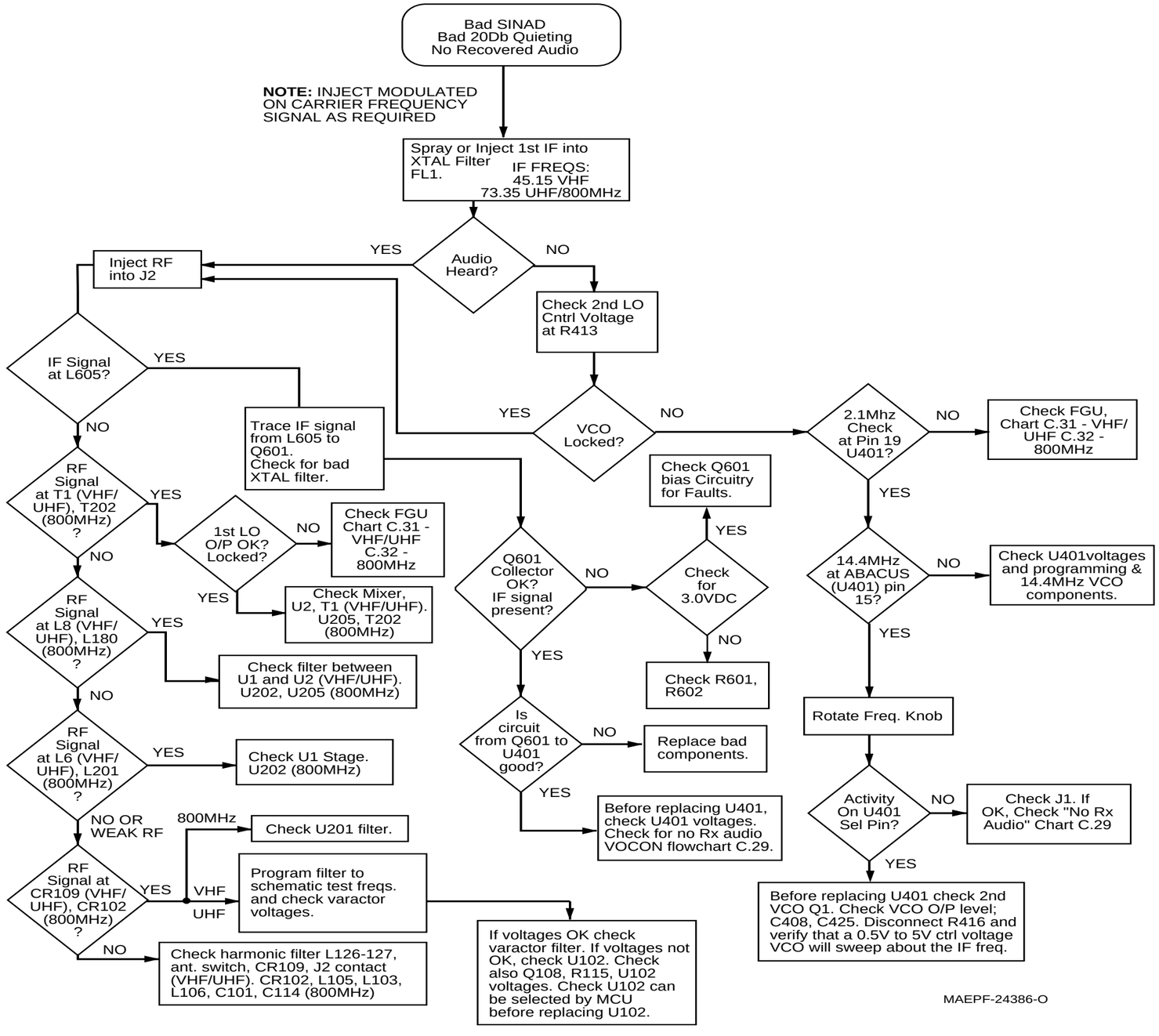
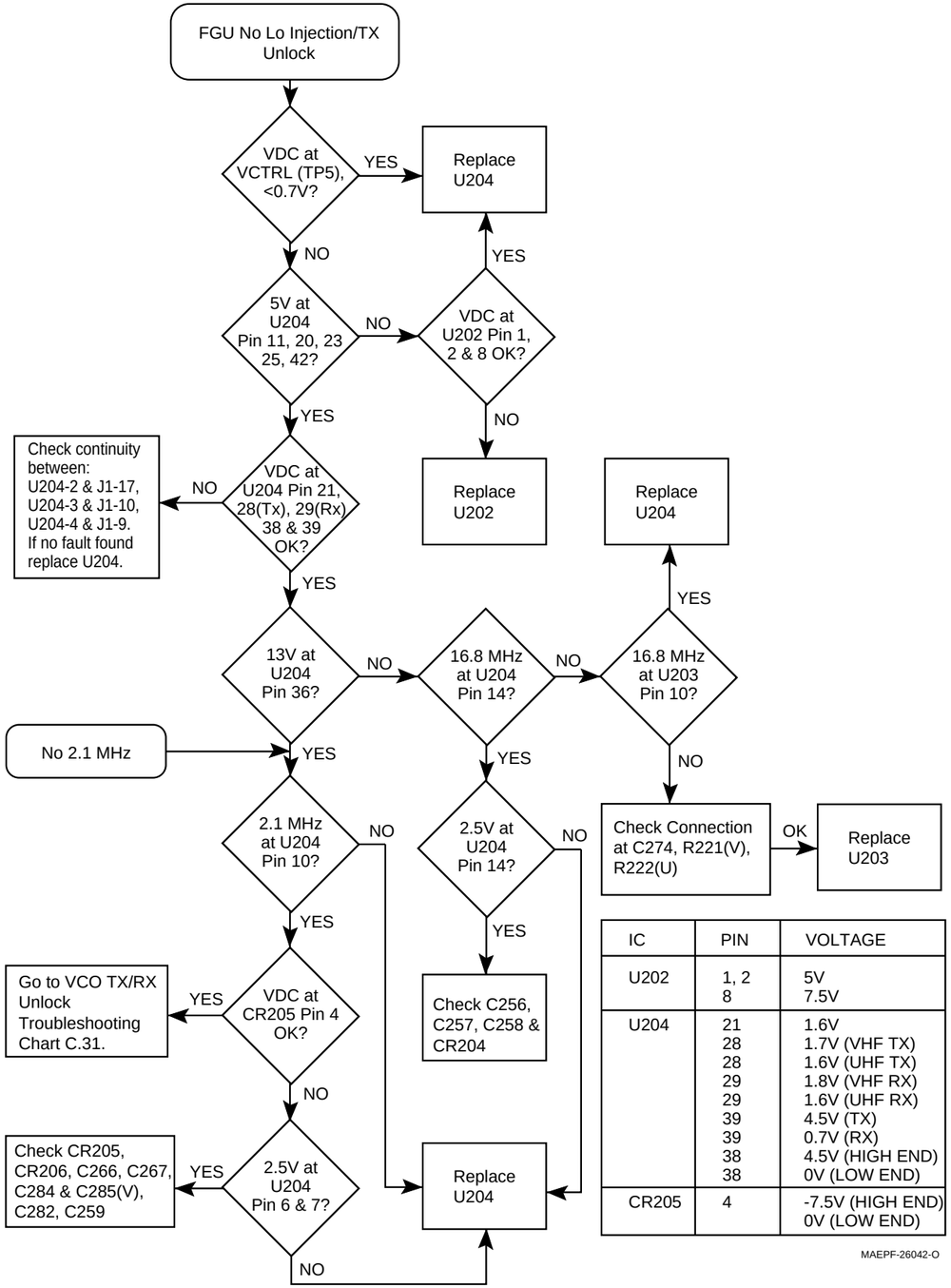


Chart 28. VHF/UHF/800 MHz Receiver RF



IC	PIN	VOLTAGE
U202	1, 2 8	5V 7.5V
U204	21 28 28 29 29 39 39 38 38	1.6V 1.7V (VHF TX) 1.6V (UHF TX) 1.8V (VHF RX) 1.6V (UHF RX) 4.5V (TX) 0.7V (RX) 4.5V (HIGH END) 0V (LOW END)
CR205	4	-7.5V (HIGH END) 0V (LOW END)

Chart 29. VHF/UHF Frequency Generation Unit (FGU)

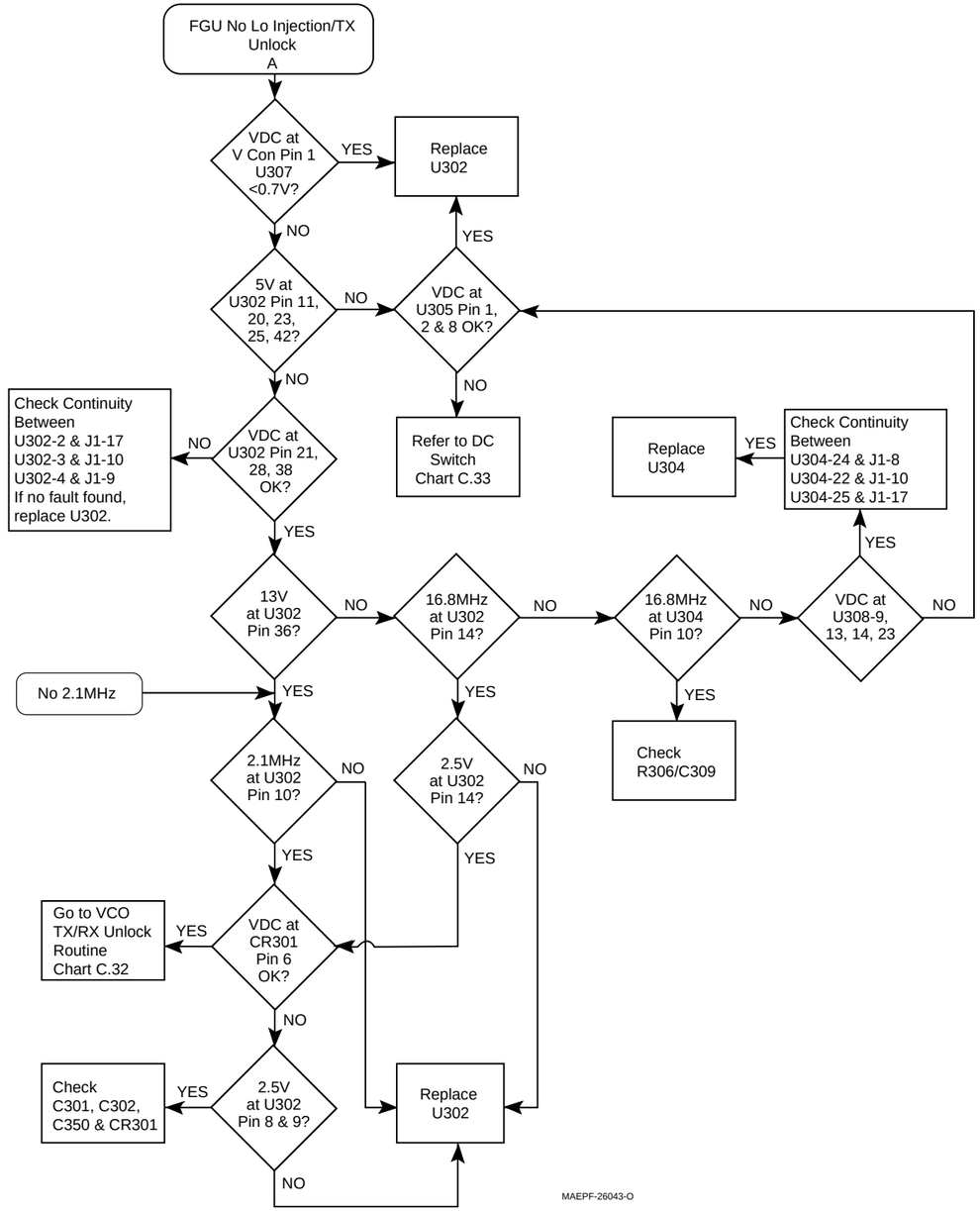


Chart 30. 800 MHz Frequency Generation Unit (FGU)

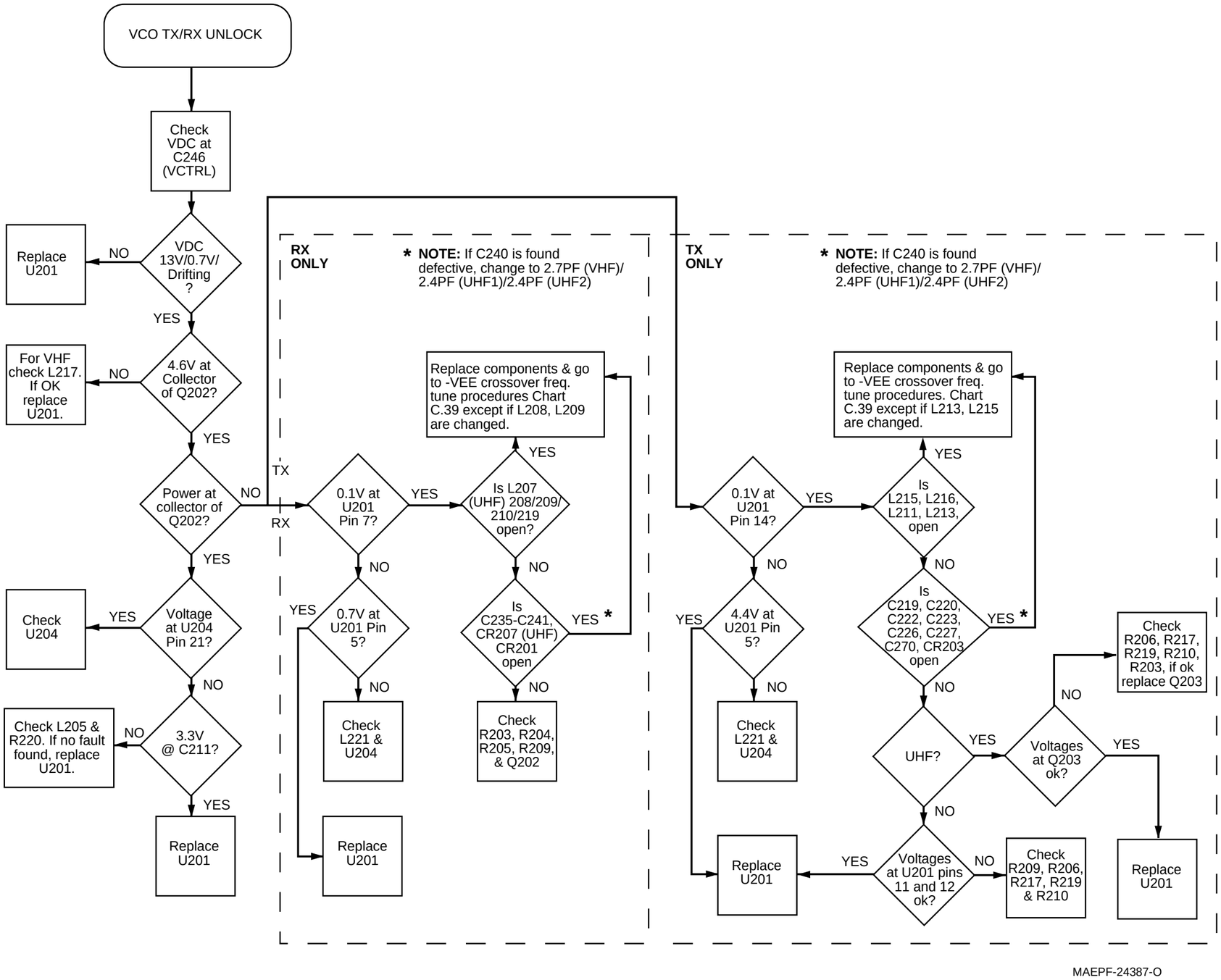


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Chart 31. VHF/UHF Voltage Controlled Oscillator (VCO)

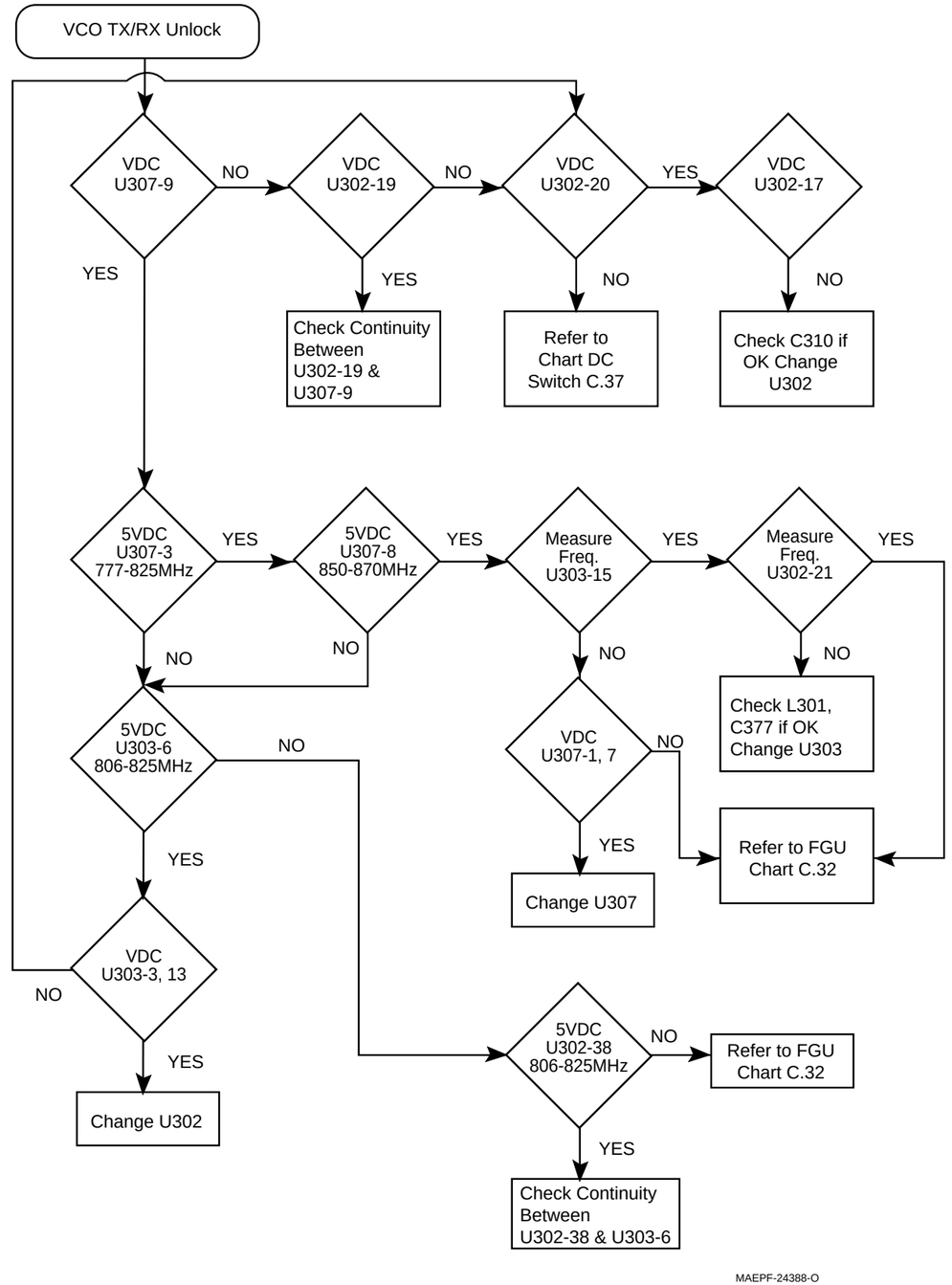


Chart 32. 800 MHz Voltage Controlled Oscillator (VCO)

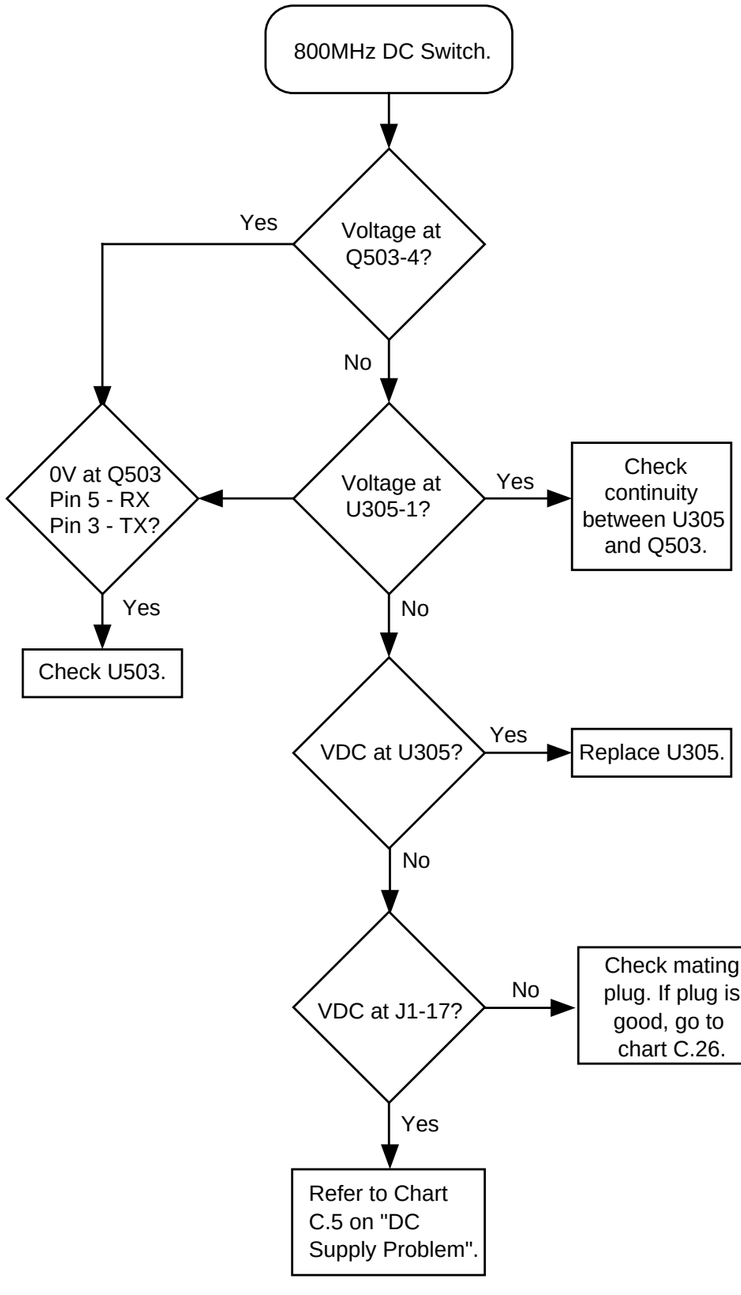


Chart 33. 800 MHz DC Switch

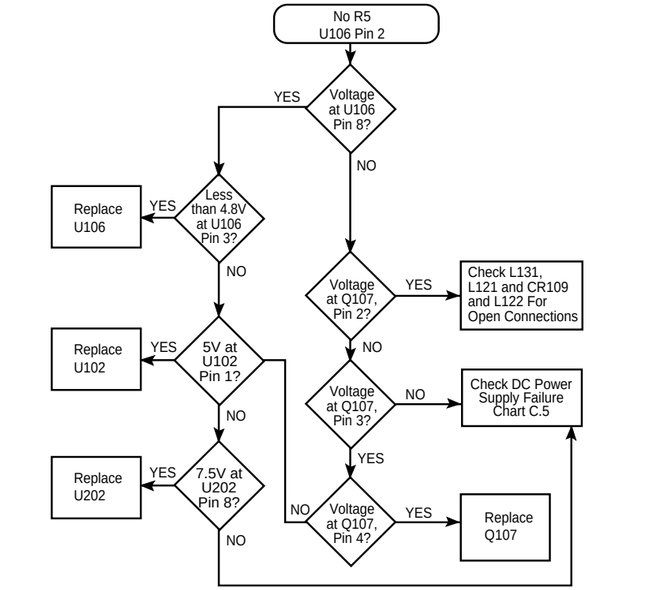


Chart 34. VHF/UHF DC Switch

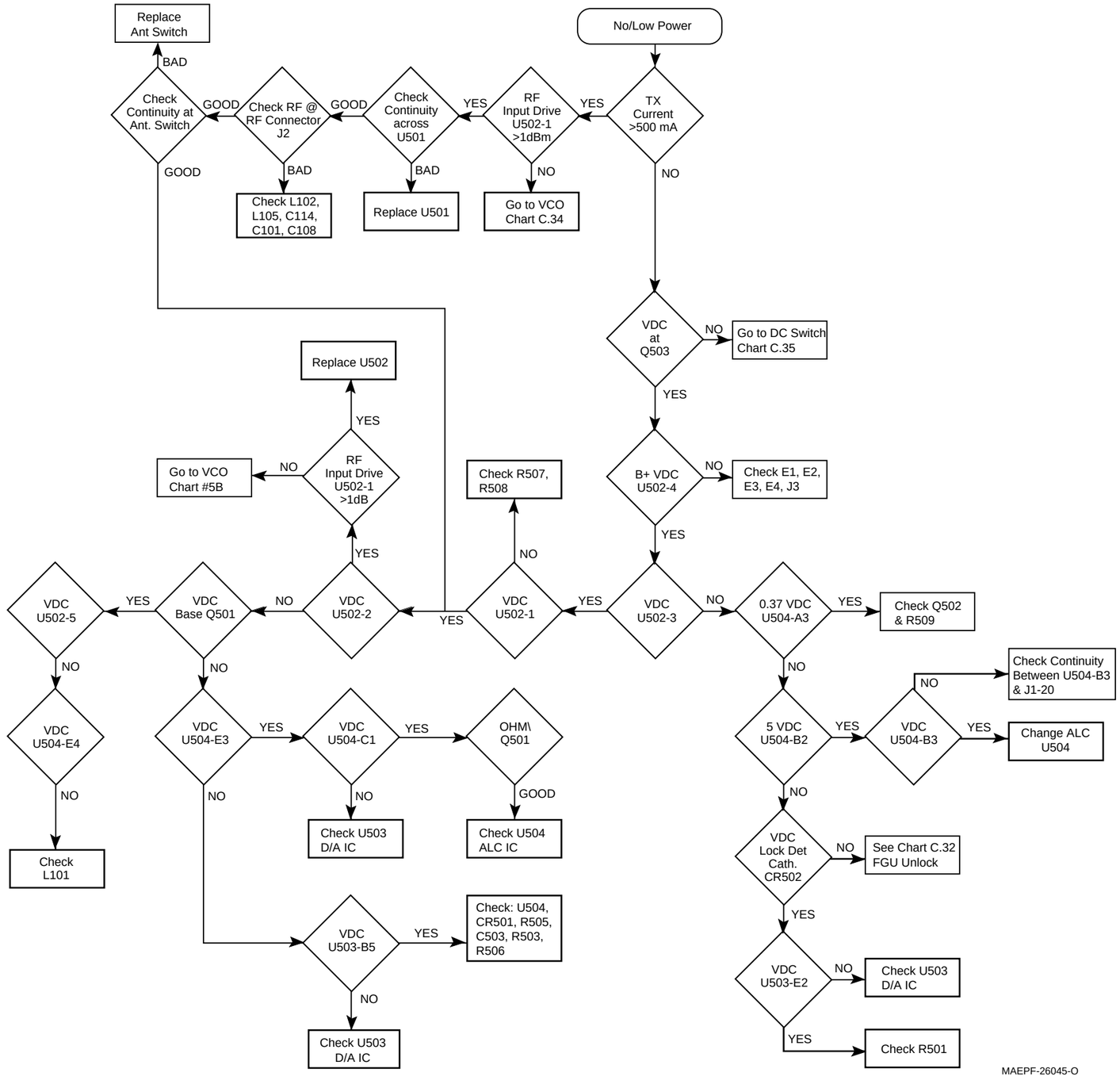


Chart 35. 800 MHz Transmitter RF

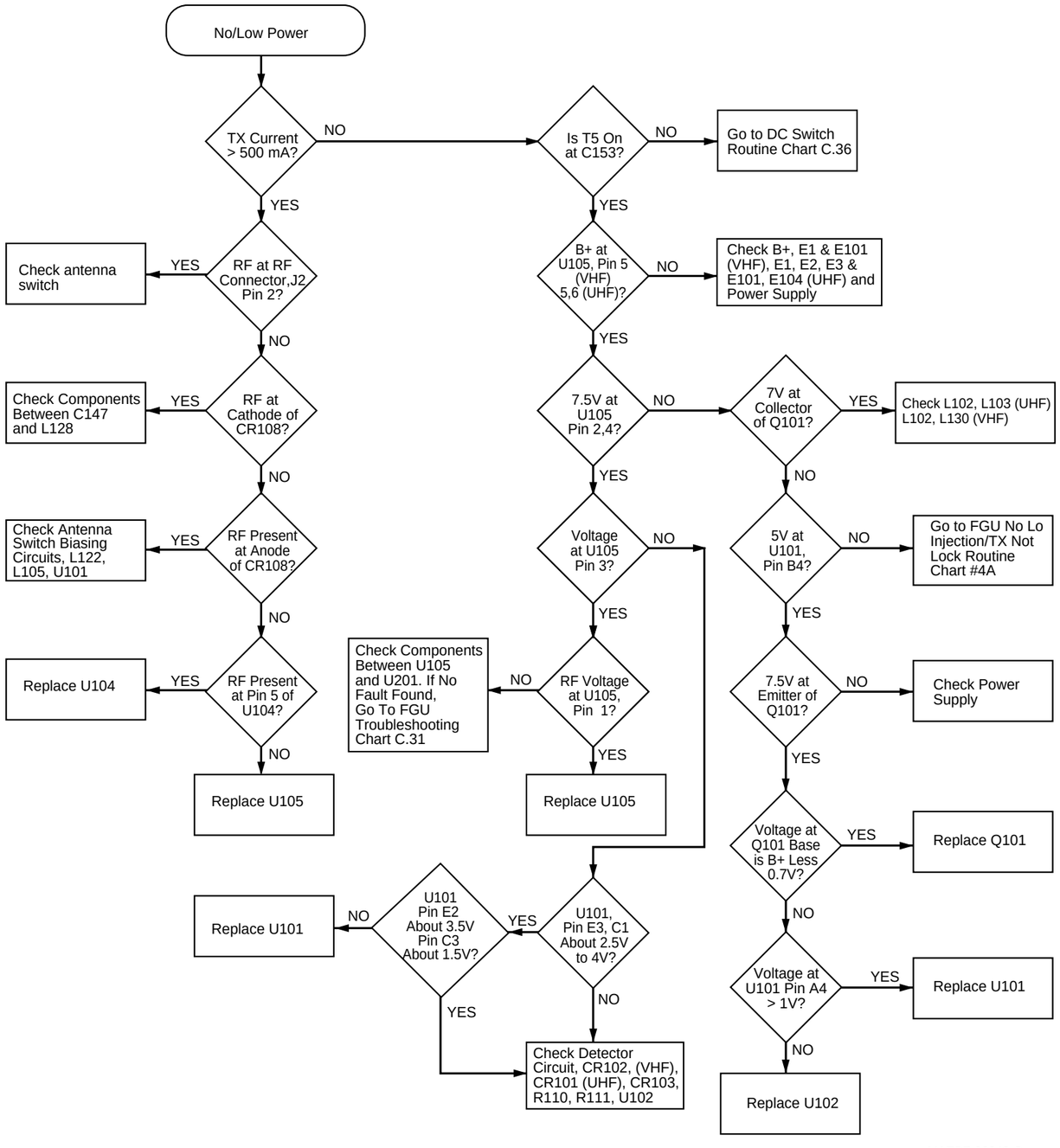


Chart 36. VHF/UHF Transmitter RF

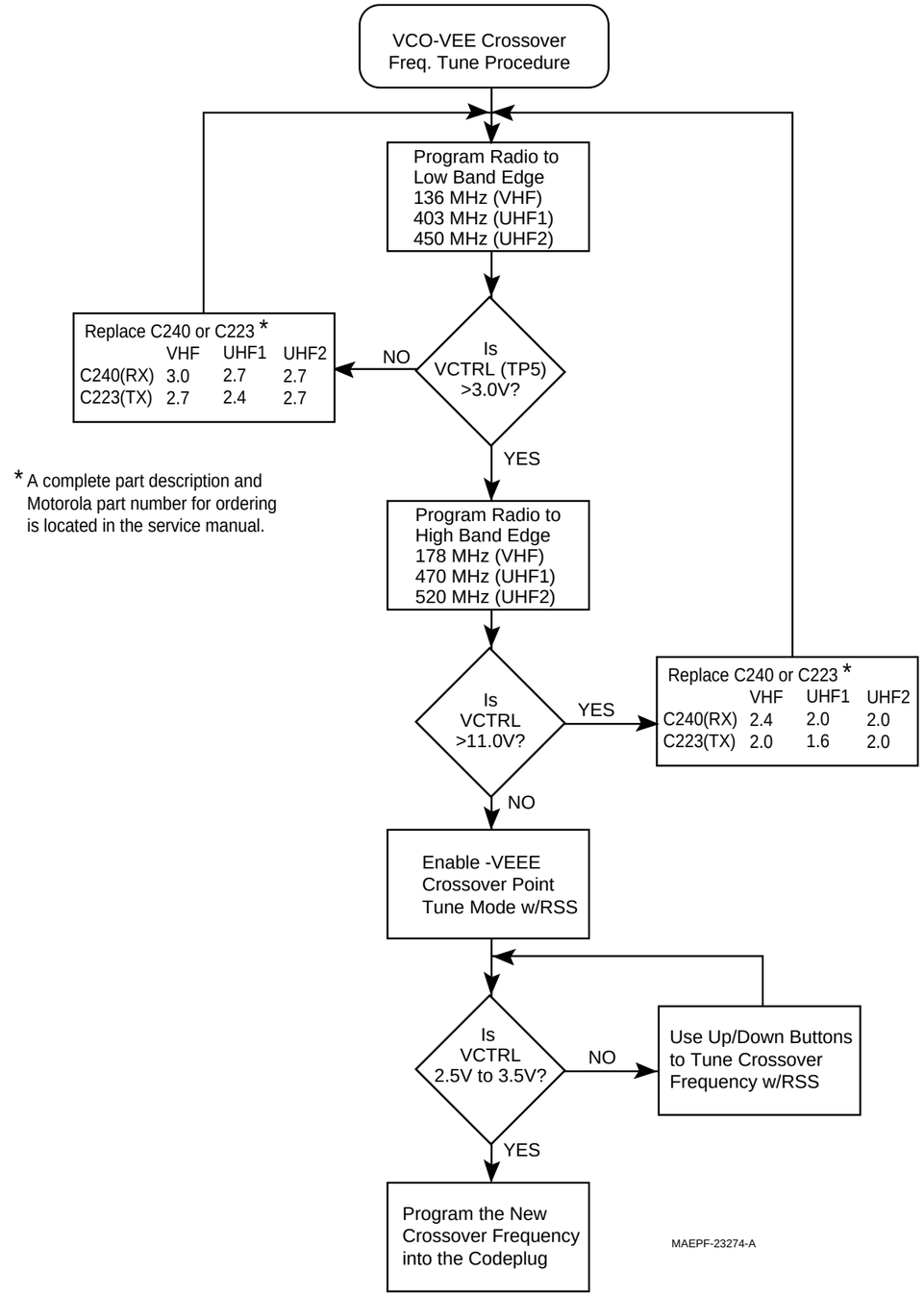


Chart 37. VHF/UHF Only, VCO Crossover Frequency Tune

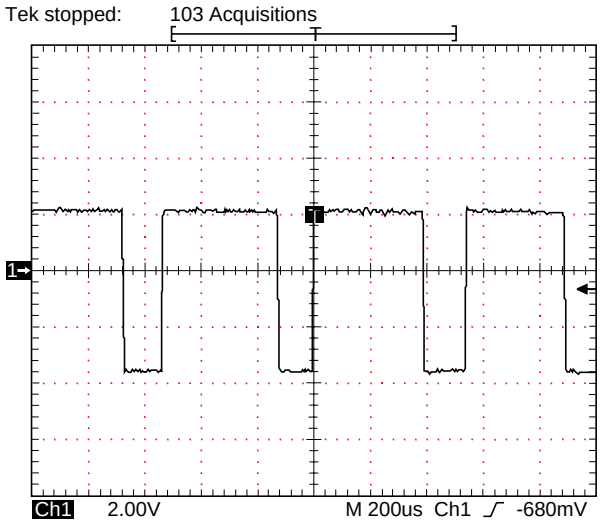
Troubleshooting Waveforms

11

Introduction to This Section

This section contains images of waveforms which may be useful in verifying operation of certain parts of the circuitry. These waveforms are for reference only; the actual data depicted will vary depending upon operating conditions.

Waveforms



W1: Switched Regulator Clock Out
Trace 1 - (U709)LX measured with radio in standby mode with UNSW_B+ at 7.5VDC.

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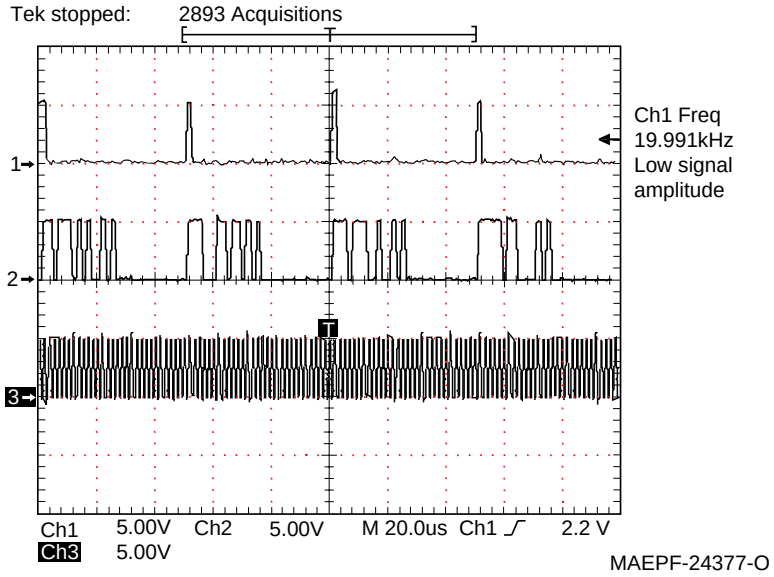
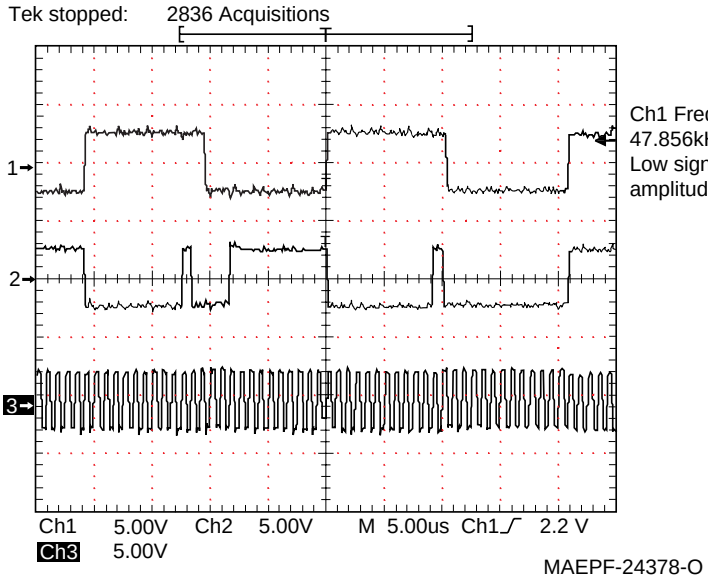
Waveform W1



W2: DSP SSI Port RX mode.
Receiving
1KHz tone @ 3KHz deviation, -60dBm.
Trace 1 - RFS
Trace 2 - RXD
Trace 3 - SCKR[1] (2.4/0.600MHz)

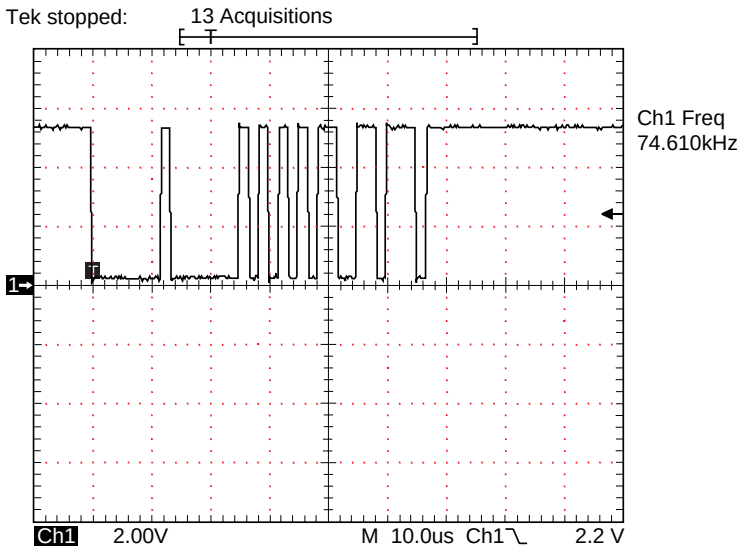
Note 1: Typically SCKR is a 2.4 MHz clock. In low power modes, as shown here, SCKR is 600KHz.

Waveform W2



W3: DSP SSI Port TX mode CSQ.
Trace 1 - SC2
Trace 2 - STD
Trace 3 - SCK (1.2MHz)

Waveform W3



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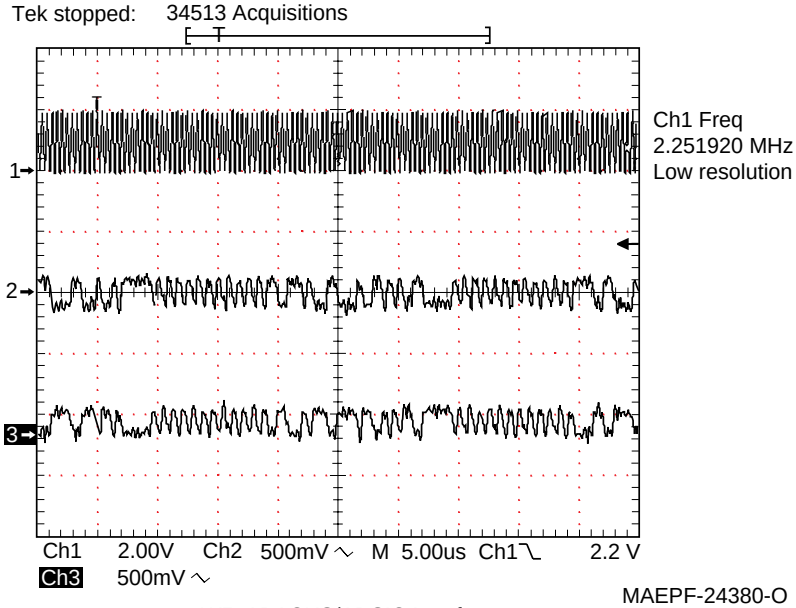
W4: ABACUS programming
captured during mode change.
Trace 1 - (ADSIC) SBI

Waveform W4



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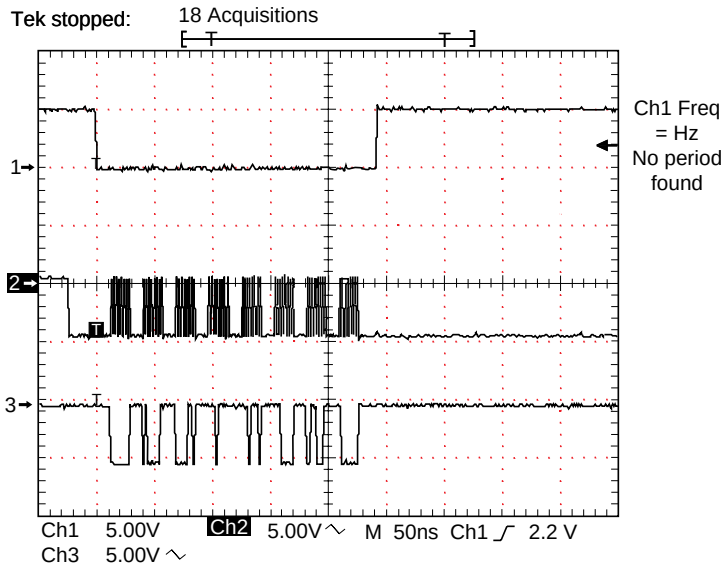
W5: ABACUS/ADSIC Interface.
Receiving 1KHz tone @ 3KHz deviation,
-60dbm.
Trace 1 -IDC (2.4MHz)
Trace 2 - DOUT [2]
TRACE 3 - DOUT*

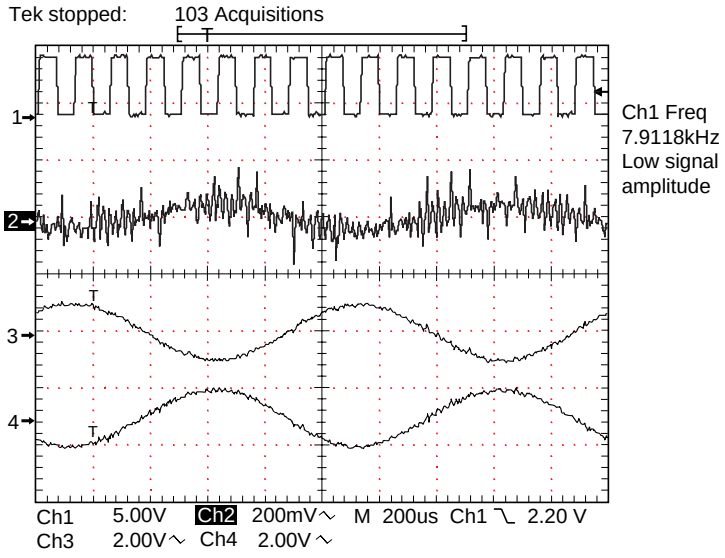
Note 2: Since these signals are a differential
current loop these voltages are very low.

Waveform W5



W6: SPI Bus Programming ADSIC. MAEPF-24381-O
Trace 1 - ADSIC_SEL*
Trace 2 - SPI_SCK
Trace 3 - MOSI
Note: These waveforms are typical to any device on the SPI bus.

Waveform W6



W7: Receive audio: Receiving
1KHz tone @ 3KHz deviation, -60dBm.
Trace 1 - IRQB @ DSP (8KHz)
Trace 2 - SD0 @ C219
Trace 3 - SPKR_COMMON
Trace 4 - INT_SPKR [3]

Note 3: Actual level is dependent upon volume setting.

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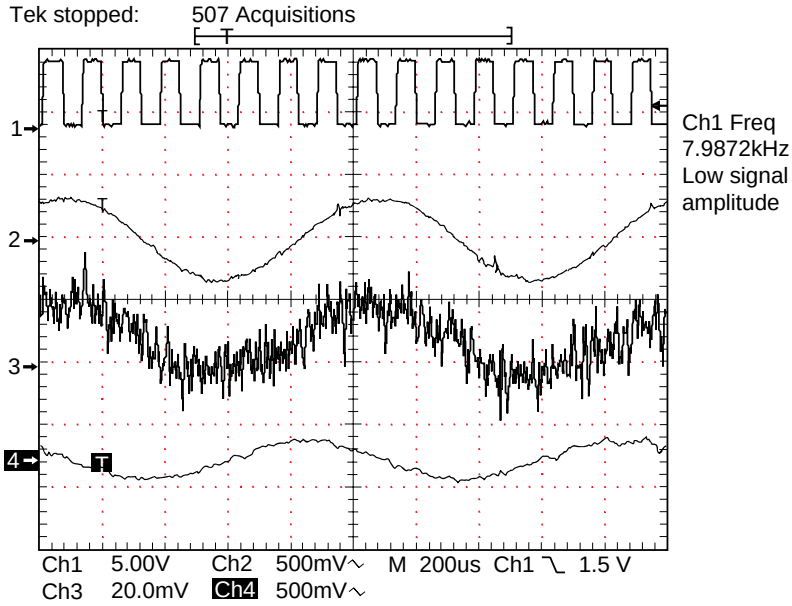
Waveform W7



W8: Transmit Audio. 1KHz Tone
which provides 3KHz deviation.
Trace 1 - IRQB @ DSP (8KHz)
Trace 2 - MODIN
Trace 3 - EXT MIC @ node C189/R198
Trace 4 - MAI @ node R207/U718
MICAMPOUT

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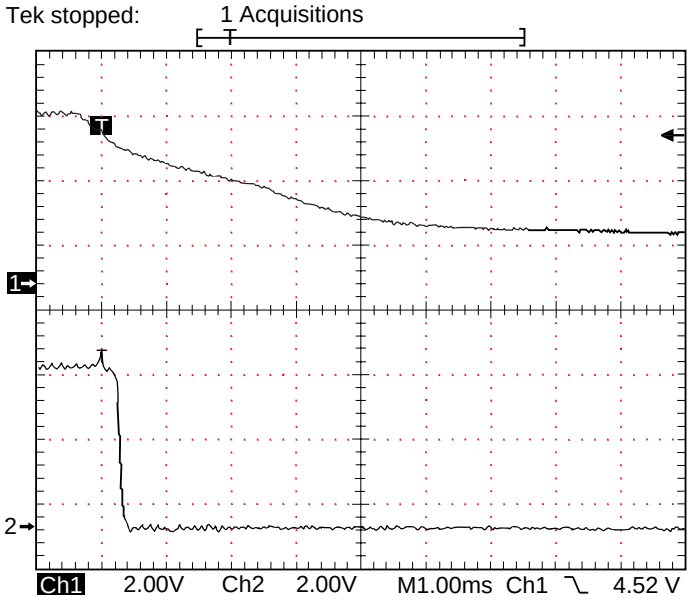
Waveform W8



W9: Power Down Reset.
Trace 1 - +5V @ U726 (VDD)
Trace 2 - Reset @ U726 (OUT)

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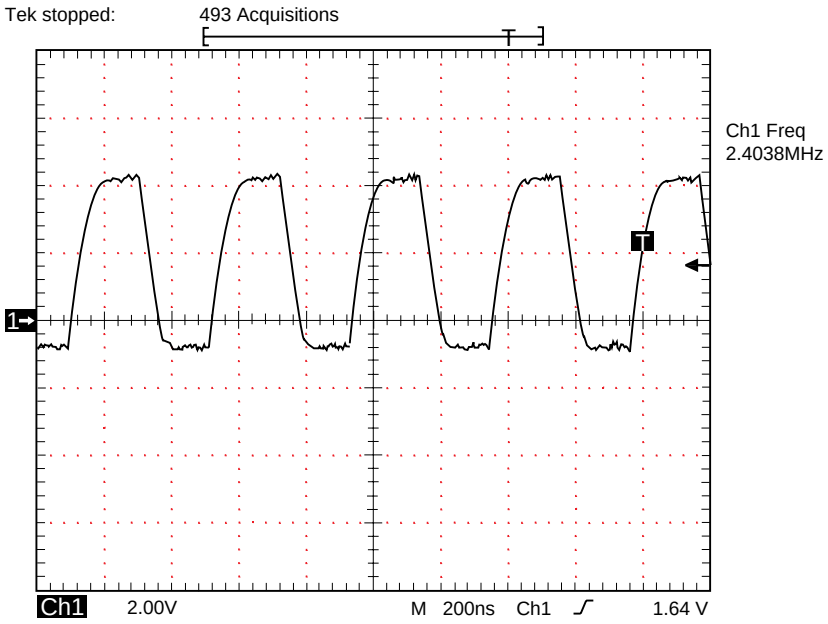
Waveform W9



W10 ADSIC 2.4 MHz Reference
Trace 1 - IDC @ U406

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Waveform W10

Troubleshooting Diagrams

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Introduction to This Section

This section contains troubleshooting diagrams necessary to isolate a problem to the component level. Use these diagrams in conjunction with the theory of operation, troubleshooting procedures, charts, and waveforms.

J101
Controller Board to Controls Flex Assembly

J101 Pin #	Description	To/From	Side Conn Pin #
1	CTSOUT*	U702-B6	10
2	LHDATA/BOOT_DOUT/KEYFAIL	U717-1	13
3	GROUND	N/C	8
4	RS232IN	U702-B2/G3	12
5	SPKR_COMMON	U718-27	6
6	RS232_DOUT/BOOT_DIN	U702-A5	11
7	OPT_SEL_2	U702-C6	5
8	SB9600_BUSY	U701-74	9
9	EXT_SPEAKER	U718-31	2
10	RTSIN*	U702-J8	7
11	OPT_SEL_1	U702-A6	1
12	OPT_B+/BOOT_SEL/VPP	VR119/D100	4
13	EXT_MIC	U714-6	3
15-18	GROUND	N/C	
19	BL_HOME	Q111-2	
20	BL_FREQ	Q111-1	
21	RED_LED	Q112-2	
22	GREEN_LED	Q112-1	
23	TG2	U701-24	
24	RTA1	U702-F4	
25	RTA3	U702-H1	
26	RTA2	U702-F2	
27	RTA0	U702-F3	
28-30	GROUND	N/C	
31	VOL	U701-25	
32	B+_SENSE	VR101	
33	UNSW_B+	P201-15/20	
34	TG1	U701-19	
35	+5V	U709-9	
36	INT_MIC	U714-2	
37	SPKR_COMMON	U718-27	
38	INT_PTT	U702-H2	
39	GROUND	N/C	
40	INT_SPKR	U718-23	
14, 41	EMERG	U701-27	

J401
Controller Board to Vocoder Board

J401 Pin #	Description	To/ From
1	R/W*	U701-35
2	HEN*	U702-J7
3	A0	U701-17
4	A2	U701-15
5	VPP	Q110
6	DSP_RST*	U701-58
7	EMC_RXD	J601-5
8	+5V	U709-9
9	+5V	U709-9
10	+5VA	U710-3
11	MICEN	U718-14
12	INTMICEN	U718-16
13	GROUND	N/C
14	HREQ*	U701-75
15	GROUND	N/C
16	A1	U701-16
17	VPP	Q110
18	BOOT_MODE	U701-76
19	EMC_TXD	J601-3
20	MOSI	U701-66
21	SPI_SCK	U701-67
22	SBI	P201-4
23	+5VA	U710-3
24	EXT_INT_SPKR*	U718-20
25	SPKEN	U718-19
26	D7	U701-49
27	D5	U701-47
28	D3	U701-45
29	D1	U701-43
30	+5V	U709-9
31	GROUND	N/C
32	GROUND	N/C
33	DOUT*	P201-1
34	SDO	U718-6
35	MODIN	P201-14
36	MAI	U718-15
37	ADSIC_RST*	701-56
38	GROUND	N/C
39	D6	U701-48
40	D4	U701-46
41	D2	U701-44
42	D0	U701-40
43	ODC-2.4MHZ	P201-11
44	GROUND	N/C
45	DOUT	P201-2
46-49	GROUND	N/C
50	ADSIC_SEL*	U701-57

J601
Controller Board to Encryption Module

J601 Pin #	Description	To/From
1	SW_B+	Q106-5
2	SW_B+	Q106-5
3	EMC_TXD	J401-19
4		N/C
5	EMC_RXD	J401-7
6		N/C
7	MISO	U701-65
8		N/C
9	SPI_SCK	U701-67
10		N/C
11	EMC_REQ	U702-H3
12		N/C
13	TAMPER	GROUND
14	UNSW_B+	P201-15, 20
15	KEYFAIL	U717-2
16		N/C
17	MOSI	U701-66
18		N/C
19	EMC_EN	U702-D6
20		N/C
21	TAMPER	GROUND
22		N/C
23		N/C
24	TAMPER	GROUND
25	EMC_WAKEUP	U702-K7

P107
Controller Board to Keypad Module

P107 Pin #	Description	To/From
1	COL1	U702-A7
2	COL2	U702-D5
3	COL3	U702-B4
4	BL_EN	U702-E7
5	ROW1	U702-J3
6	ROW2	U702-G4
7	ROW3	U702-K8
8	ROW4	U702-G9
9	ROW5	U702-F8
10	ROW6	U702-G7
11	+5V	U709-9
12	GROUND	N/C

P201
Controller Board to RF Board

P201 Pin #	Description	To/From
1	DOUT*	J401-33
2	DOUT	J401-45
3	LOCK_DET*	U702-K2
4	SBI	J401-22
5	BAT_STATUS	U701-28
6	GROUND	N/C
7	DA_SEL*	U701-68
8	ROSC/PSC_CE*	U701-59
9	SYN_SEL*	U701-62
10	SPL_SCK	U701-67
11	OD - 24MHZ	U701-43
12	POR*	U726-1
13	GROUND	N/C
14	MODIN	J401-35
15	UNSW_B+	Q1-2, 3
16	GROUND	N/C
17	MOSI	U701-66
18	SW_B+	Q106-5
19	GROUND	N/C
20	UNSW_B+	Q106-2, 3

P301
Controller Board to Display Module

P301 Pin #	Description	To/From
1	SPI_SCK	U701-67
2	MOSI	U701-66
3	DISP_EN*	U702-G8
4	BL_EN	U702-E7
5	GROUND	N/C
6	GROUND	N/C
7	+5V	U709-9

Notes

Interconnect Diagram, Schematics with Parts Lists, Circuit Board Details, Exploded Views with Parts Lists

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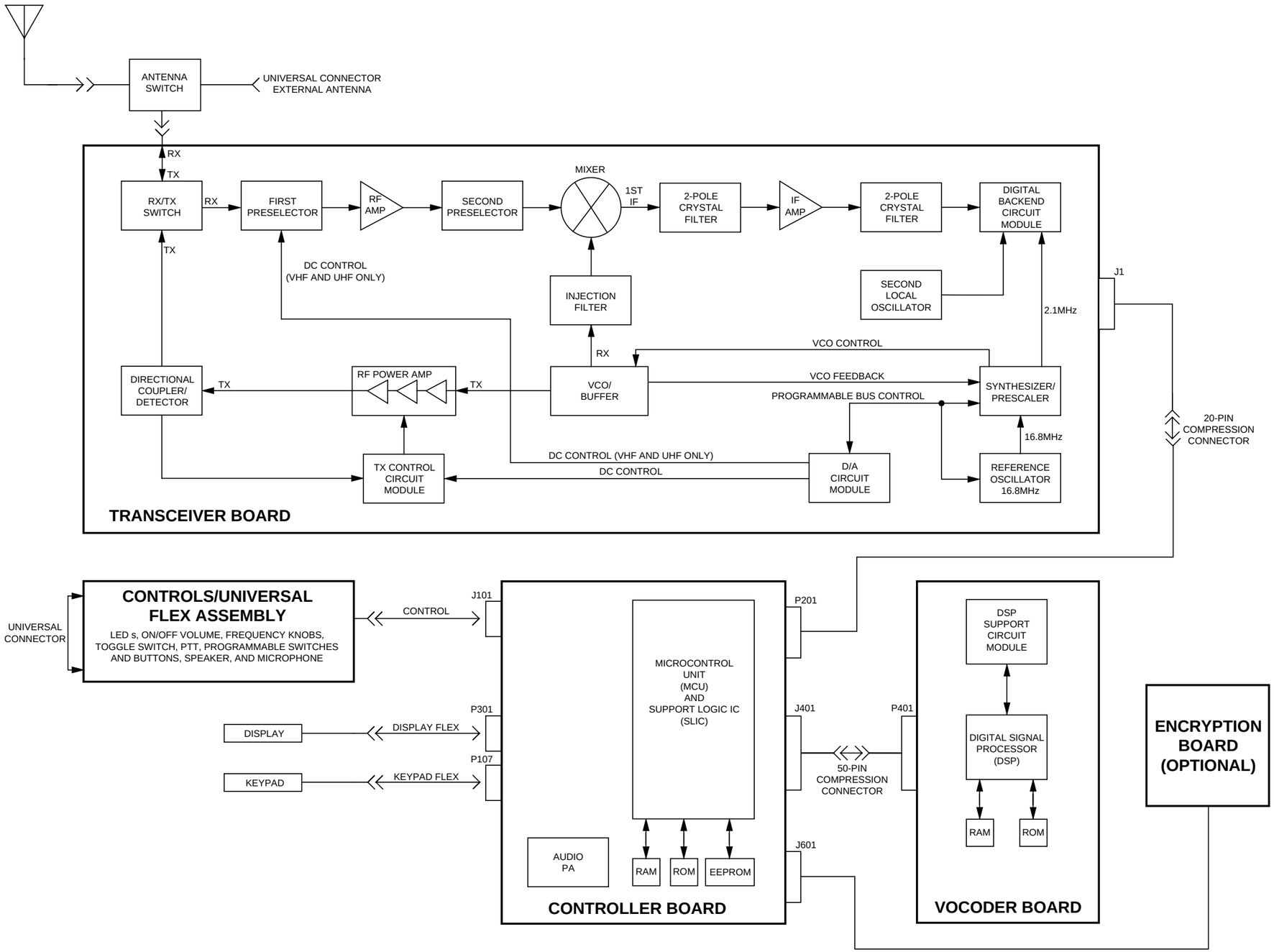

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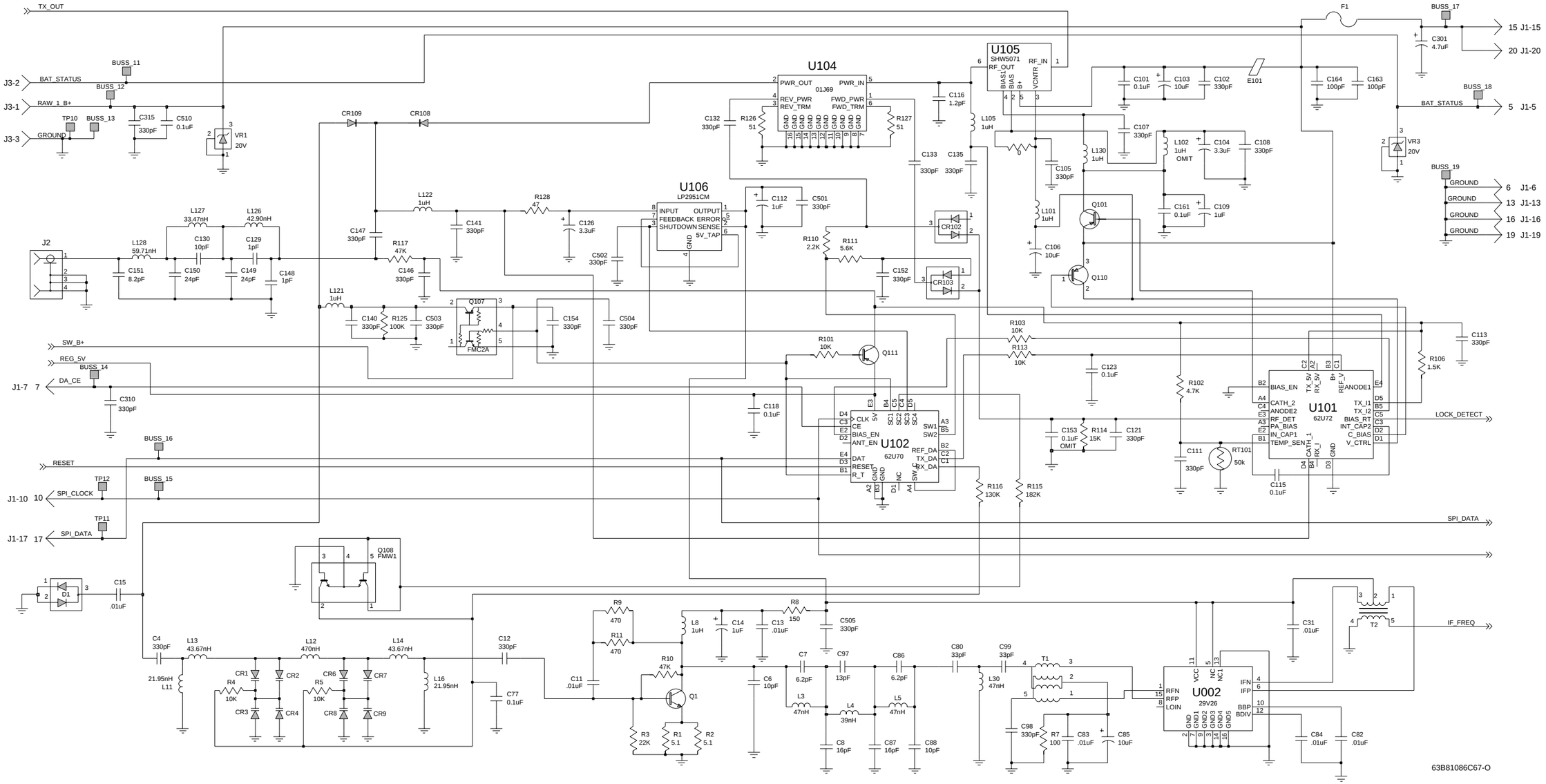
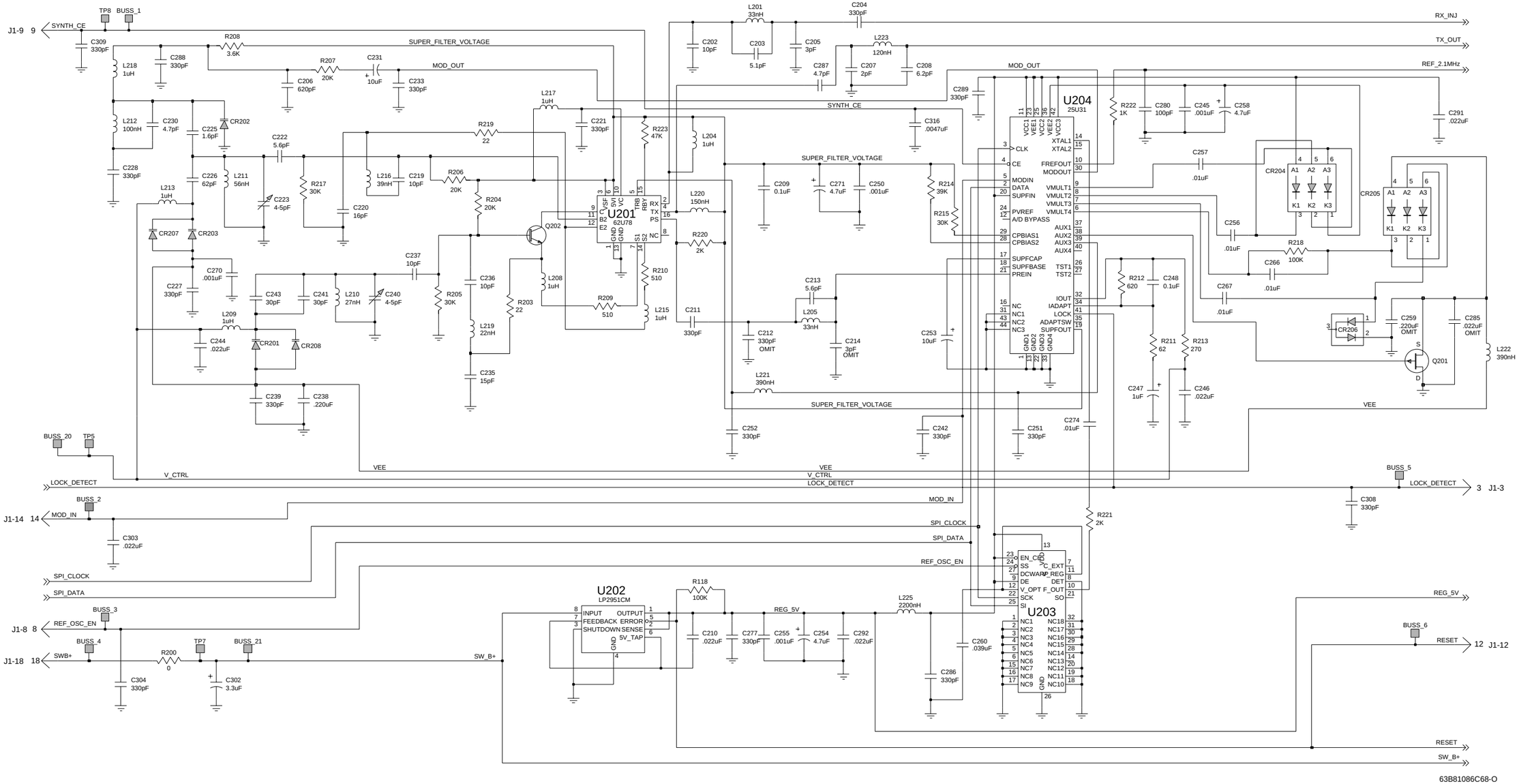
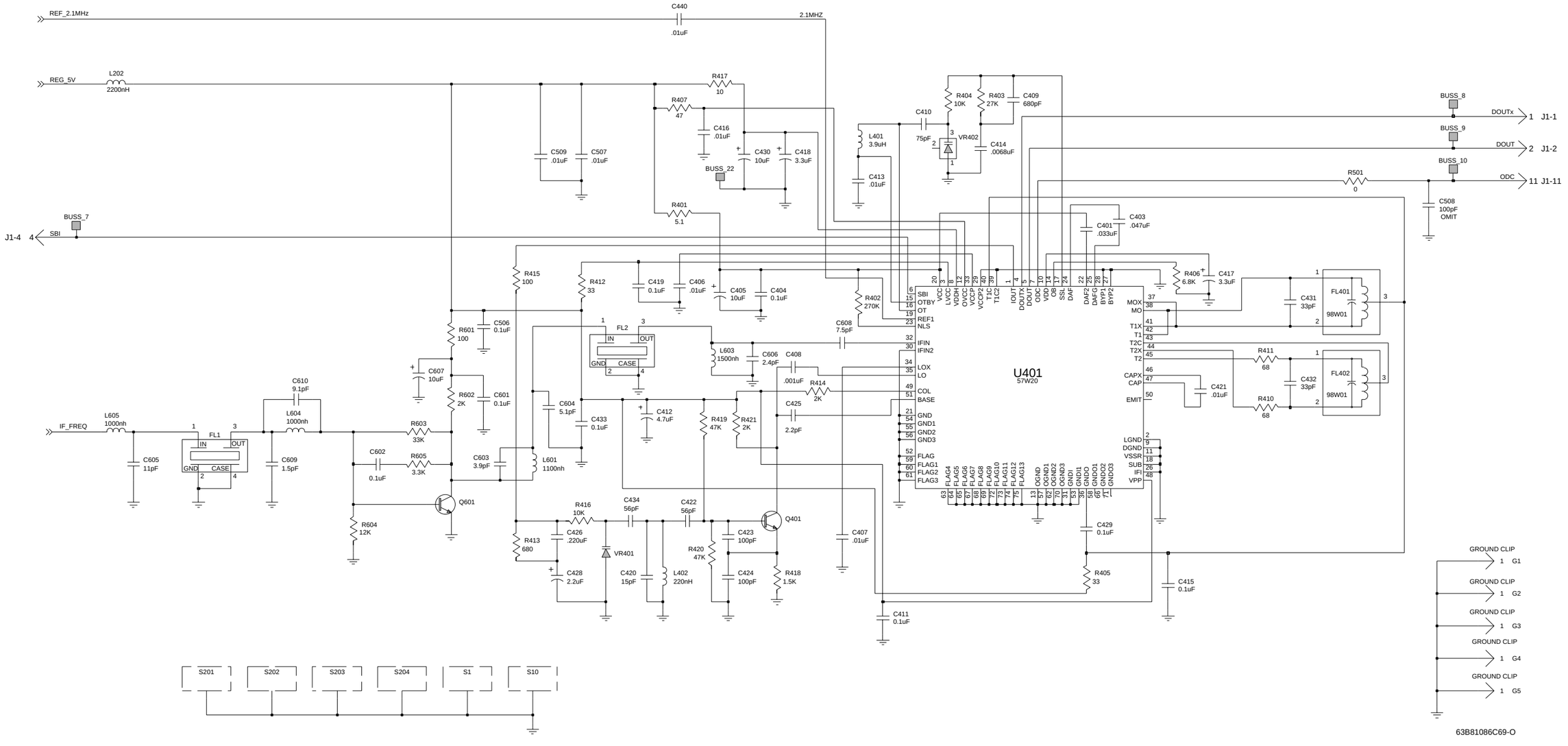
Radio Interconnect Block Diagram



NLD8898B/C/D VHF RF Board Schematic Diagram, Sheet 1 of 3

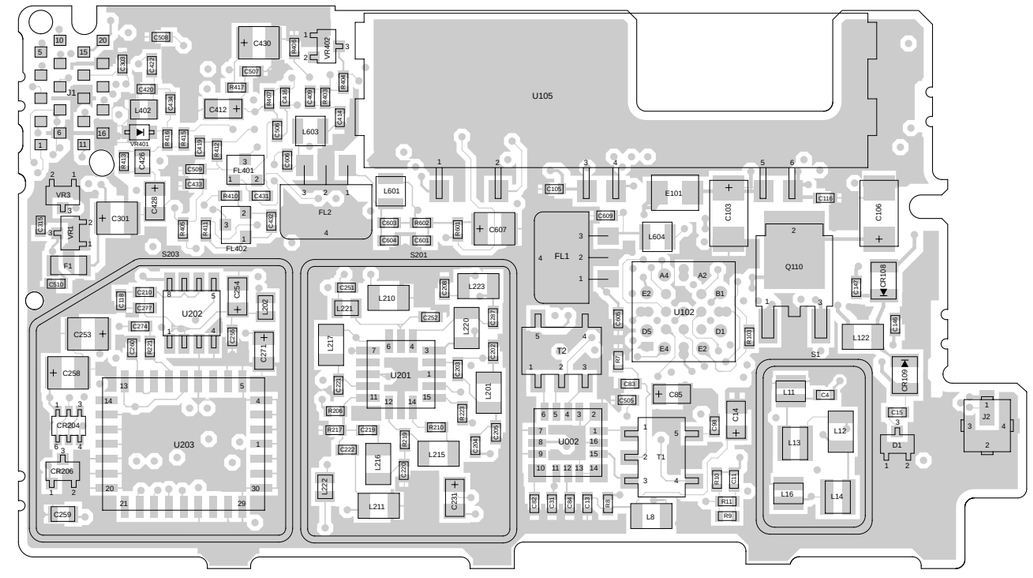


NLD8898B/C/D VHF RF Board Schematic Diagram, Sheet 2 of 3

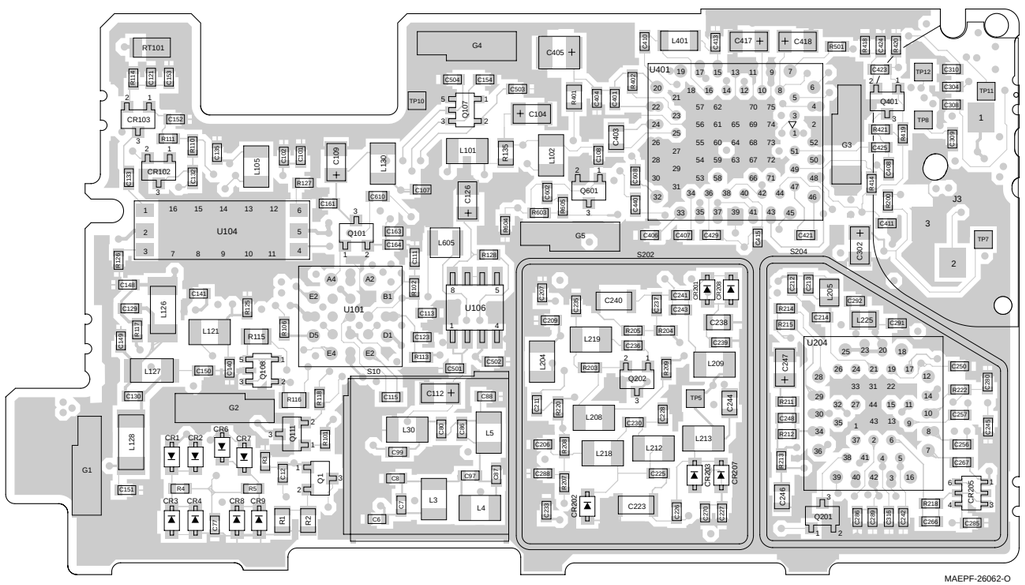


NLD8898B/C/D VHF RF Board Schematic Diagram, Sheet 3 of 3

VIEWED FROM SIDE 1



VIEWED FROM SIDE 2



NLD8898B/C/D VHF RF Board Component Location Detail and Parts List

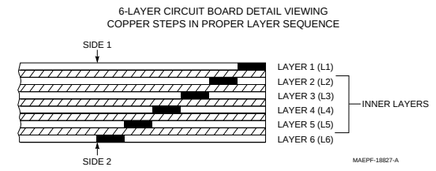
NLD8898B/C/D VHF RF Board Electrical Parts List

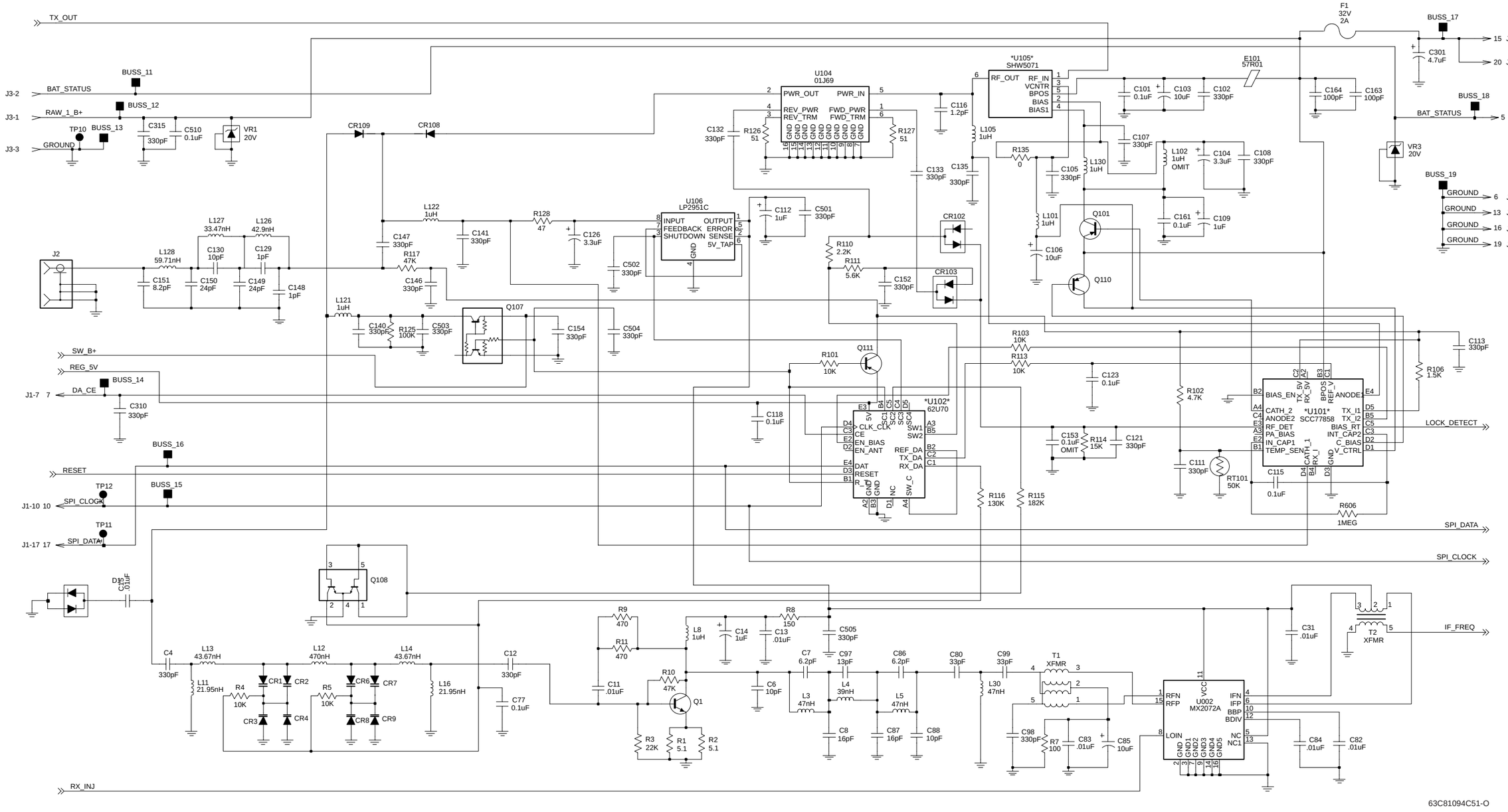
ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: unless otherwise stated
C4	2113931F13	330 pF
C6	2113930F27	10 pF
C7	2113930F22	6.2 pF
C8	2113930F32	16 pF
C11	2113931F49	10 nF
C12	2113931F13	330 pF
C13	2113931F49	10 nF
C14	2311049A07	1 µF
C15	2113931F49	10 nF
C31	2113931F49	10 nF
C77	2113932K15	0.1 µF
C80	2113930F39	33 pF
C82 thru 85	2113931F49	10 nF
C86	2113930F22	6.2 pF
C87	2113930F32	16 pF
C88	2113930F27	10 pF
C97	2113930F30	13 pF
C98	2113931F13	330 pF
C99	2113930F39	33 pF
C101	2113932K15	0.1 µF
C102	2113931F13	330 pF
C103	2311049J26	10 µF
C104	2311049A54	3.3 µF
C105	2113931F13	330 pF
C106	2311049J26	10 µF
C107, 108	2113931F13	330 pF
C109	2311049A07	1 µF
C111	2113931F13	330 pF
C112	2311049A07	1 µF
C113	2113931F13	330 pF
C115	2113932E20	0.1 µF
C116	2113930F05	1.2 pF
C118	2113932K15	0.1 µF
C121	2113931F13	330 pF
C123	2113932E20	0.1 µF
C126	2311049A54	3.3 µF
C129	2113930F03	1 pF
C130	2113930F27	10 pF
C132, 133	2113931F13	330 pF
C135	2113931F13	330 pF
C140, 141	2113931F13	330 pF
C146, 147	2113931F13	330 pF
C148	2113930F03	1 pF
C149, 150	2113930F36	24 pF
C151	2113930F25	8.2 pF
C152	2113931F13	330 pF
C153	2113932E20	Not Placed
C154	2113931F13	330 pF
C161	2113932K15	.1 µF
C163, 164	2113930F51	100 pF
C202	2113930F27	10 pF
C203	2113930F20	5.1 pF
C204	2113931F13	330 pF
C205	2113930F14	3.0 pF
C206	2113931F20	620 pF
C207	2113930F10	2.0 pF
C208	2113930F22	6.2 pF
C209	2113932K15	0.1 µF
C210	2113932E13	.022 µF
C211	2113931F13	330 pF
C212	2113931F13	Not Placed
C213	2113930F21	5.6 pF
C214	2113930F14	Not Placed
C219	2113930F27	10 pF
C220	2113930F32	16 pF
C221	2113931F13	330 pF
C222	2113930F24	7.5 pF
C223	2113906C02	?
C225	2113930F08	1.6 pF
C226	2113930F46	62 pF
C227, 228	2113931F13	330 pF
C230	2113930F19	4.7 pF
C231	2311049A60	10 µF
C233	2113931F13	330 pF
C235	2113930F31	15 pF
C236, 237	2113930F27	10 pF
C238	2113743A23	.22 µF
C239	2113931F13	330 pF
C240	2113906C02	?
C241	2113930F38	30 pF
C242	2113931F13	330 pF
C243	2113930F35	22 pF
C244	2109720D09	.022 µF
C245	2113931F25	1 nF
C246	2109720D09	.022 µF
C247	2311049A07	1 µF
C248	2113932K15	0.1 µF
C250	2113931F25	1 nF
C251, 252	2113931F13	330 pF
C253	2311049J23	10 µF
C254	2311049A56	4.7 µF
C255	2113931F25	1 nF
C256, 257	2113931F49	10 nF
C258	2311049J11	4.7 µF
C259	2113743A23	Not Placed
C260	2113932K05	.039 µF
C266, 267	2113931F49	10 nF
C270	2113931F25	1 nF
C271	2311049A56	4.7 µF
C274	2113931F49	10 nF
C277	2113931F13	330 pF
C280	2113930F51	100 pF
C285	2113932E13	Not Placed
C286	2113931F13	330 pF
C287	2113930F19	4.7 pF
C288, 289	2113931F13	330 pF
C291, 292	2113932E13	.022 µF
C301	2311049J11	4.7 µF
C302	2311049A54	3.3 µF
C303	2113932E13	.022 µF
C304	2113931F13	330 pF
C308 thru 310	2113931F13	330 pF
C315	2113931F13	330 pF
C316	2113931F41	4.7 nF
C401	2113932K03	.033 µF
C403	2113743A13	.047 µF
C404	2113932K15	.1 µF
C405	2311049J23	10 µF
C406, 407	2113931F49	10 nF
C408	2113931F25	1 nF
C409	2113931F21	680 pF
C410	2113930F48	75 pF
C411	2113932K15	.1 µF
C412	2311049A56	4.7 µF
C413	2113931F49	10 nF
C414	2113931F45	6.8 nF
C415	2113932K15	.1 µF

C416	2113931F49	10 nF
C417, 418	2311049A42	3.3 µF
C419	2113932K15	.1 µF
C420	2113930F31	15 pF
C421	2113931F49	10 nF
C422	2113930F45	56 pF
C423, 424	2113930F51	100 pF
C425	2113930F11	2.2 pF
C426	2113743A23	.22 µF
C428	2311049A40	2.2 µF
C429	2113932K15	.1 µF
C430	2311049J23	10 µF
C431, 432	2113930F39	33 pF
C433	2113932K15	.1 µF
C434	2113930F45	56 pF
C440	2113931F49	10 nF
C501 thru 505	2113931F13	330 pF
C506	2113932K15	0.1 µF
C507	2113931F49	10 nF
C508	2113930F51	Not Placed
C509	2113931F49	10 nF
C510	2113932K15	0.1 µF
C601, 602	2113932K15	0.1 µF
C603	2113930F17	3.9 pF
C604	2113930F20	5.1 pF
C605	2113930F28	11 pF
C606	2113930F12	2.4 pF
C607	2311049J23	10 µF
C608	2113930F24	7.5 pF
C609	2113930F07	1.5 pF
C610	2113930F26	9.1 pF
		DIODE: See Note 1.
CR1 thru 4	4862824C01	Varactor
CR6 thru 9	4862824C01	Varactor
CR102, 103	4805129M67	Dual
CR108	4802482J02	PIN
CR109	4805656W07	PIN
CR201 thru 203	4802245J29	Varactor
CR204, 205	4802233J09	Triple
CR206	4805129M06	Triple
CR207	4862824C03	Not Placed
CR208	4802245J29	Varactor
		DIODE: See Note 1.
D1	4880154K03	Dual Schottky
		CORE:
E101	2484657R01	Ferrite Bead
		FUSE:
F1	6505757V02	Fuse, 2A
		FILTER: See Note 2.
FL1, 2	4805245J32	45.15 MHz Crystal Filter
FL401, 402	9105398W01	450 kHz Filter
		JACK:
J2	0905304Z01	RF Coax Connector
		COIL, RF: unless otherwise stated
L3	2462587T42	47 nH
L4	2462587T41	39 nH
L5	2462587T42	47 nH
L8	2462587T30	1 µH
L11	2460591M12	21.95 nH
L12	2462587T23	470 nH
L13, 14	2460591N36	43.67 nH
L16	2460591M12	21.95 nH
L30	2462587T42	47 nH
L101, 102	2462587T30	1 µH
L105	2462587T30	1 µH
L121, 122	2462587T30	1 µH
L126	2460591H40	42.90 nH
L127	2460591G24	33.47 nH
L128	2460591K40	59.71 nH
L130	2462587T30	1 µH
L201	2462587T40	33 nH
L202	2462587Q20	2200 nH
L204	2462587T30	1 µH
L205	2462587V28	33 nH
L208, 209	2462587T30	1 µH
L210	2462587T39	27 nH
L211	2462587T12	56 nH
L212	2462587T15	100 nH
L213	2462587T30	1 µH
L215	2462587T30	1 µH
L216	2462587T41	39 nH
L217, 218	2462587T30	1 µH
L219	2462587T38	22 nH
L220	2462587T17	150 nH
L221, 222	2462587Q42	390 nH
L223	2462587T16	120 nH
L225	2462587Q20	2200 nH
L401	2462575A16	3900 nH
L402	2462587V38	220 nH
L601	2405452C61	1100 nH
L603	2405452C64	1500 nH
L604, 605	2405452C60	1000 nH
		TRANSISTOR: See Note 1.
Q1	4882022N70	NPN
Q101	4805128M16	PNP
Q107	4805921T02	Switching
Q108	4802245J10	Dual NPN
Q110	4813822A10	PNP
Q111	4805128M16	PNP
Q201	4802245J15	JFET, P-channel
Q202	4805218N55	NPN
Q401	4882022N70	NPN
Q601	4882022N70	NPN
		RESISTOR: Ω
R1, 2	0660079U18	5.1
R3	0662057A81	22K
R4, 5	0662057A73	10K
R7	0662057A25	100
R8	0662057A29	150
R9	0662057A41	470
R10	0662057A89	47K
R11	0662057A41	470
R101	0662057A73	10K
R102	0662057A65	4.7K
R103	0662057A73	10K
R106	0662057A53	1.5K
R110	0662057A57	2.2K
R111	0662057A67	5.6K
R113	0662057A73	10K
R114	0662057A77	15K
R115	0662057G27	182K
R116	0662057G19	130K
R117	0662057A89	47K
R118	0662057A97	100K
R125	0662057A97	100K
R126, 127	0662057A18	51
R128	0662057A17	47
R135	0662057C01	0 (Placed on NLD8898D only)
R200	0662057B47	0
R203	0662057A09	22
R204	0662057A80	20K
R205	0662057A84	30K
R206, 207	0662057A80	20K
R208	0662057A62	3.6K
R209, 210	0662057A42	510
R211	0662057A20	62
R212	0662057A44	620
R213	0662057A35	270
R214	0662057A87	39K
R215	0662057A84	30K
R217	0662057A84	30K
R218	0662057A97	100K
R219	0662057A09	22
R220, 221	0662057A56	2K
R222	0662057A49	1K
R223	0662057A89	47K
R401	0660079U18	5.1
R402	0662057B08	270K
R403	0662057A83	27K
R404	0662057A73	10K
R405	0662057A13	33
R406	0662057A69	6.8K
R407	0662057A17	47
R410, 411	0662057A21	68
R412	0662057A13	33
R413	0662057A45	680
R414	0662057A56	2K
R415	0662057A25	100
R416	0662057A73	10K
R417	0662057A01	10
R418	0662057A53	1.5K
R419, 420	0662057A89	47K
R421	0662057A56	2K
R501	0662057B47	0
R601	0662057A25	100
R602	0662057A56	2K
R603	0662057A85	33K
R604	0662057A75	12K
R605	0662057A61	3.3K
		THERMISTOR:
RT101	0605621T02	50k
		TRANSFORMER:
T1	2505515V08	4:1
T2	2505515V11	16:1
		INTEGRATED CIRCUIT MODULE: See Note 1.
U002	5105329V26	Mixer
U101	5105662U72	TX ALC
U102	5105662U70	D/A Converter
U104	5102001J69	Coupler
U105	5105625U90	RF Power Amp (NLD8898B/C)
	or 5105625U03	RF Power Amp (NLD8898D)
U106	5105469E71	5V Regulator
U201	5105662U78	VCO Buffer
U202	5105469E71	5V Regulator
U203	5105279V38	16.8 MHz Reference Oscillator
U204	5105457W73	Fractional-N Synthesizer
U401	5105457W20	ABACUS
		DIODE: See Note 1.
VR1	4813830A33	Zener, 20V
VR3	4813830A33	Zener, 20V
VR401	4862824C01	Varactor
VR402	4805129M58	Varactor
		MISCELLANEOUS:
G1 thru 5	3905643V01	Ground Contact
S1	2602661J01	Varactor Filter Shield
S10	2602815X01	Tuned Filter Shield
S201	2602657J01	VCO Shield
S202	2602674J02	VCO Back Shield
S203	2602658J01	Pendulum Shield
S204	2602675J01	Synthesizer Back Shield
	8405432Z01	PC Board (NLD8898B)
	or 8405432Z03	PC Board (NLD8898C)
	or 8405432Z04	PC Board (NLD8898D)

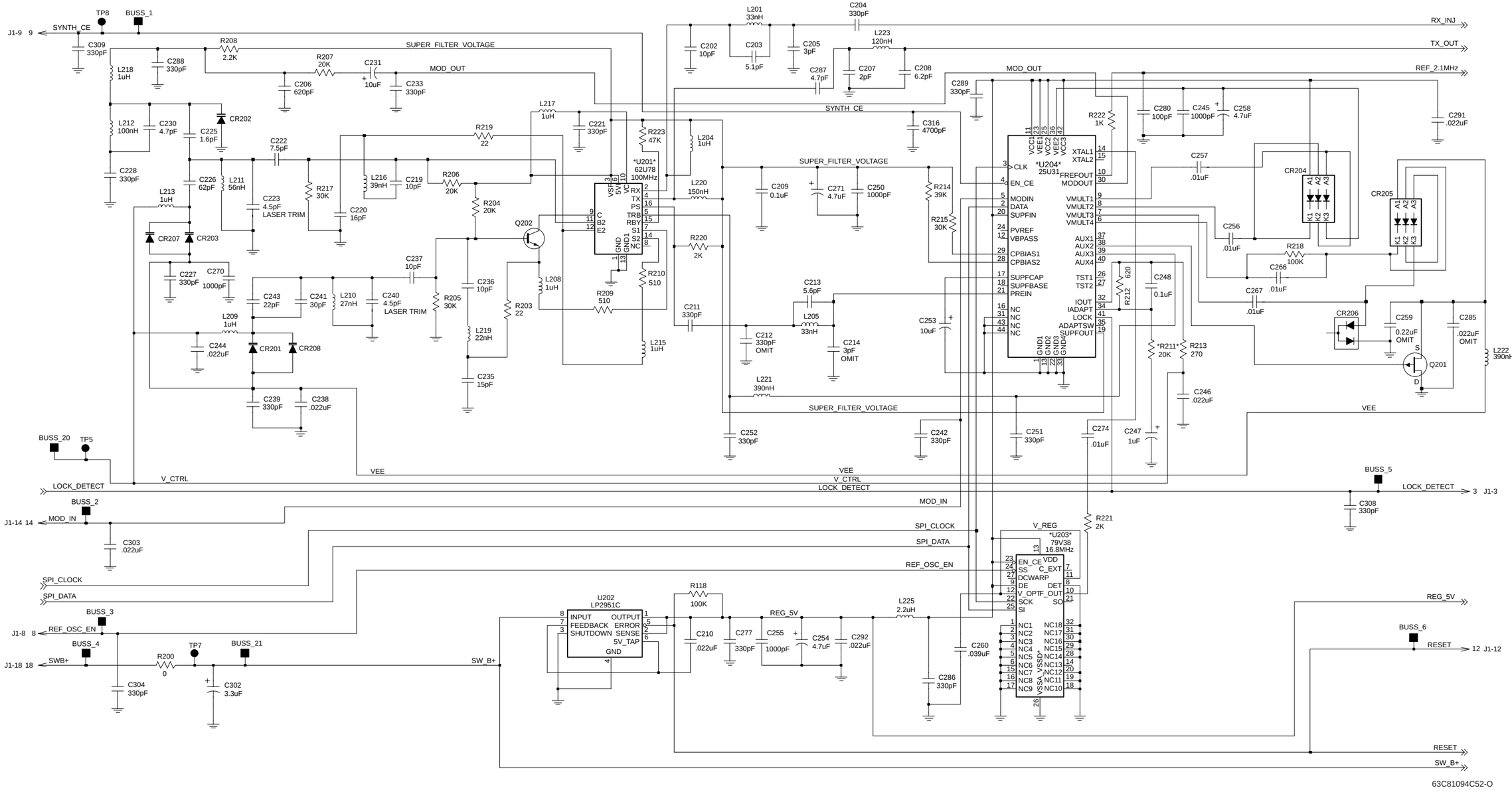
Notes:

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. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NLD8898 RF Board Kits use a 6-layer printed circuit board.

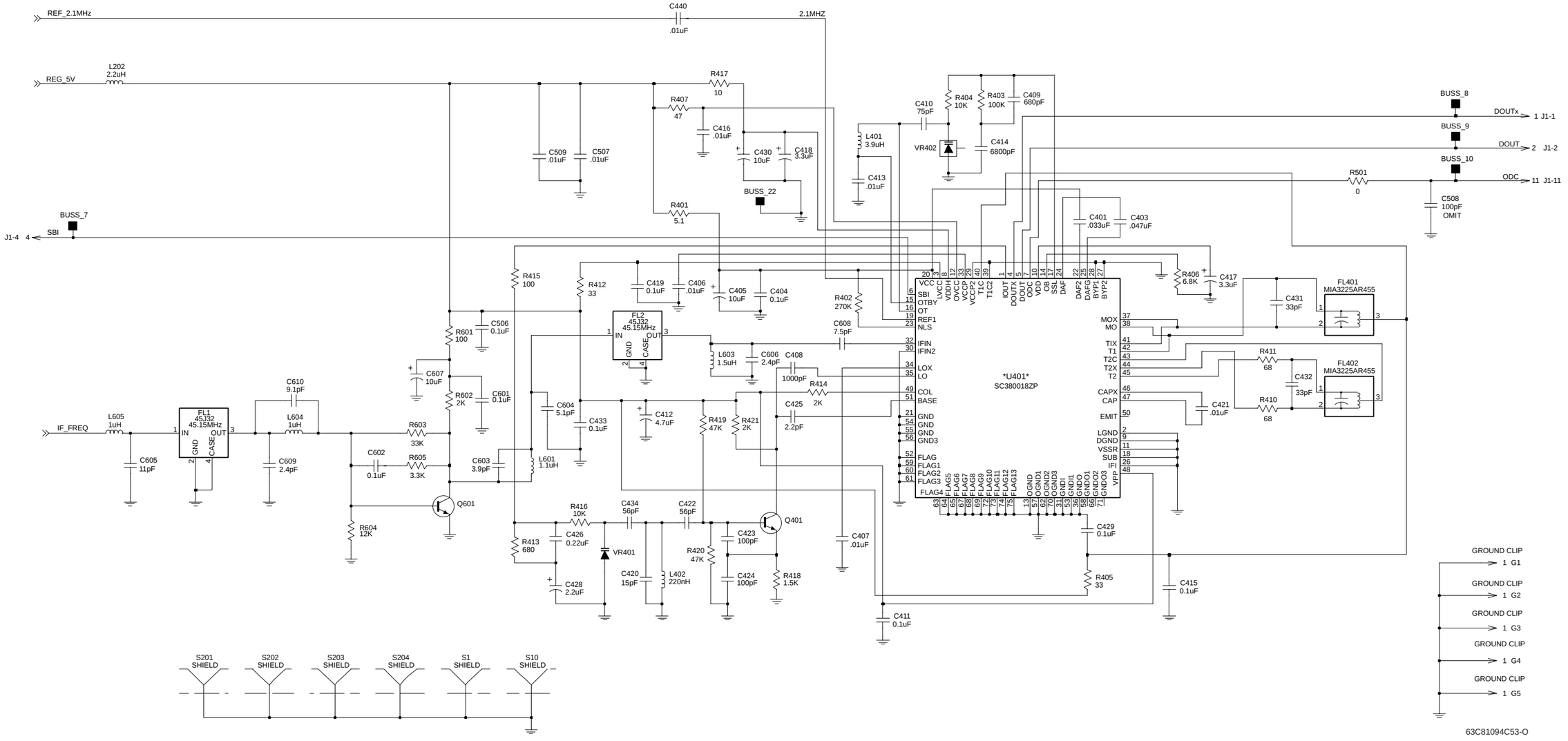




NLD8898H VHF RF Board Schematic Diagram, Sheet 1 of 3

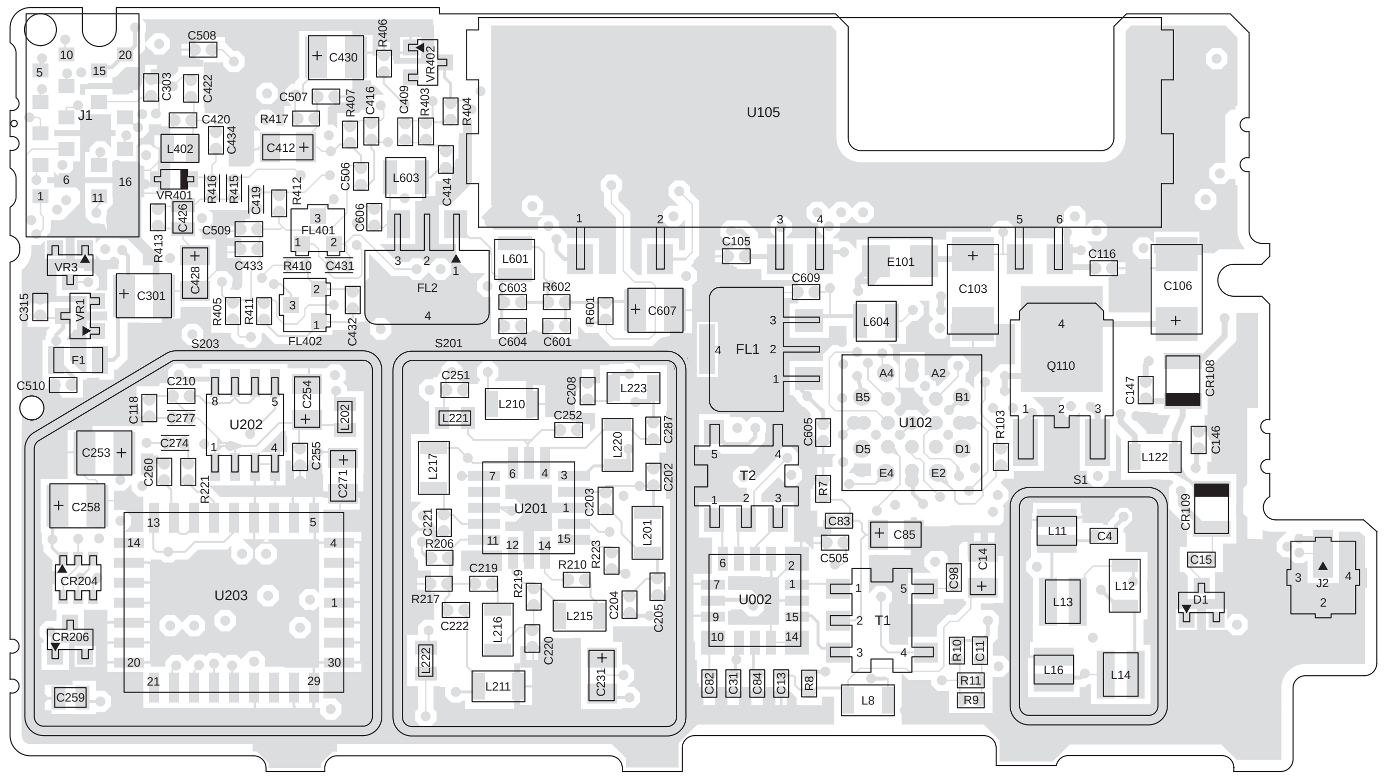


NLD8898H VHF RF Board Schematic Diagram, Sheet 2 of 3



NLD8898H VHF RF Board Schematic Diagram, Sheet 3 of 3

VIEWED FROM SIDE 1



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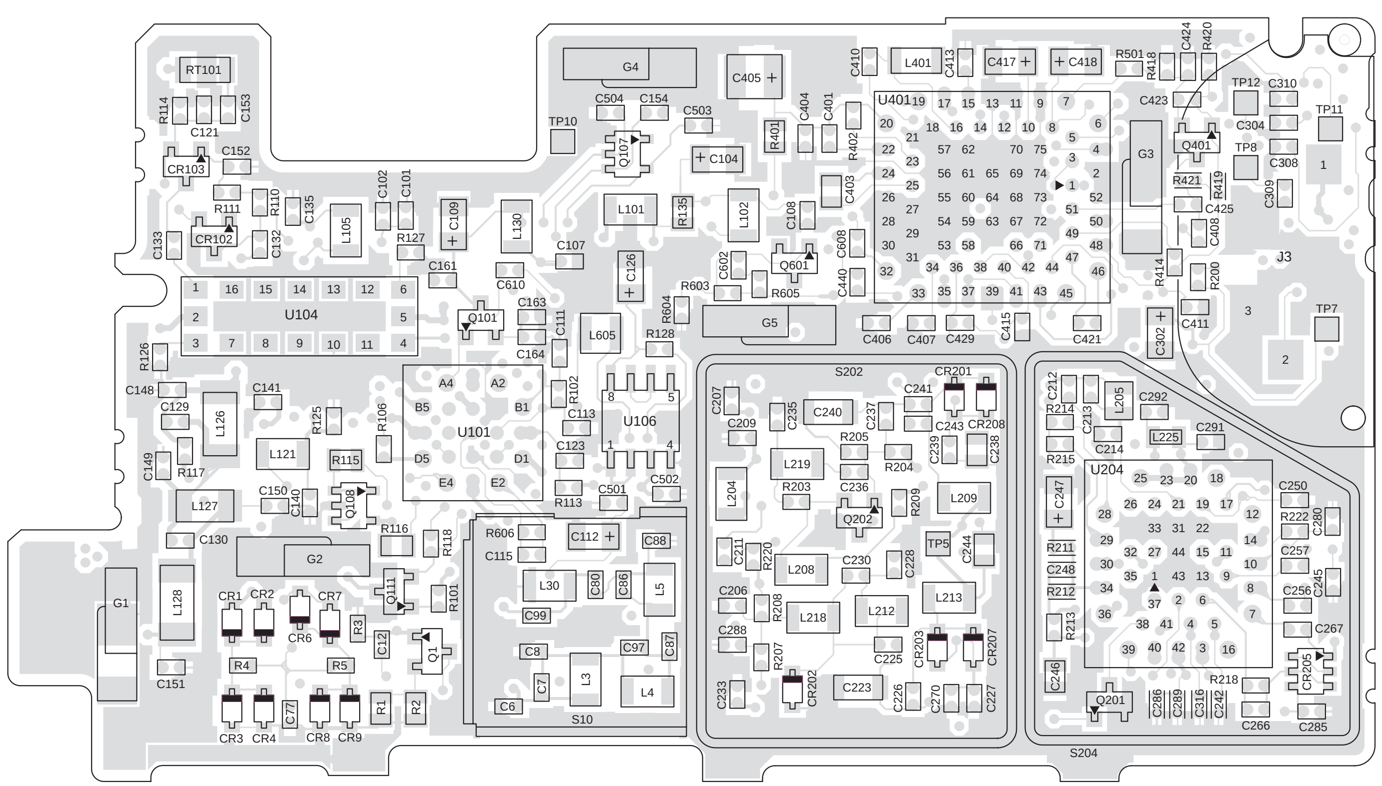
VIEWED FROM SIDE 2



MAEPF-27126-O

NLD8898H VHF RF Board Component Location Detail and Parts List

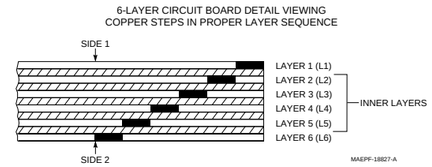
NLD8898H VHF RF Board Electrical Parts List

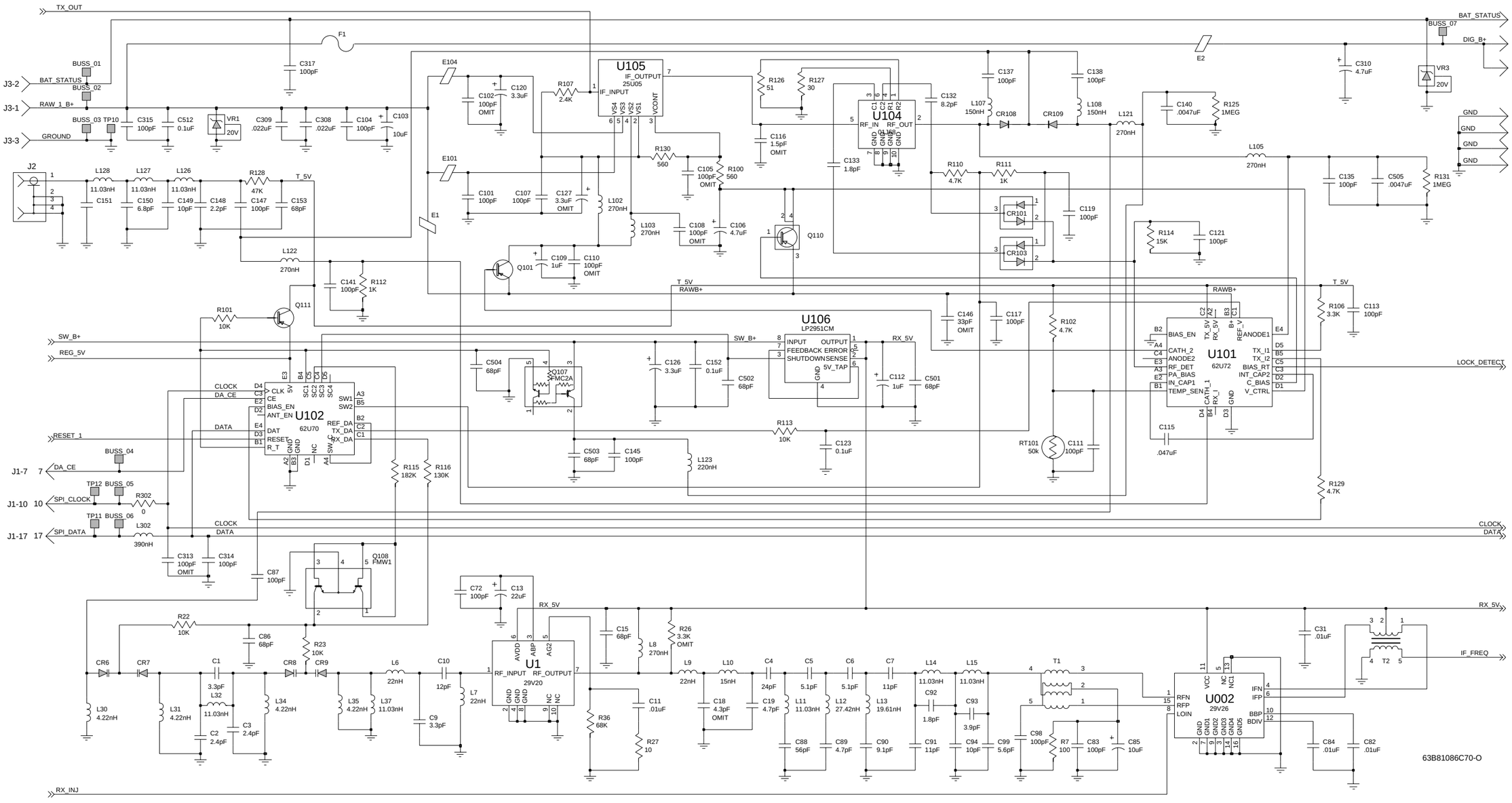
ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 50V unless otherwise stated
C4	2113931F13	330 pF
C6	2113930F27	10 pF
C7	2113930F22	6.2 pF 50V ±0.25 PF 50V
C8	2113930F32	16 pF
C11	2113931F49	10 nF
C12	2113931F13	330 pF
C13	2113931F49	10 nF
C14	2311049A07	1 µF
C15	2113931F49	10 nF
C31	2113931F49	10 nF
C77	2113932K15	0.1 µF +80/-20% 16V
C80	2113930F39	33 pF
C82 thru C84	2113931F49	10 nF
C85	2311049A60	10 µF
C86	2113930F22	6.2 pF 50V ±0.25 PF 50V
C87	2113930F32	16 pF
C88	2113930F27	10 pF
C97	2113930F30	13 pF
C98	2113931F13	330 pF
C99	2113930F39	33 pF
C101	2113932K15	0.1 µF +80/-20% 16V
C102	2113931F13	330 pF
C103	2311049J26	10 µF
C104	2311049A54	3.3 µF
C105	2113931F13	330 pF
C106	2311049J26	10 µF
C107, C108	2113931F13	330 pF
C109	2311049A07	1 µF
C111	2113931F13	330 pF
C112	2311049A07	1 µF
C113	2113931F13	330 pF
C115	2113932E20	0.1 µF 10% 16V
C116	2113930F05	1.2 pF 50V ±0.1 pF 50V
C118	2113932K15	0.1 µF +80/-20% 16V
C121	2113931F13	330 pF
C123	2113932E20	0.10 µF 10% 16V
C126	2311049A54	3.3 µF
C129	2113930F03	1 pF 50V ±0.1 pF 50V
C130	2113930F27	10 pF
C132, C133	2113931F13	330 pF
C135	2113931F13	330 pF
C140, C141	2113931F13	330 pF
C146, C147	2113931F13	330 pF
C148	2113930F03	1 pF 50V ±0.1 pF 50V
C149, C150	2113930F36	24 pF
C151	2113930F25	8.2 pF 50V ±0.25 pF 50V
C152	2113931F13	330 pF
C153	----------------	Not Placed
C154	2113931F13	330 pF
C161	2113932K15	0.1 µF +80/-20% 16V
C163, C164	2113930F51	100 pF
C202	2113930F27	10 pF
C203	2113930F20	5.1 pF 50V ±0.25 pF 50V
C204	2113931F13	330 pF
C205	2113930F14	3 pF 50V ±0.25 pF 50V
C206	2113931F20	620 pF
C207	2113930F10	2 pF 50V ±0.25 pF 50V
C208	2113930F22	6.2 pF 50V ±0.25 pF 50V
C209	2113932K15	0.1 µF +80/-20% 16V
C210	2113932E07	.022 µF 10% 16V
C211	2113931F13	330 pF
C212	----------------	Not Placed
C213	2113930F21	5.6 pF 50V ±0.25 pF 50V
C214	----------------	Not Placed
C219	2113930F27	10 pF
C220	2113930F32	16 pF
C221	2113931F13	330 pF
C222	2113930F24	7.5 pF 50V ±0.25 pF 50V
C223	2113906C02	4.5 pF Laser Trimmed
C225	2113930F08	1.6 pF 50V ±0.1 pF 50V
C226	2113930F46	62 pF
C227, C228	2113931F13	330 pF
C230	2113930F19	4.7 pF 50V ±0.25 pF 50V
C231	2311049A60	10µF
C233	2113931F13	330 pF
C235	2113930F31	15 pF
C236, C237	2113930F27	10 pF
C238	2109720D09	.022 UF
C239	2113931F13	330 pF
C240	2113906C02	4.5 pF Laser Trimmed
C241	2113930F38	30 pF
C242	2113931F13	330 pF
C243	2113930F35	22 pF
C244	2109720D09	.022 UF
C245	2113931F25	1,000 PF 5% 50V
C246	2109720D09	.022 µF
C247	2311049A07	1 µF
C248	2113932K15	0.1 µF +80/-20% 16V
C250	2113931F25	1 nF
C251, C252	2113931F13	330 pF
C253	2311049J23	10 µF
C254	2311049A56	4.7 µF
C255	2113931F25	1 nF
C256, C257	2113931F49	10 nF
C258	2311049J11	4.7 µF
C259	---------------	Not Placed
C260	2113932K05	.039 µF +80/-20% 16V
C266, C267	2113931F49	10 nF
C270	2113931F25	1 nF
C271	2311049A56	4.7 µF
C274	2113931F49	10 nF
C277	2113931F13	330 pF
C280	2113930F51	100 pF
C285	----------------	Not Placed
C286	2113931F13	330 pF
C287	2113930F19	4.7 pF 50V ±0.25 pF 50V
C288, C289	2113931F13	330 pF
C291, C292	2113932E07	.022 µF 10% 16V
C301	2311049J11	4.7 µF
C302	2311049A54	3.3 µF
C303	2113932E07	.022 µF 10% 16V
C304	2113931F13	330 pF
C308 thru C310	2113931F13	330 pF
C315	2113931F13	330 pF
C316	2113931F41	4.7 nF
C401	2113932K03	.033 µF +80/-20% 16V
C403	2113743A13	.047 µF
C404	2113932K15	0.1 µF +80/-20% 16V
C405	2311049J23	10 µF
C406, C407	2113931F49	10 nF
C408	2113931F25	1 nF
C409	2113931F21	680 pF
C410	2113930F48	75 pF
C411	2113932K15	0.1 µF +80/-20% 16V
C412	2311049A56	4.7 µF
C413	2113931F49	10 nF
C414	2113931F45	6.8 nF
C415	2113932K15	0.1 µF +80/-20% 16V
C416	2113931F49	10 nF

C417, C418	2311049A42	3.3 µF
C419	2113932K15	0.1 µF +80/-20% 16V
C420	2113930F31	15 pF
C421	2113931F49	10 nF
C422	2113930F45	56 pF
C423, C424	2113930F51	100 pF
C425	2113930F11	2.2 pF 50V ±0.25 pF 50V
C426	2113743A23	0.22 µF
C428	2311049A40	2.2 µF
C429	2113932K15	0.1 µF +80/-20% 16V
C430	2311049J23	10 µF
C431, C432	2113930F39	33 pF
C433	2113932K15	0.1 µF +80/-20% 16V
C434	2113930F45	56 pF
C440	2113931F49	10 nF
C501 thru C505	2113931F13	330 pF
C506	2113932K15	0.1 µF +80/-20% 16V
C507	2113931F49	10 nF
C508	----------	Not Placed
C509	2113931F49	10 nF
C510	2113932K15	0.1 µF +80/-20% 16V
C601, C602	2113932K15	0.1 µF +80/-20% 16V
C603	2113930F17	3.9 pF 50V ±0.25 pF 50V
C604	2113930F20	5.1 pF 50V ±0.25 pF 50V
C605	2113930F28	11 pF
C606	2113930F12	2.4 pF 50V ±0.25 pF 50V
C607	2311049J23	10 µF
C608	2113930F24	7.5 pF 50V ±0.25 pF 50V
C609	2113930F12	2.4 pF 50V ±0.25 pF 50V
C610	2113930F26	9.1 pF 50V ±0.25 pF 50V
		DIODE: See Note 1
CR1 thru CR4	4862824C01	Varactor
CR6 thru CR9	4862824C01	Varactor
CR102, CR103	4805129M67	Dual
CR108, CR109	4802482J02	PIN
CR201	4802245J29	Varactor
CR202, CR203	4862824C03	Varactor
CR204, CR205	4802233J09	Triple
CR206	4805129M06	Dual
CR207	----------	Not Placed
CR208	4802245J29	Varactor
		DIODE: See Note 1
D1	4880154K03	Schottky, Dual Mixer
		CORE:
E101	2484657R01	Bead, Inductor
		FUSE:
F1	6505757V02	Fuse, 2 Amp
		FILTER: See Note 2.
FL1, FL2	4805245J32	Crystal, Mono, 45.15 MHz
FL401, FL402	9105398W01	Surface Mount, 450kHz
		JACK:
J1	----------	Not Placed
J2	0905304Z01	RF Connector, Coaxial
J3	----------	Not Placed
		COIL RF:
L3	2462587T42	47 nH
L4	2462587T41	39 nH
L5	2462587T42	47 nH
L8	2462587T30	1 µH
L11	2460591M12	21.95 nH
L12	2462587T23	470 nH
L13, L14	2460591N36	43.67 nH
L16	2460591M12	21.95 nH
L30	2462587T42	47 nH
L101	2462587T30	1 µH
L102	----------	Not Placed
L105	2462587T30	1 µH
L121	2462587T30	1 µH
L122	2462587T30	1 µH
L126	2460591H40	42.90 nH
L127	2460591G24	33.47 nH
L128	2460591K40	59.71 nH
L130	2462587T30	1 µH
L201	2462587T40	33 nH
L202	2462587Q20	2.2 µH
L204	2462587T30	1 µH
L205	2462587V28	33 nH
L208, L209	2462587T30	1 µH
L210	2462587T39	27 nH
L211	2462587T12	56 nH
L212	2462587T15	100 nH
L213	2462587T30	1 µH
L215	2462587T30	1 µH
L216	2462587T41	39 nH
L217, L218	2462587T30	1 nH
L219	2462587T38	22 nH
L220	2462587T17	150 nH
L221, L222	2462587Q42	390 nH
L223	2462587T16	120 nH
L225	2462587Q20	2.2 µH
L401	2462575A16	3.9 µH
L402	2462587V38	220 nH
L601	2405452C61	1.1 µH
L603	2405452C64	1.5 µH
L604, L605	2405452C60	1 µH
		TRANSISTOR: See Note 2.
Q001	4882022N70	NPN
Q101	4805128M16	PNP
Q107	4805921T02	Switching
Q108	4802245J10	Dual NPN
Q110	4813822A10	PNP
Q111	4805128M16	PNP
Q201	4802245J15	JFET, P-Channel
Q202	4805218N55	NPN
Q401	4882022N70	NPN
Q601	4882022N70	NPN
		RESISTOR, Fixed: Ω **±5%; 1/8W** unless otherwise stated
R1, R2	0660079U18	5.1
R3	0662057A81	22k
R4, R5	0662057A73	10k
R7	0662057A25	100
R8	0662057A29	150
R9	0662057A41	470
R010	0662057A89	47k
R011	0662057A41	470
R101	0662057A73	10k
R102	0662057A65	4.7k
R103	0662057A73	10k
R106	0662057A53	1.5k
R110	0662057A57	2.2k
R111	0662057A67	5.6k
R113	0662057A73	10k
R114	0662057A77	15k
R115	0662057G27	182k 1%
R116	0662057G19	130k 1%
R117	0662057A89	47k
R118	0662057A97	100k
R125	0662057A97	100k
R126, R127	0662057A18	51
R128	0662057A17	47
R135	0662057C01	0
R200	0662057B47	0
R203	0662057A09	22
R204	0662057A80	20k
R205	0662057A84	30k
R206, R207	0662057A80	20k
R208	0662057A57	2.2k
R209, R210	0662057A42	510
R211	0662057A20	62
R212	0662057A44	620
R213	0662057A35	270
R214	0662057A87	39k
R215	0662057A84	30k
R217	0662057A84	30k
R218	0662057A97	100k
R219	0662057A09	22
R220, R221	0662057A56	2k
R222	0662057A49	1k
R223	0662057A89	47k
R401	0660079U18	5.1
R402	0662057B08	270k
R403	0662057A97	100k
R404	0662057A73	10k
R405	0662057A13	33
R406	0662057A69	6.8k
R407	0662057A17	47
R410, R411	0662057A21	68
R412	0662057A13	33
R413	0662057A45	680
R414	0662057A56	2k
R415	0662057A25	100
R416	0662057A73	10k
R417	0662057A01	10
R418	0662057A53	1.5k
R419	0662057A89	47k
R420	0662057A89	47K
R421	0662057A56	2k
R501	0662057B47	0
R601	0662057A25	100
R602	0662057A56	2k
R603	0662057A85	33k
R604	0662057A75	12k
R605	0662057A61	3.3k
R606	0662057B22	1MEG
		THERMISTOR:
RT101	0605621T02	50k
		TRANSFORMER:
T1	2505515V08	4:1
T2	2505515V11	16:1
		CIRCUIT MODULE: See Note 1.
U2	5105329V26	Mixer
U101	5105835U52	TX (ALC)
U102	5105835U51	D/A Converter
U104	5102001J69	Coupler, VHF
U105	5105385Y36	Power Amplifier, VHF
U106	5105469E65	5V Regulator
U201	5102227J37	VCO Buffer
U202	5105469E65	5V Regulator
U203	5105385Y43	16.8 MHz Reference Oscillator
U204	5105457W81	Fractional-N Synthesizer
U401	5105835U90	ABACUS
		DIODE: See Note 1.
VR1	4813830A33	Zener, 20V
VR3	4813830A33	Zener, 20V
VR401	4862824C01	Varactor
VR402	4805129M58	Varactor
		MISCELLANEOUS:
G1 thru G5	3905643V01	Contact, Antenna Ground
S1	2602661J01	Shield, Varactor Filter, VHF
S010	2602815X01	Shield, Fixed Tuned Filter
S201	2602657J01	Shield, VCO
S202	2602674J02	Shield, VCO Back
S203	2602658J01	Shield, Pendulum
S204	2602675J01	Shield, Synthesizer, Back

Notes:

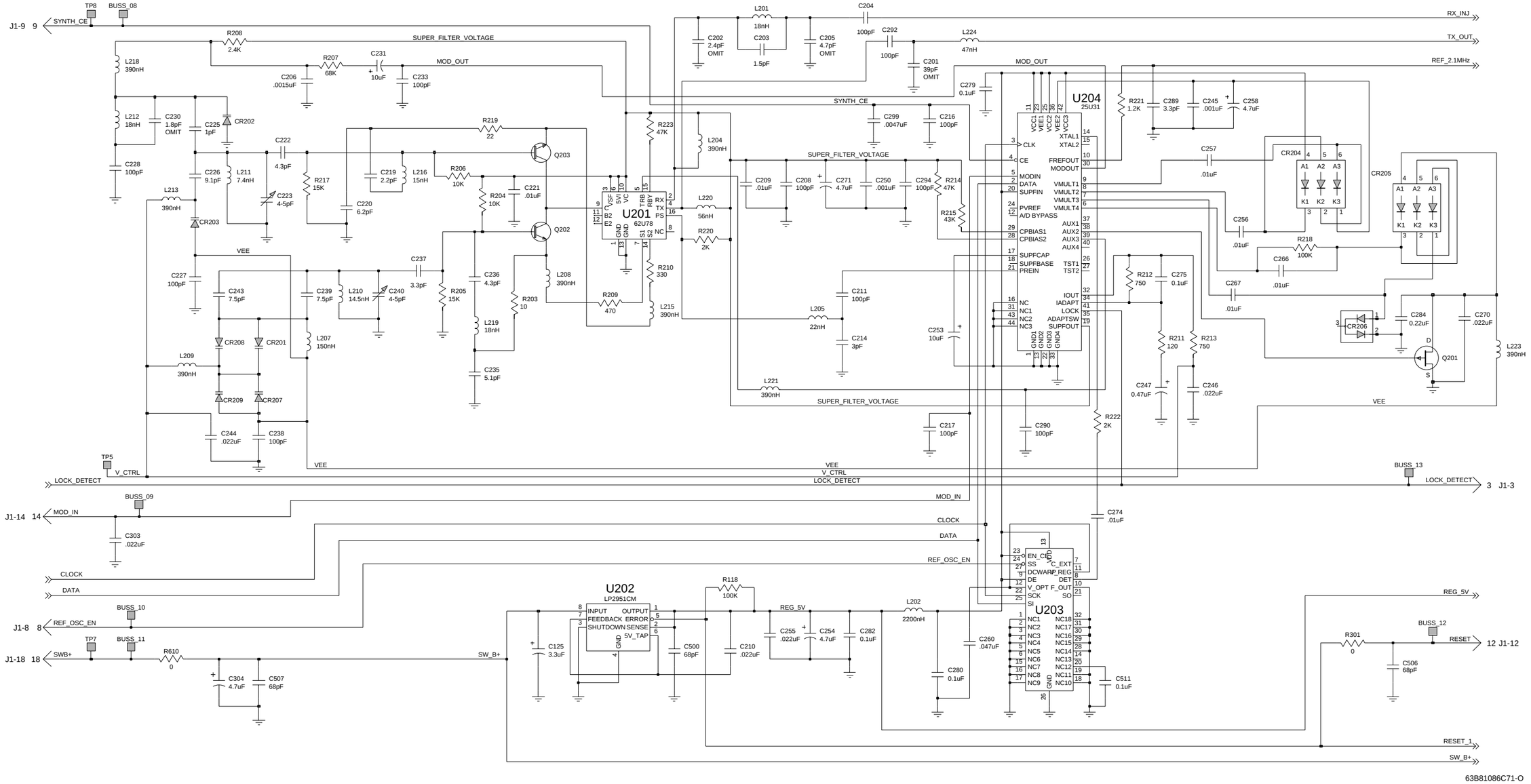
1. For optimum performance, order replacement diodes, transistors, and circuit modules by Motorola part number only.
2. When ordering crystals, specify carrier frequency, crystal frequency, crystal type number, and Motorola part number.
3. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NLD8898 RF Board Kits use a 6-layer printed circuit board.



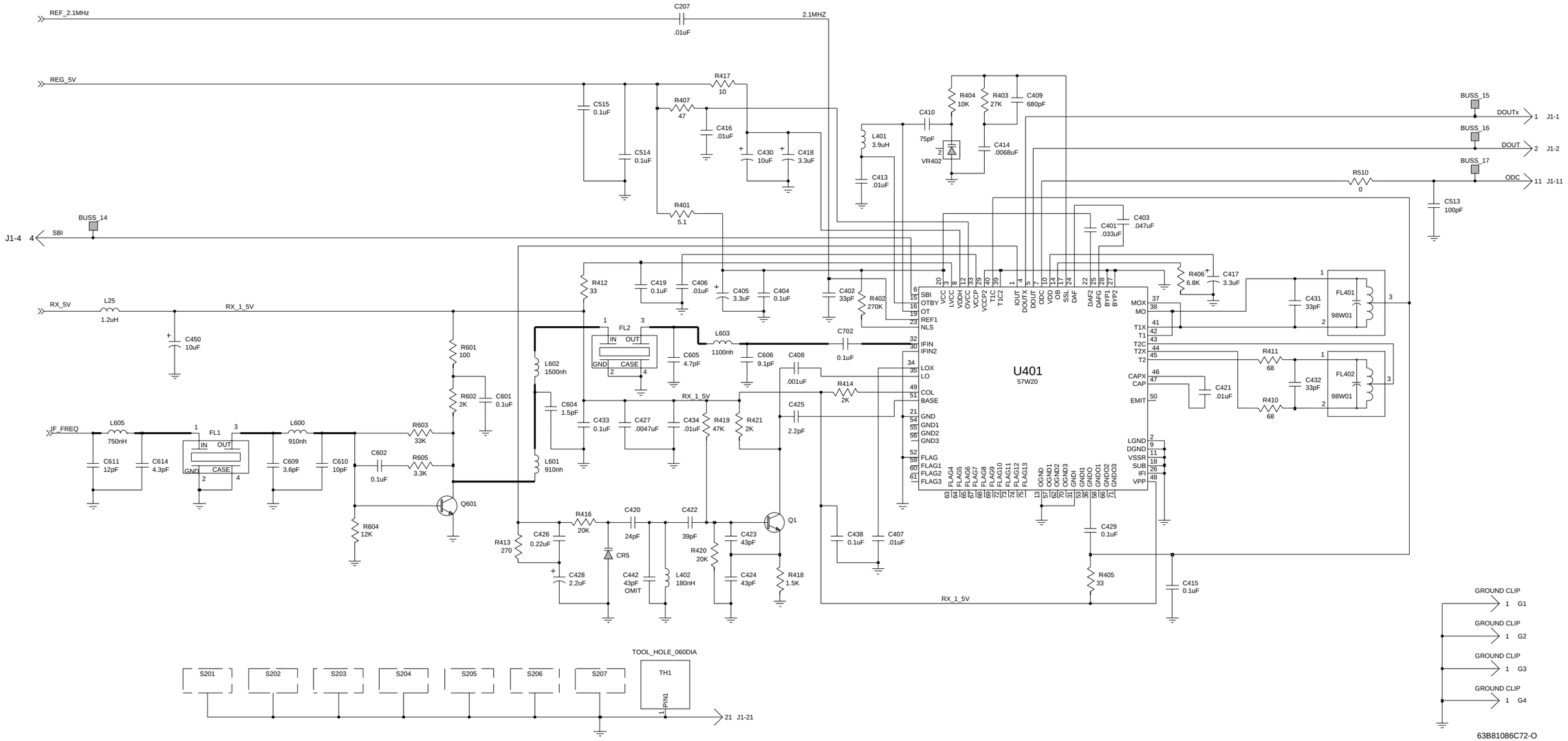


NOTE: If NTN8250G Vocoder Board is used with NLE4249A-D (UHF-R1) or NLE4250A-E (UHF-R2) RF Boards, the capacitor C513 must be removed from the RF Boards for proper operation.

NLE4249A UHF Range 1 RF Board Schematic Diagram, Sheet 1 of 3

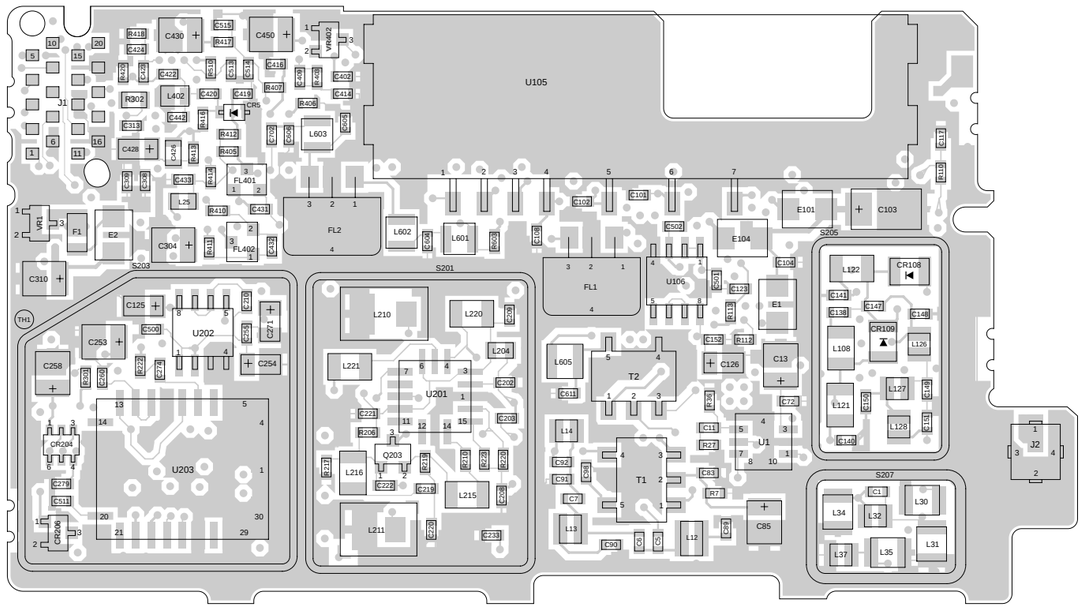


NLE4249A UHF Range 1 RF Board Schematic Diagram, Sheet 2 of 3

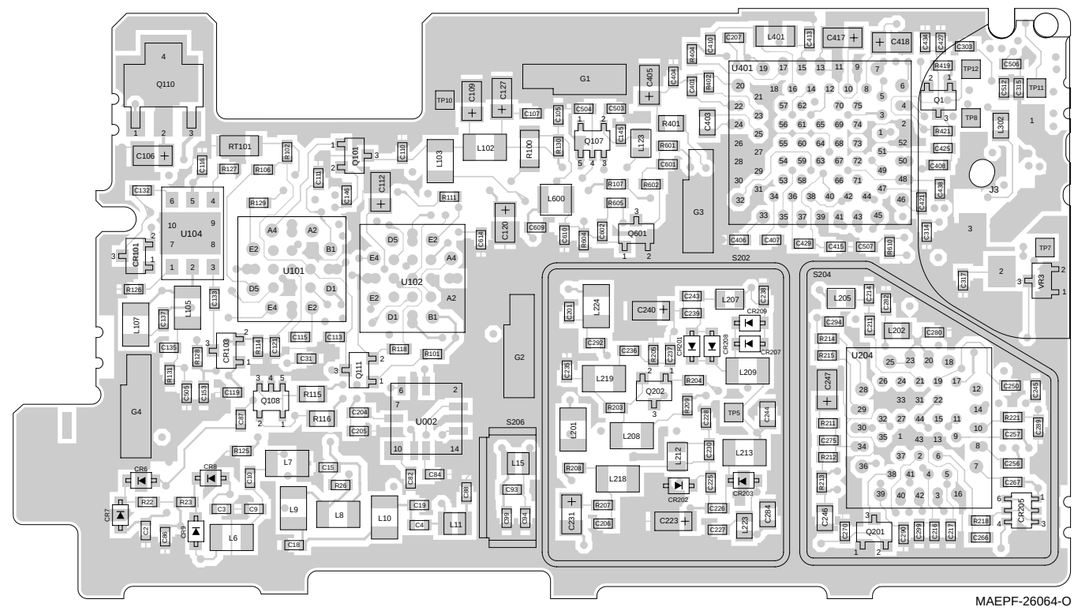


NLE4249A UHF Range 1 RF Board Schematic Diagram, Sheet 3 of 3

VIEWED FROM SIDE 1



VIEWED FROM SIDE 2



NLE4249A UHF Range 1 RF Board Component Location Detail and Parts List

NLE4249A UHF Range 1 RF Board Electrical Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: unless otherwise stated
C1	2113930F19	4.7 pF
C2, 3	2113930F12	Not Placed
C4	2113930F31	15 pF
C5	2113930F23	6.8 pF
C6	2113930F20	5.1 pF
C7	2113930F27	10 pF
C9	2113930F05	1.2 pF
C10	2113930F03	1 pF
C11	2113931F49	10 nF
C13	2311049A66	22 µF
C15	2113930F47	68 pF
C18, 19	2113930F07	1.5 pF
C31	2113931F49	10 nF
C72	2113930F51	100 pF
C82	2113931F49	10 nF
C83	2113930F51	100 pF
C84	2113931F49	10 nF
C85	2311049J23	10 µF
C86	2113930F47	68 pF
C87	2113930F51	100 pF
C88	2113930F45	56 pF
C89	2113930F22	6.2 pF
C90	2113930F31	15 pF
C91	2113930F28	11 pF
C92	2113930F18	4.3 pF
C93	2113930F20	5.1 pF
C94	2113930F29	12 pF
C98	2113930F51	100 pF
C99	2113930F28	11 pF
C101	2113930F51	100 pF
C102	2113930F51	Not Placed
C103	2311049J26	10 µF
C104, 105	2113930F51	100 pF
C106	2311049A56	4.7 µF
C107	2113930F51	100 pF
C108	2113930F51	Not Placed
C109	2311049A07	1 µF
C110	2113930F51	Not Placed
C111	2113930F51	100 pF
C112	2311049A07	1 µF
C113	2113930F51	100 pF
C115	2113932K07	.047 µF
C116	2113930F07	Not Placed
C117	2113930F51	100 pF
C119	2113930F51	100 pF
C120	2311049A42	Not Placed
C121	2113930F51	100 pF
C123	2113932K15	.1 µF
C125, 126	2311049A54	3.3 µF
C127	2311049A54	Not Placed
C132	2113930F25	8.2 pF
C133	2113930F15	3.3 pF
C135	2113930F51	100 pF
C137, 138	2113930F51	100 pF
C140	2113931F41	CAP
C141	2113930F51	100 pF
C145	2113930F51	100 pF
C146	2113930F39	Not Placed
C147	2113930F51	100 pF
C148	2113930F16	3.6 pF
C149	2113930F35	22 pF
C150	2113930F32	16 pF
C151	2113930F14	3.0 pF
C152	2113932K15	.1 µF
C153	2113930F47	68 pF
C201	2113930F03	1 pF
C202	2113930F12	Not Placed
C203	2113930F07	1.5 pF
C204	2113930F51	100 pF
C205	2113930F19	Not Placed
C206	2113741F37	3.3 nF
C207	2113931F49	10 nF
C208	2113930F51	100 pF
C209	2113931F49	10 nF
C210	2113932E07	.022 µF
C211	2113930F51	100 pF
C214	2113930F20	5.1 pF
C216, 217	2113930F51	100 pF
C219	2113930F17	3.9 pF
C220	2113930F20	5.1 pF
C221	2113931F49	10 nF
C222	2113930F17	3.9 pF
C223	2113906C02	4 pF
C225	2113930F03	1 pF
C226	2113930F28	11 pF
C227, 228	2113930F51	100 pF
C230	2113930F09	Not Placed
C231	2311049A60	10 µF
C233	2113930F51	100 pF
C235	2113930F18	4.3 pF
C236	2113930F20	5.1 pF
C237	2113930F15	3.3 pF
C238	2113930F51	100 pF
C239	2113930F27	10 pF
C240	2113906C02	4 pF
C243	2113930F25	8.2 pF
C244	2109720D09	.022 µF
C245	2113931F25	1 nF
C246	2109720D09	.022 µF
C247	2311049A05	.47 µF
C250	2113931F25	1 nF
C253	2311049J23	10 µF
C254	2311049A56	4.7 µF
C255	2113932E07	.022 µF
C256, 257	2113931F49	10 nF
C258	2311049J11	4.7 µF
C260	2113932K07	.047 µF
C266, 267	2113931F49	10 nF
C270	2113932E07	.022 µF
C271	2311049A56	4.7 µF
C274	2113931F49	10 nF
C275	2113932K15	.1 µF
C279, 280	2113932K15	.1 µF
C282	2113932K15	.1 µF
C284	2113743A23	.22 µF
C289, 290	2113930F51	100 pF
C292	2113930F03	1 pF
C294	2113930F51	100 pF
C299	2113931F41	4.7 nF
C303	2113932E07	.022 µF
C304	2311049J11	4.7 µF
C308	2113932E07	.022 µF
C309	2113932E07	.022 µF
C310	2311049J11	4.7 µF
C313	2113930F51	Not Placed
C314, 315	2113930F51	100 pF
C317	2113930F51	100 pF
C401	2113932K03	.033 µF
C402	2113930F39	33 pF

C403	2113743A13	.047 µF
C404	2113932K15	.1 µF
C405	2311049A42	3.3 µF
C406, 407	2113931F49	10 nF
C408	2113931F25	1 nF
C409	2113931F21	680 pF
C410	2113930F48	75 pF
C413	2113931F49	10 nF
C414	2113931F45	6.8 nF
C415	2113932K15	.1 µF
C416	2113931F49	10 nF
C417, 418	2311049A42	3.3 µF
C419	2113932K15	.1 µF
C420	2113930F36	24 pF
C421	2113931F49	10 nF
C422	2113930F41	39 pF
C423, 424	2113930F42	43 pF
C425	2113930F11	2.2 pF
C426	2113743A23	.22 µF
C427	2113931F41	4.7 nF
C428	2311049A40	2.2 µF
C429	2113932K15	.1 µF
C430	2311049J23	10 µF
C431, 432	2113930F39	33 pF
C433	2113932K15	.1 µF
C434	2113931F49	10 nF
C438	2113932K15	.1 µF
C442	2113930F42	Not Placed
C450	2311049J23	10 µF
C500 thru 504	2113930F47	68 pF
C505	2113931F41	4.7 nF
C506, 507	2113930F47	68 pF
C511, 512	2113932K15	.1 µF
C513	2113930F51	100 pF
C514, 515	2113932K15	.1 µF
C601, 602	2113932K15	.1 µF
C604	2113930F10	2 pF
C605	2113930F17	3.9 pF
C606	2113930F27	10 pF
C609	2113930F18	4.3 pF
C610	2113930F33	18 pF
C611	2113930F34	20 pF
C614	2113930F14	3 pF
C702	2113932K15	.1 µF
		DIODE: See Note 1.
CR5 thru 9	4862824C01	Varactor
CR101	4805129M67	Dual
CR103	4805129M67	Dual
CR108, 109	4802482J02	PIN
CR201	4802245J29	Varactor
CR202	4862824C01	Varactor
CR203	4862824C03	Varactor
CR204, 205	4802233J09	Triple
CR206	4805129M06	Triple
CR207 thru 209	4802245J29	Varactor
		CORE:
E1, 2	2484657R01	Ferrite Bead
E101	2484657R01	Ferrite Bead
E104	2484657R01	NOT PLACED
		FUSE:
F1	6505757V02	2 Amp
		FILTER: See Note 2.
FL1, 2	4805245J33	73.35 MHz
FL401, 402	9105398W01	450 kHz

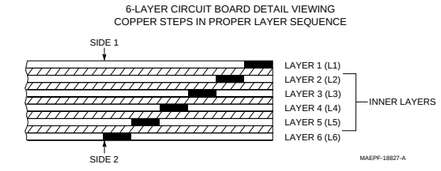
		JACK:
J2	0905304Z01	Connector, RF Coax
		COIL, RF: unless otherwise stated
L6	2462587T41	39 nH
L7	2462587T40	33 nH
L8	2462587T42	47 nH
L9	2462587T40	33 nH
L10	2462587T42	47 nH
L11	2460591B04	11.03 nH
L12	2460591M32	27.42 nH
L13	2460591B80	19. 61 nH
L14, 15	2460591B04	11.03 nH
L25	2462587Q48	1200 nH
L30, 31	2460591B22	8.67 nH
L32	2460591B04	11.03 nH
L34, 35	2460591B22	8.67 nH
L37	2460591B04	11.03 nH
L102	2462587T20	Not Placed
L103	2462587T20	270 nH
L105	2462587T20	270 nH
L107, 108	2462587T17	150 nH
L121, 122	2462587T20	270 nH
L123	2462587V38	220 nH
L126 thru 128	2460591B04	11.03 nH
L201	2462587T38	22 nH
L202	2462587Q20	2200 nH
L204	2462587Q42	390 nH
L205	2462587V27	27 nH
L207	2462587V38	220 nH
L208, 209	2462587T22	390 nH
L210	2405619V01	18.1 nH
L211	2405619V05	12 nH
L212	2462587V26	22 nH
L213	2462587T15	100 nH
L215	2462587T22	390 nH
L216	2462587T05	15 nH
L218	2462587T22	390 nH
L219	2462587T37	18 nH
L220	2462587T39	27 nH
L221	2462587T22	390 nH
L223	2462587Q42	390 nH
L224	2462587T40	33 nH
L302	2462587Q42	390 nH
L401	2462575A16	3900 nH
L402	2462587V37	180 nH
L600, 601	2405452C59	910 nH
L602	2405452C64	1500 nH
L603	2405452C61	1100 nH
L605	2462587N65	750 nH
		TRANSISTOR: See Note 1.
Q1	4805218N55	NPN
Q101	4805128M16	PNP
Q107	4805921T02	Switching
Q108	4802245J10	Dual NPN
Q110	4802245J12	PNP
Q111	4805128M16	PNP
Q201	4802245J15	JFET P-channel
Q202, 203	4805218N55	NPN
Q601	4882022N70	NPN
		RESISTOR; Ω:
R7	0662057A25	100
R22, 23	0662057A73	10K
R26	0662057A61	Not Placed
R27	0662057A01	10
R36	0662057A93	Not Placed

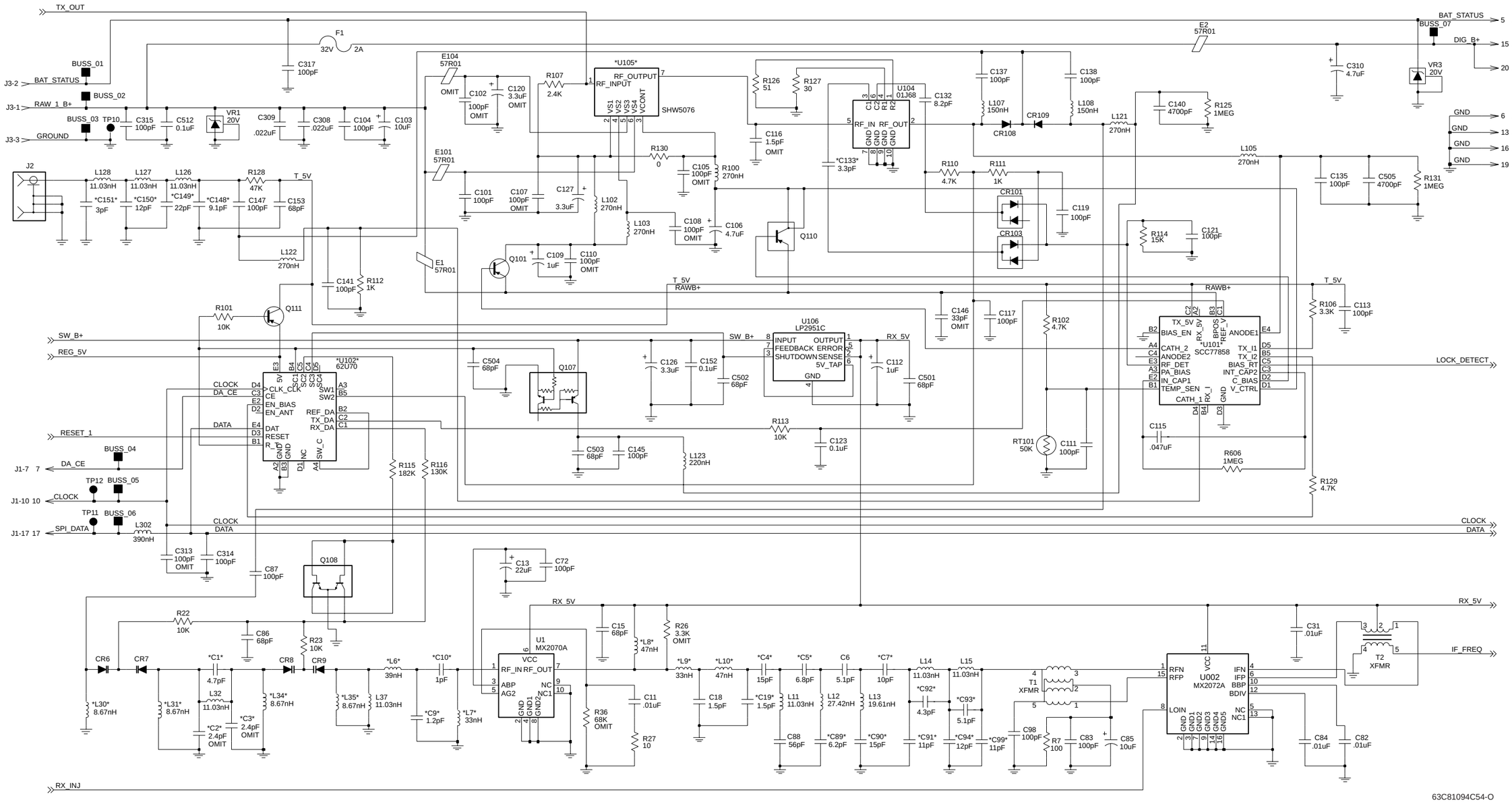
R100	0611077A68	560
R101	0662057A73	10K
R102	0662057A65	4.7K
R106	0662057A61	3.3K
R107	0662057A58	2.4K
R110	0662057A65	4.7K
R111, 112	0662057A49	1K
R113	0662057A73	10K
R114	0662057A77	15K
R115	0662057G27	182K
R116	0662057G19	130K
R118	0662057A97	100K
R125	0662057B22	1M
R126	0662057A18	51
R127	0662057A12	30
R128	0662057A89	47K
R129	0662057A65	4.7K
R130	0662057B47	0
R131	0662057B22	1M
R203	0662057A09	22
R204	0662057A73	10K
R205	0662057A77	15K
R206	0662057A73	10K
R207	0662057A93	68K
R208	0662057A56	2K
R209	0662057A41	470
R210	0662057A37	330
R211	0662057A27	120
R212	0662057A46	750
R213	0662057A46	750
R214	0662057A89	47K
R215	0662057A88	43K
R217	0662057A77	15K
R218	0662057A97	100K
R219	0662057A01	10
R220	0662057A56	2K
R221	0662057A51	1.2K
R222	0662057A56	2K
R223	0662057A89	47K
R301	0662057B47	0
R302	0662057C01	0
R401	0660079U18	5.1
R402	0662057B08	270K
R403	0662057A83	27K
R404	0662057A73	10K
R405	0662057A13	33
R406	0662057A69	6.8K
R407	0662057A17	47
R410, 411	0662057A21	68
R412	0662057A13	33
R413	0662057A35	270
R414	0662057A56	2K
R416	0662057A80	20K
R417	0662057A01	10
R418	0662057A53	1.5K
R419	0662057A89	47K
R420	0662057A80	20K
R421	0662057A56	2K
R510	0662057B47	0
R601	0662057A25	100
R602	0662057A56	2K
R603	0662057A85	33K
R604	0662057A75	12K
R605	0662057A61	3.3K
R610	0662057B47	0
		THERMISTOR:
RT501	0605621T02	50k

		TRANSFORMER:
T1	2505515V08	4:1
T2	2505515V11	16:1
		INTEGRATED CIRCUIT MODULE: See Note 1.
U1	5105329V20	RF Amplifier
U101	5105835U52	TX ALC
U102	5105835U51	D/A Converter
U104	5102001J68	Coupler
U105	5105385Y10	LDMOS RF PA
U106	5105469E71	5V Regulator
U2	5105329V26	Mixer
U201	5105662U78	VCO Buffer
U202	5105469E71	5V Regulator
U203	5102845C08	16.8 MHz Ref. Oscillator
U204	5105457W98	Frac-N Synthesizer
U401	5105457W20	ABACUS
		DIODE: See Note 1.
VR1	4813830A33	20V
VR3	4813830A33	20V
VR402	4805129M58	VARACTOR
		MISCELLANEOUS:
G1	3905643V01	Ground Contact
G2	3905643V01	Ground Contact
G3	3905643V01	Ground Contact
G4	3905643V01	Ground Contact
S201	2602657J02	Shield, VCO
S202	2602674J02	Shield, VCO Back
S203	2602658J01	Shield, Pendulum
S204	2602675J01	Shield, Synthesizer
S205	2602660J01	Shield, Harmonic Filter
S206	2602686J01	Shield, Coil
S207	2605547X01	Shield, Varactor
	8405260Z02	UHF Range 1 PC Board

Notes:

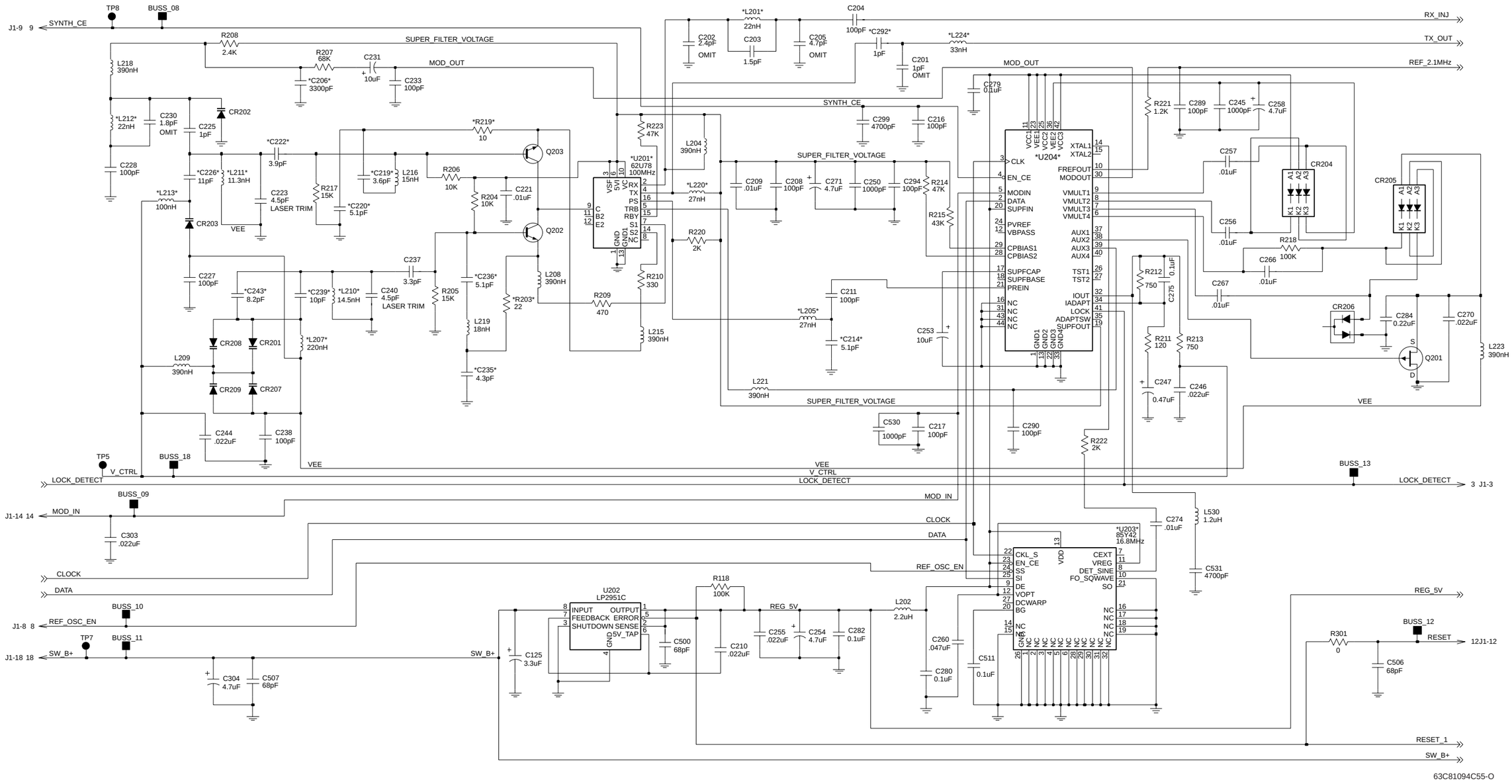
1. For optimum performance, order replacement diodes, transistors, and circuit modules by Motorola part number only.
2. When ordering crystals, specify carrier frequency, crystal frequency, crystal type number, and Motorola part number.
3. Part value notations:
   $p=10^{-12}$
   $n=10^{-9}$
   $\mu=10^{-6}$
   $m=10^{-3}$
   $k=10^{3}$
   $M=10^{6}$
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NLE4249 UHF RF Board uses a 6-layer printed circuit board.



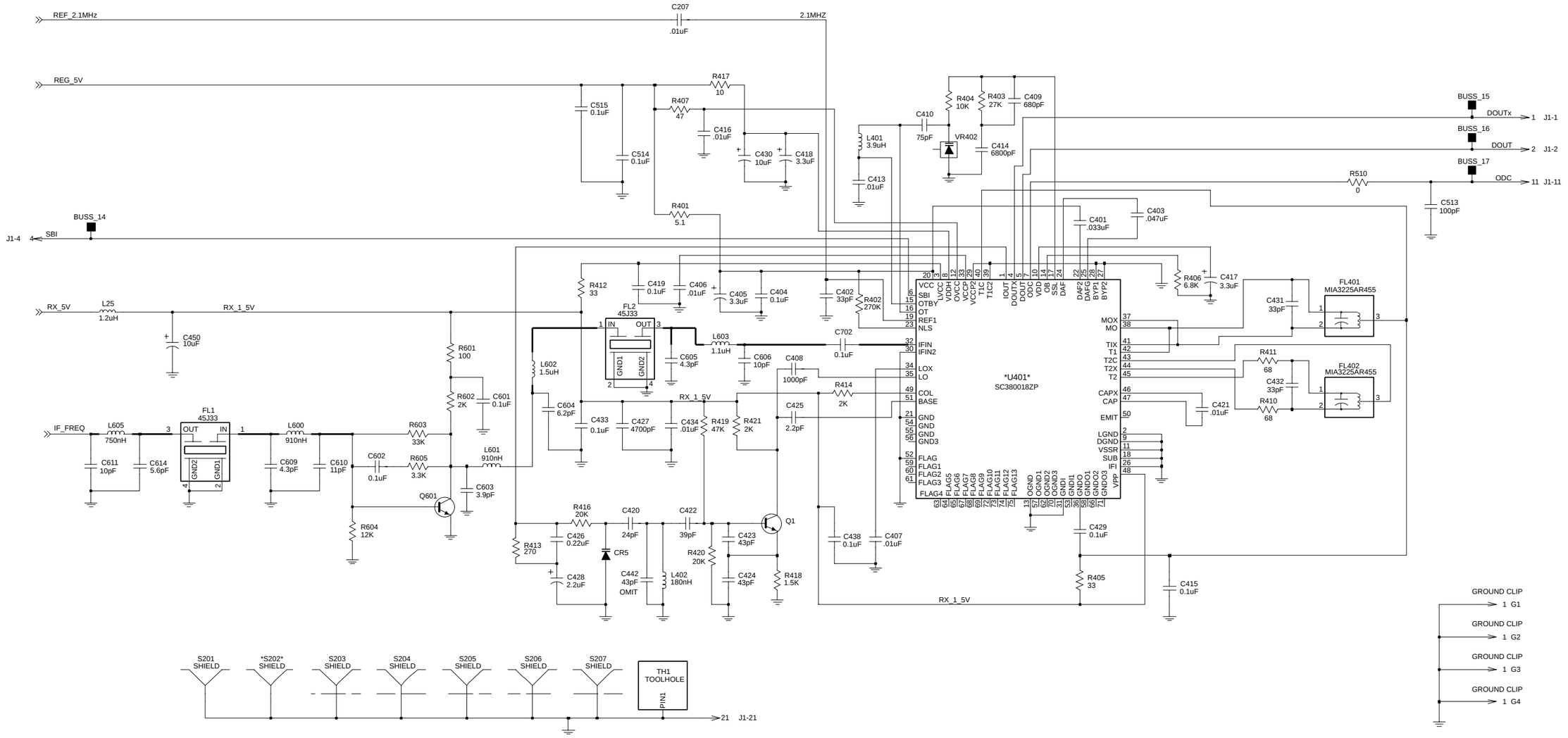


NOTE: If NTN8250G Vocoder Board is used with NLE4249A-D (UHF-R1) or NLE4250A-E (UHF-R2) RF Boards, the capacitor C513 must be removed from the RF Boards for proper operation.

NLE4249D, NLE4250E UHF Range 1 and 2 RF Board Schematic Diagram, Sheet 1 of 3

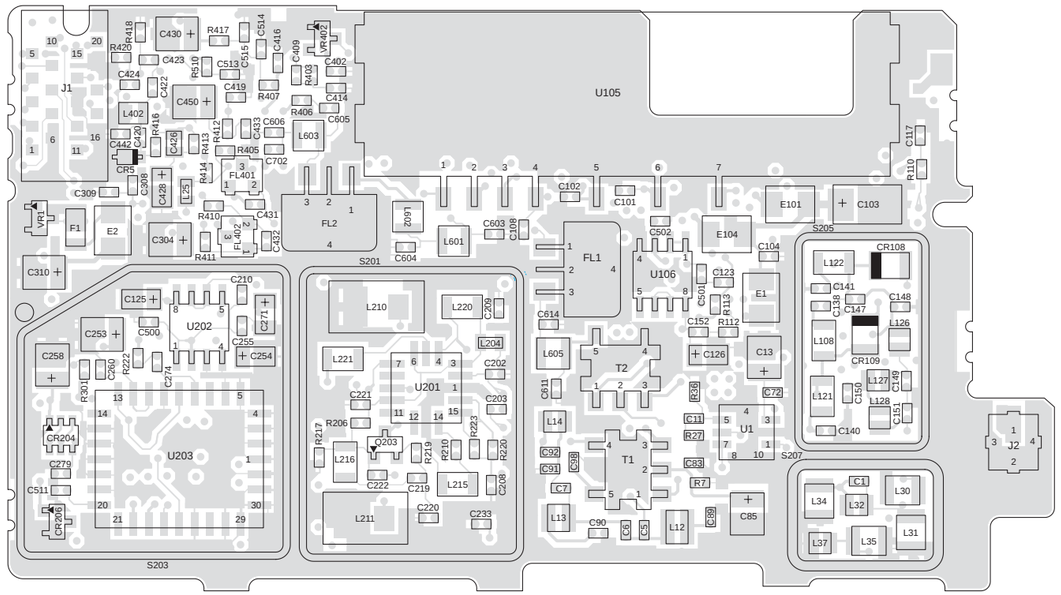


NLE4249D, NLE4250E UHF Range 1 and 2 RF Board Schematic Diagram, Sheet 2 of 3



NLE4249D, NLE4250E UHF Range 1 and 2 RF Board Schematic Diagram, Sheet 3 of 3

VIEWED FROM SIDE 1



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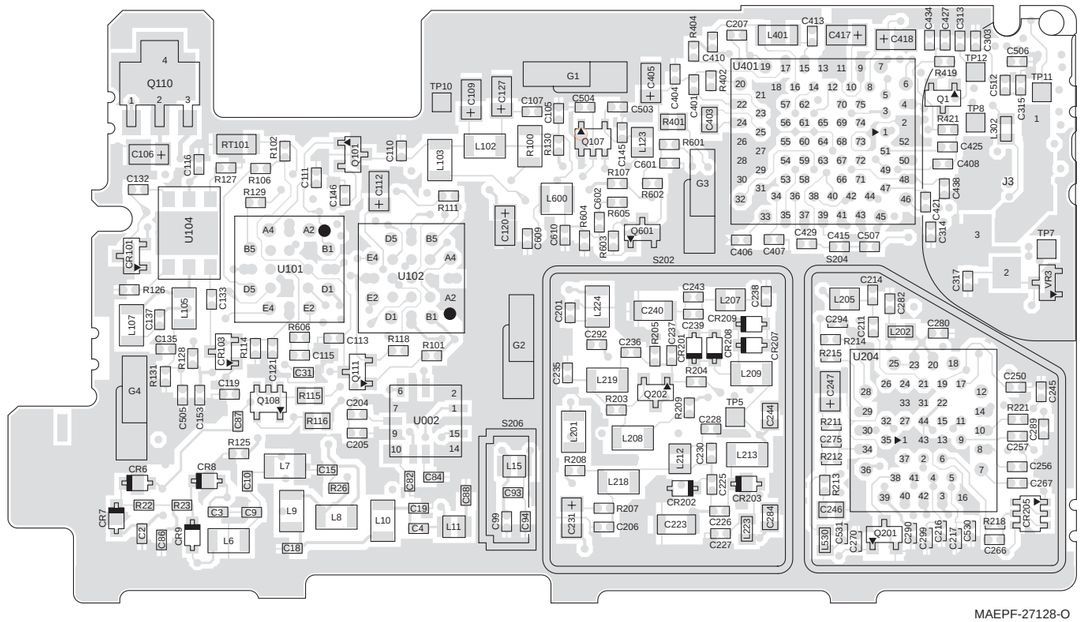
VIEWED FROM SIDE 2



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NLE4249D, NLE4250E UHF Range 1 and 2 RF Board Component Location Detail and Parts List

NLE4249D, NLE4250E UHF Range 1 (R1) and Range 2 (R2) RF Board Electrical Parts List

NOTE: Unless otherwise stated, the following parts are used for both UHF R1 and R2.

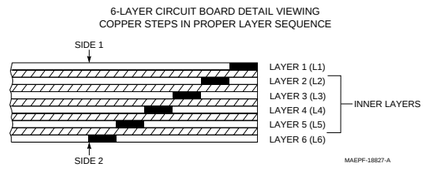
ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 50V unless otherwise stated
C1 (R1)	2113930F19	4.7 pF 50V ±0.25 pF 50V
C1 (R2)	2113930F13	3.3 pF 50V ±0.25 pF 50V
C2 (R1), C3 (R1)	----------	Not Placed
C2 (R2), C3 (R2)	2113930F12	2.4 pF 50V ±0.25 pF 50V
C4 (R1)	2113930F31	15 pF
C4 (R2)	2113930F36	24 pF
C5 (R1)	2113930F23	6.8 pF 50V ±0.25 pF 50V
C5 (R2)	2113930F22	6.2 pF 50V ±0.25 pF 50V
C6	2113930F20	5.1 pF 50V ±0.25 pF 50V
C7 (R1)	2113930F27	10 pF
C7 (R2)	2113930F28	11 pF
C9 (R1)	2113930F05	1.2 pF 50V ±0.1 pF 50V
C9 (R2)	2113930F15	3.3 pF 50V ±0.1 pF 50V
C10 (R1)	2113930F03	1 pF 50V ±0.1 pF 50V
C10 (R2)	2113930F29	12 pF
C11	2113931F49	10 nF
C13	2311049A66	22 µF
C15	2113930F47	68 pF
C18 (R1), C19 (R1)	2113930F07	1.5 pF 50V ±0.1 pF 50V
C18 (R2)	----------	Not Placed
C19 (R2)	2113930F19	4.7 pF 50V ±0.25 pF 50V
C31	2113931F49	10 nF
C72	2113930F51	100 pF
C82	2113931F49	10 nF
C83	2113930F51	100 pF
C84	2113931F49	10n pF
C85	2311049J23	10 µF
C86	2113930F47	68 pF
C87	2113930F51	100 pF
C88	2113930F45	56 pF
C89 (R1)	2113930F22	6.2 pF 50V ±0.25 pF 50V
C89 (R2)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C90 (R1)	2113930F31	15 pF
C90 (R2)	2113930F26	9.1 pF 50V ±0.25 pF 50V
C91 (R1)	2113930F28	11 pF
C91 (R2)	2113930F27	10 pF
C92 (R1)	2113930F18	4.3 pF 50V ±0.25 pF 50V
C92 (R2)	2113930F09	1.8 pF 50V ±0.1 pF 50V
C93 (R1)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C93 (R2)	2113930F17	3.9 pF 50V ±0.25 pF 50V
C94 (R1)	2113930F29	12 pF
C94 (R2)	2113930F27	10 pF
C98	2113930F51	100 pF
C99 (R1)	2113930F28	11 pF
C99 (R2)	2113930F21	5.6 pF 50V ±0.25 pF 50V
C101	2113930F51	100 pF
C102	----------	Not Placed
C103	2311049J26	10 µF
C104, C105	2113930F51	100 pF
C106	2311049A56	4.7 µF
C107	2113930F51	100 pF
C108	----------	Not Placed
C109	2311049A07	1 µF
C110	----------	Not Placed
C111	2113930F51	100 pF
C112	2311049A07	1 µF
C113	2113930F51	100 pF
C115	2113932K07	.047 µF +80/-20% 16V
C116	----------	Not Placed
C117	2113930F51	100 pF
C119	2113930F51	100 pF
C120	----------	Not Placed
C121	2113930F51	100 pF
C123	2113932K15	0.1 µF +80/-20% 16V
C125, C126	2311049A54	3.3 µF
C127	----------	Not Placed
C132	2113930F25	8.2 pF 50V ±0.25 pF 50V
C133 (R1)	2113930F15	3.3 pF 50V ±0.25 pF 50V
C133 (R2)	2113930F09	1.8 pF 50V ±0.1 pF 50V
C135	2113930F51	100 pF
C137, C138	2113930F51	100 pF
C140	2113931F41	.0047 µF
C141	2113930F51	100 pF
C145	2113930F51	100 pF
C146	----------	Not Placed
C147	2113930F51	100 pF
C148 (R1)	2113930F26	9.1 pF 50V ±0.25 pF 50V
C148 (R2)	2113930F11	2.2pF 50V ±0.25 pF 50V
C149 (R1)	2113930F35	22 pF
C149 (R2)	2113930F27	10 pF
C150 (R1)	2113930F29	12 pF
C150 (R2)	2113930F25	8.2 pF 50V ±0.25 pF 50V
C151 (R1)	2113930F14	3.0 pF 50V ±0.25 pF 50V
C151 (R2)	2113930F18	4.3 pF 50V ±0.25 pF 50V
C152	2113932K15	0.1 µF +80/-20% 16V
C153	2113930F47	68 pF
C201 (R1)	2113930F03	1.0 pF 50V ±0.1 pF 50V
C201 (R2)	----------	Not Placed
C202	----------	Not Placed
C203	2113930F07	1.5 pF 50V ±0.1 pF 50V
C204	2113930F51	100 pF
C205	----------	Not Placed
C206 (R1)	2113931F37	3.3 nF
C206 (R2)	2113931F29	1.5 nF
C207	2113931F49	10 nF
C208	2113930F51	100 pF
C209	2113931F49	10 nF
C210	2113932E07	.022 µF 10% 16V
C211	2113930F51	100 pF
C214 (R1)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C214 (R2)	2113930F14	3.0 pF 50V ±0.25 pF 50V
C216, C217	2113930F51	100 pF
C219 (R1)	2113930F16	3.6 pF 50V ±0.25 pF 50V

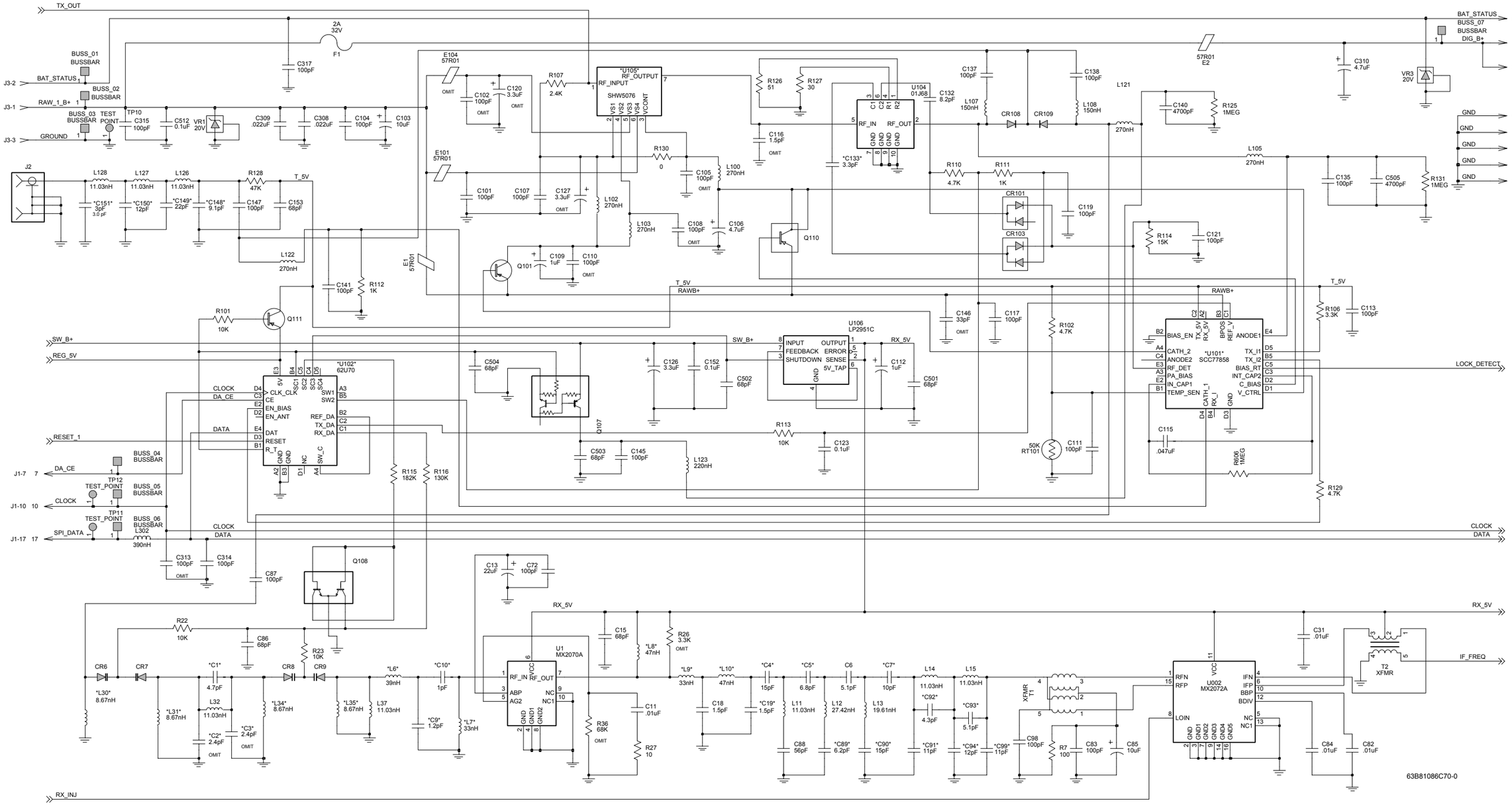
C219 (R2)	2113930F11	2.2 pF 50V ±0.25 pF 50V
C220 (R1)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C220 (R2)	2113930F22	6.2 pF 50V ±0.25 pF 50V
C221	2113931F49	10 nF
C222 (R1)	2113930F17	3.9 pF 50V ±0.25 pF 50V
C222 (R2)	2113930F18	4.3 pF 50V ±0.25 pF 50V
C223	2113906C02	4.5 pF Laser Trim
C225	2113930F03	1 pF 50V ±0.1 pF 50V
C226 (R1)	2113930F28	11 pF
C226 (R2)	2113930F26	9.1 pF 50V ±0.25 pF 50V
C227, C228	2113930F51	100 pF
C230	----------	Not Placed
C231	2311049A60	10 µF
C233	2113930F51	100 pF
C235 (R1)	2113930F18	4.3 pF 50V ±0.25 pF 50V
C235 (R2)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C236 (R1)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C236 (R2)	2113930F18	4.3 pF 50V ±0.25 pF 50V
C237	2113930F15	3.3 pF 50V ±0.25 pF 50V
C238	2113930F51	100 pF
C239 (R1)	2113930F27	10 pF
C239 (R2)	2113930F24	7.5 pF 50V ±0.25 pF 50V
C240	2113906C02	4.5 pF Laser Trim
C243 (R1)	2113930F25	8.2 pF 50V ±0.25 pF 50V
C243 (R2)	2113930F24	7.5 pF 50V ±0.25 pF 50V
C244	2109720D09	.022 µF
C245	2113931F25	1 nF
C246	2109720D09	.022 µF
C247	2311049A05	0.47 µF
C250	2113931F25	1 nF
C253	2311049J23	10 µF
C254	2311049A56	4.7 µF
C255	2113932E07	.022 µF 10% 16V
C256, C257	2113931F49	10 nF
C258	2311049J11	4.7 µF
C260	2113932K07	.047 µF +80/-20% 16V
C266, C267	2113931F49	10 nF
C270	2113932E07	.022 µF 10% 16V
C271	2311049A56	4.7 µF
C274	2113931F49	10 nF
C275	2113932K15	0.1 µF +80/-20% 16V
C279, C280	2113932K15	0.1 µF +80/-20% 16V
C282	2113932K15	0.1 µF +80/-20% 16V
C284	2113743A23	0.22 µF 10%
C289, C290	2113930F51	100 pF
C292 (R1)	2113930F03	1.0 pF 50V ±0.1 pF 50V
C292 (R2)	2113930F51	100 pF
C294	2113930F51	100 pF
C299	2113931F41	4.7 nF
C303	2113932E07	.022 µF 10% 16V
C304	2311049J11	4.7 µF
C308, C309	2113932E07	.022 µF 10% 16V
C310	2311049J11	4.7 µF
C313	----------	Not Placed
C314, C315	2113930F51	100 pF
C317	2113930F51	100 pF
C401	2113932K03	.033 µF +80/-20% 16V
C402	2113930F39	33 pF
C403	2113743A13	.047 µF
C404	2113932K15	0.1 µF +80/-20% 16V
C405	2311049A42	3.3 µF
C406, C407	2113931F49	10 nF
C408	2113931F25	1 nF
C409	2113931F21	680 pF
C410	2113930F48	75 pF
C413	2113931F49	10 nF
C414	2113931F45	6.8 nF
C415	2113932K15	0.1 µF +80/-20% 16V
C416	2113931F49	10 nF
C417, C418	2311049A42	3.3 µF
C419	2113932K15	0.1 µF +80/-20% 16V
C420	2113930F36	24 pF
C421	2113931F49	10 nF
C422	2113930F41	39 pF
C423, C424	2113930F42	43 pF
C425	2113930F11	2.2 pF 50V ±0.25 pF 50V
C426	2113743A23	0.22 µF 10%
C427	2113931F41	4.7 nF
C428	2311049A40	2.2 µF
C429	2113932K15	0.1 µF +80/-20% 16V
C430	2311049J23	10 µF
C431, C432	2113930F39	33 pF
C433	2113932K15	0.1 µF +80/-20% 16V
C434	2113931F49	10 nF
C438	2113932K15	0.1 µF +80/-20% 16V
C442	----------	Not Placed
C450	2311049J23	10 µF
C500 thru C504	2113930F47	68 pF
C505	2113931F41	4.7 nF
C506, C507	2113930F47	68 pF
C511, C512	2113932K15	0.1 µF +80/-20% 16V
C513	2113930F51	100 pF
C514, C515	2113932K15	0.1 µF +80/-20% 16V
C530	2113931F25	1 nF
C531	2113931F41	4.7 nF
C601, C602	2113932K15	0.1 µF +80/-20% 16V
C603	2113930F17	3.9 pF 50V ±0.25 pF 50V
C604	2113930F22	6.2 pF 50V ±0.25 pF 50V
C605	2113930F18	4.3 pF 50V ±0.25 pF 50V
C606	2113930F27	10 pF
C609	2113930F18	4.3 pF 50V ±0.25 pF 50V
C610	2113930F28	11 pF
C611	2113930F27	10 pF
C614	2113930F21	5.6 pF 50V ±0.25 pF 50V
C702	2113932K15	0.1 µF +80/-20% 16V
		DIODE: See Note 1.
CR5 thru CR9	4862824C01	Varactor
CR101	4805129M67	Dual
CR103	4805129M67	Dual
CR108, CR109	4802482J02	PIN
CR201	4802245J29	Varactor
CR202	4862824C01	Varactor
CR203	4862824C03	Varactor
CR204, CR205	4802233J09	Triple
CR205	4802233J09	TRIPLE
CR206	4805129M06	Dual
CR207 thru CR209	4802245J29	Varactor
		CORE:
E1, E2	2484657R01	Bead, Inductor
E101	2484657R01	Bead, Inductor
E104	----------	Not Placed
		FUSE:
F1	6505757V02	Surface Mount, 2 Amp
		FILTER: See Note 2.
FL1, FL2	4805245J33	Crystal, Mono, 73.35 MHz
FL401, FL402	9105398W01	450 kHz
		JACK:
J1	----------	Not Placed
J2	0905304Z01	Connector, Coaxial
J3	----------	Not Placed
		COIL, RF:
L6 (R1)	2462587T41	39 nH
L6 (R2)	2462587T38	22 nH
L7 (R1)	2462587T40	33 nH
L7 (R2)	2462587T38	22 nH
L8 (R1)	2462587T42	47 nH
L8 (R2)	2462587T20	270 nH
L9 (R1)	2462587T40	33 nH
L9 (R2)	2462587T38	22 nH
L10 (R1)	2462587T42	47 nH
L10 (R2)	2462587T05	15 nH
L11	2460591B04	11.03 nH
L12	2460591M32	27.42 nH
L13	2460591B80	19.61 nH
L14, L15	2460591B04	11.03 nH
L25	2462587Q48	1.2 µH
L30 (R1), L31 (R2)	2460591B22	8.67 nH
L30 (R1), L31 (R2)	2460591A01	4.22 nH
L32	2460591B04	11.03 nH
L34 (R1), L35 (R2)	2460591B22	8.67 nH
L34 (R2), L35 (R2)	2460591A01	4.22
L37	2460591B04	11.03
L102	----------	Not Placed
L103	2462587T20	270 nH
L105	2462587T20	270 nH
L107, L108	2462587T17	150 nH
L121, L122	2462587T20	270 nH
L123	2462587V38	220 nH
L126 thru L128	2460591B04	11.03 nH
L201 (R1)	2462587T38	22 nH
L201 (R2)	2462587T37	18 nH
L202	2462587Q20	2.2 µH
L204	2462587Q42	390 nH
L205 (R1)	2462587V27	27 nH
L205 (R2)	2462587V26	22 nH
L207 (R1)	2462587V38	220 nH
L207 (R2)	2462587V36	150 nH
L208, L209	2462587T22	390 nH
L210 (R1)	2405619V01	14.9 nH
L210 (R2)	2405619V03	15.1 nH
L211 (R1)	2405619V05	11.3 nH
L211 (R2)	2405619V07	9 nH
L212 (R1)	2462587V26	22 nH
L212 (R2)	2462587V25	18 nH
L213 (R1)	2462587T15	100 nH
L213 (R2)	2462587T22	390 nH
L215	2462587T22	390 nH
L216	2462587T05	15 nH
L218	2462587T22	390 nH
L219	2462587T37	18 nH
L220 (R1)	2462587T39	27 nH
L220 (R2)	2462587T12	56 nH
L221	2462587T22	390 nH
L223	2462587Q42	390 nH
L224 (R1)	2462587T40	33 nH
L224 (R2)	2462587T42	47 nH
L302	2462587Q42	390 nH
L401	2462575A16	3.9 µH
L402	2462587V37	180 nH
L530	2462587Q48	1.2 µH
L600, L601	2405452C59	910 nH
L602	2405452C64	1.5 µH
L603	2405452C61	1.1 µH
L605	2462587N65	750 nH
		TRANSISTOR: See Note 1.
Q001	4805218N55	NPN
Q101	4805128M16	PNP
Q107	4805921T02	Switching
Q108	4802245J10	Dual NPN
Q110	4802245J12	PNP
Q111	4805128M16	PNP
Q201	4802245J15	JFET P-Channel
Q202, Q203	4805218N55	NPN
Q601	4882022N70	NPN
		RESISTOR, Fixed: Ω **±5%; 1/8W** unless otherwise stated
R7	0662057A25	100
R22, R23	0662057A73	10k
R26	----------	Not Placed
R27	0662057A01	10
R036	----------	Not Placed
R100	2462587T20	270 nH
R101	0662057A73	10k
R102	0662057A65	4.7k
R106	0662057A61	3.3k
R107	0662057A58	2.4k
R110	0662057A65	4.7k
R111, R112	0662057A49	1k
R113	0662057A73	10k
R114	0662057A77	15k
R115	0662057G27	182k
R116	0662057G19	130k
R118	0662057A97	100k
R125	0662057B22	1M
R126	0662057A18	51
R127	0662057A12	30
R128	0662057A89	47k
R129	0662057A65	4.7k

R130	0662057B47	0
R131	0662057B22	1 M
R203 (R1)	0662057A09	22
R203 (R2)	0662057A01	10
R204	0662057A73	10k
R205	0662057A77	15k
R206	0662057A73	10k
R207	0662057A93	68k
R208	0662057A58	2.4k
R209	0662057A41	470
R210	0662057A37	330
R211	0662057A27	120
R212, R213	0662057A46	750
R214	0662057A89	47k
R215	0662057A88	43k
R217	0662057A77	15k
R218	0662057A97	100k
R219 (R1)	0662057A01	10
R219 (R2)	0662057A09	22
R220	0662057A56	2k
R221	0662057A51	1.2k
R222	0662057A56	2k
R223	0662057A89	47k
R301	0662057B47	0
R401	0660079U18	5.1
R402	0662057B08	270k
R403	0662057A83	27k
R404	0662057A73	10k
R405	0662057A13	33
R406	0662057A69	6.8k
R407	0662057A17	47
R410, R411	0662057A21	68
R412	0662057A13	33
R413	0662057A35	270
R414	0662057A56	2k
R416	0662057A80	20k
R417	0662057A01	10
R418	0662057A53	1.5k
R419	0662057A89	47k
R420	0662057A80	20K
R421	0662057A56	2k
R510	0662057B47	0
R601	0662057A25	100
R602	0662057A56	2k
R603	0662057A85	33k
R604	0662057A75	12k
R605	0662057A61	3.3k
R606	0662057B22	1 M
		THERMISTOR:
RT101	0605621T02	50k
		SHIELD:
S201	2602657J02	VCO
S202 (R1)	2602674J03	VCO Back
S202 (R2)	2602674J02	VCO Back
S203	2602658J01	Pendulum
S204	2602675J01	Synthesizer, Back
S205	2602660J01	Harmonic Filter, UHF
S206	2602686J01	Coil
S207	2605547X01	Varactor
		TRANSFORMER:
T1	2505515V08	4:1
T2	2505515V11	16:1
		INTEGRATED CIRCUIT MODULE: See Note 1.
U1	5105329V20	RF Amplifier
U2	5105329V26	Mixer
U101	5105835U52	TX ALC
U102	5105835U51	D/A CONVERTER
U104	5102001J68	Coupler
U105 (R1)	5105385Y10	LDMOS RF PA UHF-1
U105 (R2)	5105385Y11	LDMOS RF PA UHF-2
U106	5105469E65	5V Regulator
U201	5102227J37	VCO Buffer
U202	5105469E65	5V Regulator
U203	5105385Y42	16.8 MHz Reference Oscillator
U204	5105457W81	Fractional-N Synthesizer
U401	5105835U90	ABACUS
		DIODE: See Note 1.
VR1	4813830A33	20V
VR3	4813830A33	20V
VR402	4805129M58	Varactor

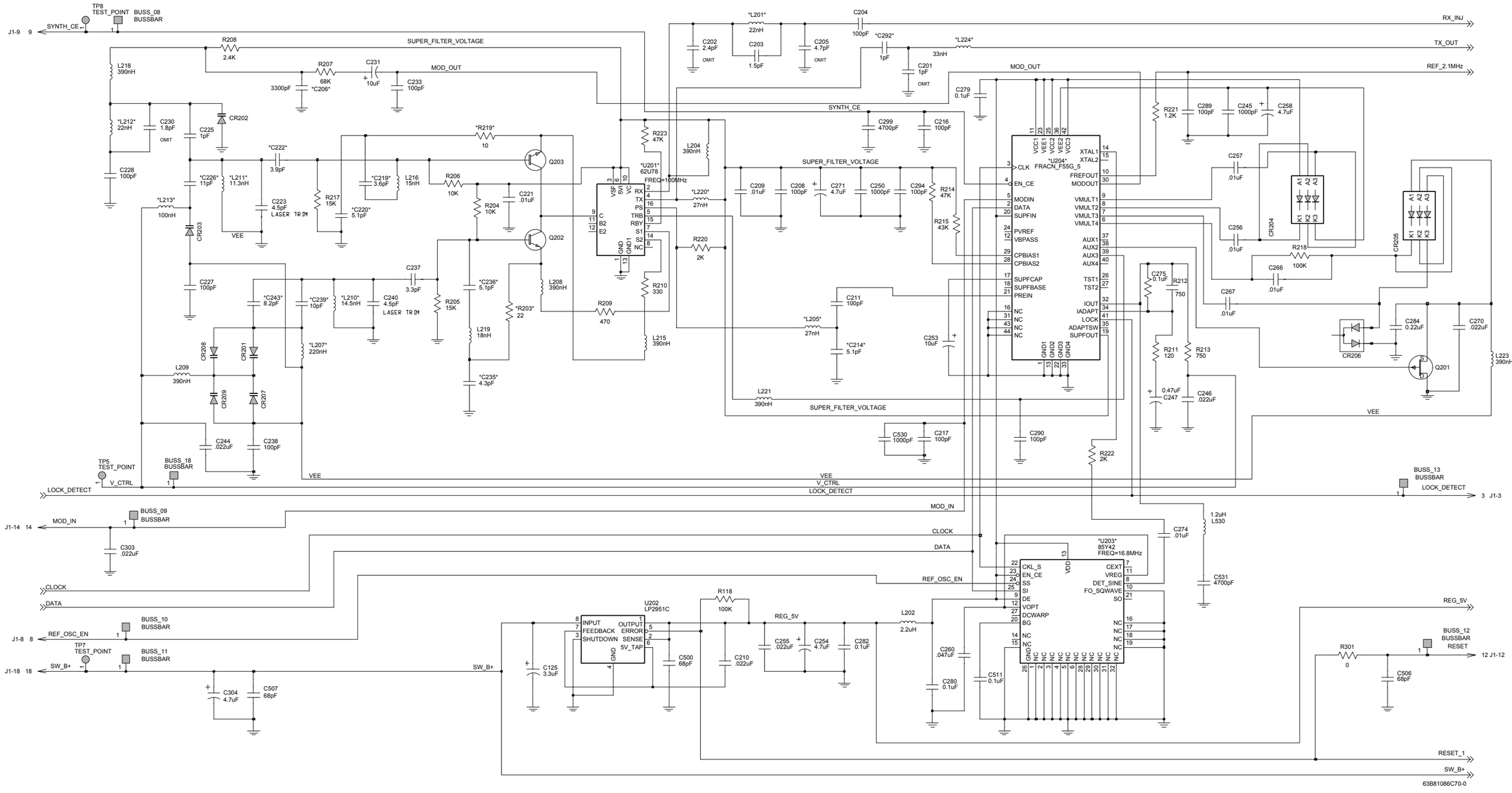
Notes:

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. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NLE4249 UHF RF Board uses a 6-layer printed circuit board.

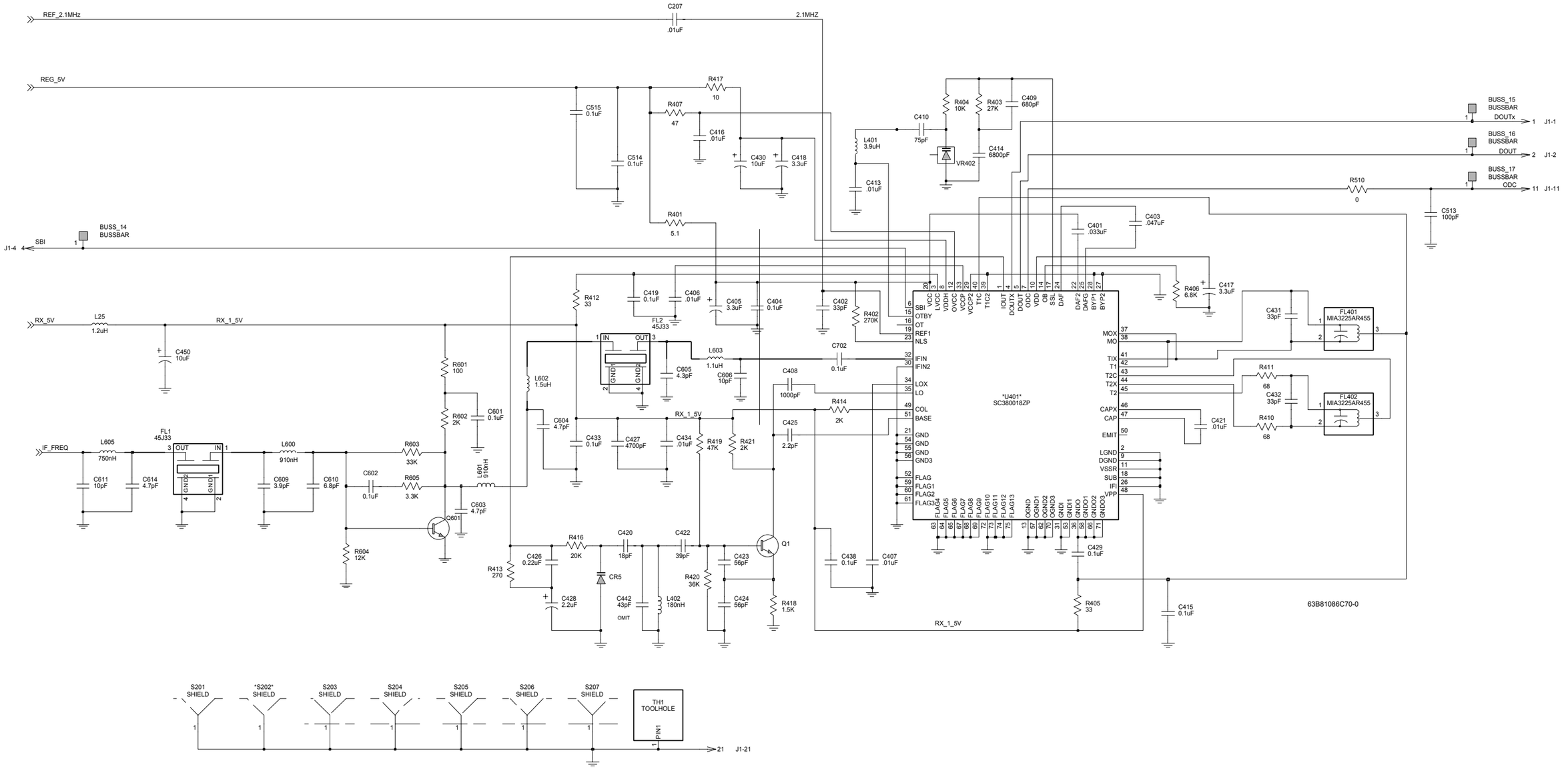




NLE4249E, NLE4250F UHF Range 1 and 2 RF Board Schematic Diagram, Sheet 1 of 3

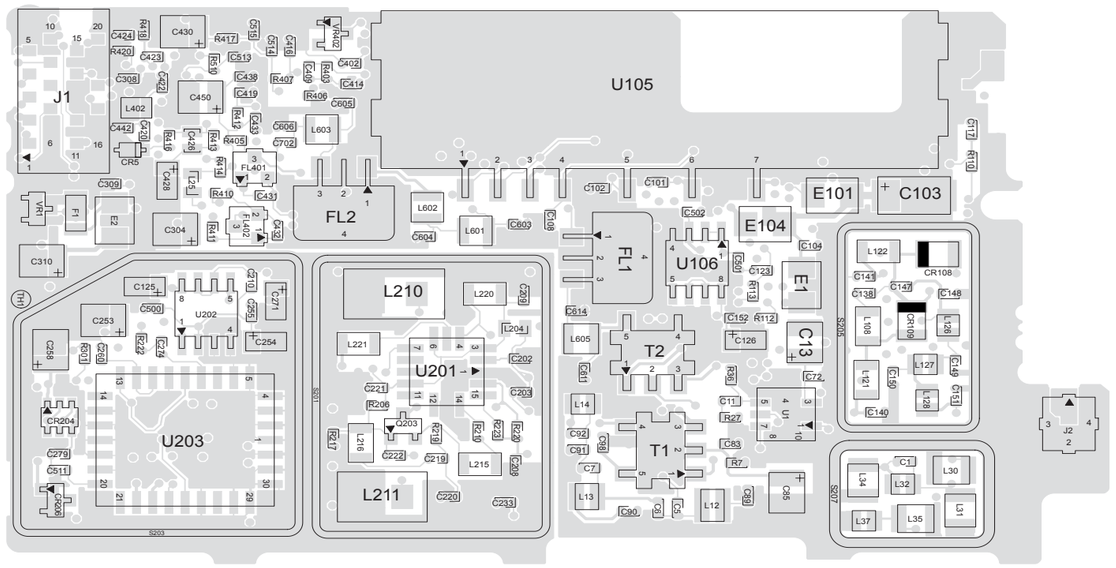


NLE4249E, NLE4250F UHF Range 1 and 2 RF Board Schematic Diagram, Sheet 2 of 3

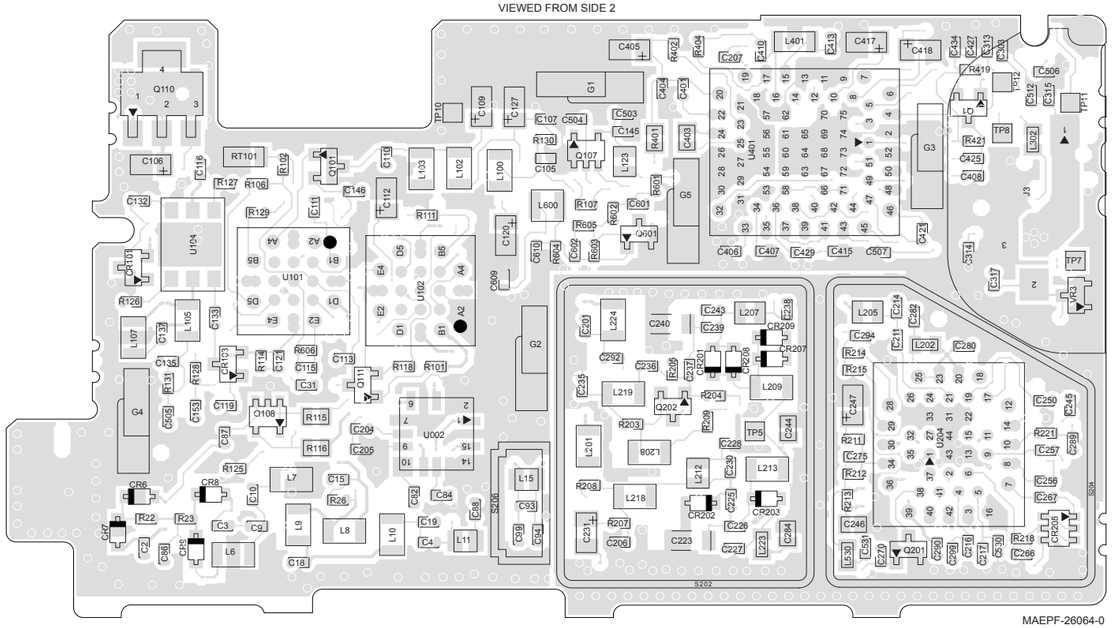


NLE4249E, NLE4250F UHF Range 1 and 2 RF Board Schematic Diagram, Sheet 3 of 3

VIEWED FROM SIDE 1



VIEWED FROM SIDE 2



NLE4249E, NLE4250F UHF Range 1 and 2 RF Board Component Location Detail and Parts List

NLE4249E, NLE4250F UHF Range 1 (R1) and Range 2 (R2) RF Board Electrical Parts List

NOTE: Unless otherwise stated, the following parts are used for both UHF R1 and R2.

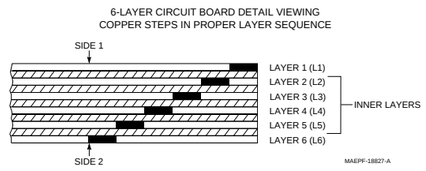
ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 50V unless otherwise stated
C1 (R1)	2113930F19	4.7 pF 50V ±0.25 pF 50V
C1 (R2)	2113930F13	3.3 pF 50V ±0.25 pF 50V
C2 (R1), C3 (R1)	----------	Not Placed
C2 (R2), C3 (R2)	2113930F12	2.4 pF 50V ±0.25 pF 50V
C4 (R1)	2113930F31	15 pF
C4 (R2)	2113930F36	24 pF
C5 (R1)	2113930F23	6.8 pF 50V ±0.25 pF 50V
C5 (R2)	2113930F22	6.2 pF 50V ±0.25 pF 50V
C6	2113930F20	5.1 pF 50V ±0.25 pF 50V
C7 (R1)	2113930F27	10 pF
C7 (R2)	2113930F28	11 pF
C9 (R1)	2113930F05	1.2 pF 50V ±0.1 pF 50V
C9 (R2)	2113930F15	3.3 pF 50V ±0.1 pF 50V
C10 (R1)	2113930F03	1 pF 50V ±0.1 pF 50V
C10 (R2)	2113930F29	12 pF
C11	2113931F49	10 nF
C13	2311049A66	22 µF
C15	2113930F47	68 pF
C18 (R1), C19 (R1)	2113930F07	1.5 pF 50V ±0.1 pF 50V
C18 (R2)	----------	Not Placed
C19 (R2)	2113930F19	4.7 pF 50V ±0.25 pF 50V
C31	2113931F49	10 nF
C72	2113930F51	100 pF
C82	2113931F49	10 nF
C83	2113930F51	100 pF
C84	2113931F49	10n pF
C85	2311049J23	10 µF
C86	2113930F47	68 pF
C87	2113930F51	100 pF
C88	2113930F45	56 pF
C89 (R1)	2113930F22	6.2 pF 50V ±0.25 pF 50V
C89 (R2)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C90 (R1)	2113930F31	15 pF
C90 (R2)	2113930F26	9.1 pF 50V ±0.25 pF 50V
C91 (R1)	2113930F28	11 pF
C91 (R2)	2113930F27	10 pF
C92 (R1)	2113930F18	4.3 pF 50V ±0.25 pF 50V
C92 (R2)	2113930F09	1.8 pF 50V ±0.1 pF 50V
C93 (R1)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C93 (R2)	2113930F17	3.9 pF 50V ±0.25 pF 50V
C94 (R1)	2113930F29	12 pF
C94 (R2)	2113930F27	10 pF
C98	2113930F51	100 pF
C99 (R1)	2113930F28	11 pF
C99 (R2)	2113930F21	5.6 pF 50V ±0.25 pF 50V
C101	2113930F51	100 pF
C102	----------	Not Placed
C103	2311049J26	10 µF
C104, C105	2113930F51	100 pF
C106	2311049A56	4.7 µF
C107	2113930F51	100 pF
C108	----------	Not Placed
C109	2311049A07	1 µF
C110	----------	Not Placed
C111	2113930F51	100 pF
C112	2311049A07	1 µF
C113	2113930F51	100 pF
C115	2113932K07	.047 µF +80/-20% 16V
C116	----------	Not Placed
C117	2113930F51	100 pF
C119	2113930F51	100 pF
C120	----------	Not Placed
C121	2113930F51	100 pF
C123	2113932K15	0.1 µF +80/-20% 16V
C125, C126	2311049A54	3.3 µF
C127	----------	Not Placed
C132	2113930F25	8.2 pF 50V ±0.25 pF 50V
C133 (R1)	2113930F15	3.3 pF 50V ±0.25 pF 50V
C133 (R2)	2113930F09	1.8 pF 50V ±0.1 pF 50V
C135	2113930F51	100 pF
C137, C138	2113930F51	100 pF
C140	2113931F41	.0047 µF
C141	2113930F51	100 pF
C145	2113930F51	100 pF
C146	----------	Not Placed
C147	2113930F51	100 pF
C148 (R1)	2113930F26	9.1 pF 50V ±0.25 pF 50V
C148 (R2)	2113930F11	2.2pF 50V ±0.25 pF 50V
C149 (R1)	2113930F35	22 pF
C149 (R2)	2113930F27	10 pF
C150 (R1)	2113930F29	12 pF
C150 (R2)	2113930F25	8.2 pF 50V ±0.25 pF 50V
C151 (R1)	2113930F14	3.0 pF 50V ±0.25 pF 50V
C151 (R2)	2113930F18	4.3 pF 50V ±0.25 pF 50V
C152	2113932K15	0.1 µF +80/-20% 16V
C153	2113930F47	68 pF
C201 (R1)	2113930F03	1.0 pF 50V ±0.1 pF 50V
C201 (R2)	----------	Not Placed
C202	----------	Not Placed
C203	2113930F07	1.5 pF 50V ±0.1 pF 50V
C204	2113930F51	100 pF
C205	----------	Not Placed
C206 (R1)	2113931F37	3.3 nF
C206 (R2)	2113931F29	1.5 nF
C207	2113931F49	10 nF
C208	2113930F51	100 pF
C209	2113931F49	10 nF
C210	2113932E07	.022 µF 10% 16V
C211	2113930F51	100 pF
C214 (R1)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C214 (R2)	2113930F14	3.0 pF 50V ±0.25 pF 50V
C216, C217	2113930F51	100 pF
C219 (R1)	2113930F16	3.6 pF 50V ±0.25 pF 50V

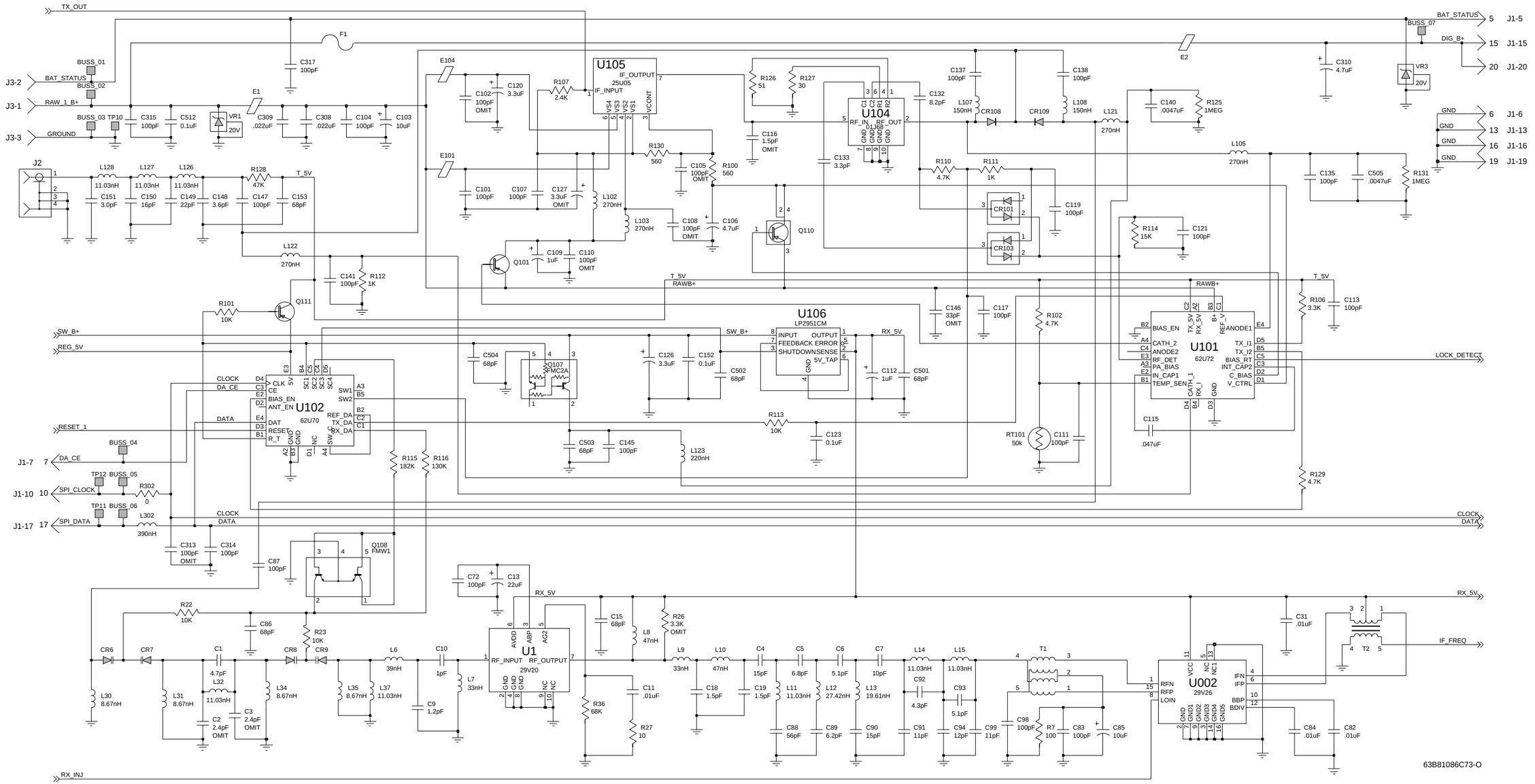
C219 (R2)	2113930F11	2.2 pF 50V ±0.25 pF 50V
C220 (R1)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C220 (R2)	2113930F22	6.2 pF 50V ±0.25 pF 50V
C221	2113931F49	10 nF
C222 (R1)	2113930F17	3.9 pF 50V ±0.25 pF 50V
C222 (R2)	2113930F18	4.3 pF 50V ±0.25 pF 50V
C223	2113906C02	4.5 pF Laser Trim
C225	2113930F03	1 pF 50V ±0.1 pF 50V
C226 (R1)	2113930F28	11 pF
C226 (R2)	2113930F26	9.1 pF 50V ±0.25 pF 50V
C227, C228	2113930F51	100 pF
C230	----------	Not Placed
C231	2311049A60	10 µF
C233	2113930F51	100 pF
C235 (R1)	2113930F18	4.3 pF 50V ±0.25 pF 50V
C235 (R2)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C236 (R1)	2113930F20	5.1 pF 50V ±0.25 pF 50V
C236 (R2)	2113930F18	4.3 pF 50V ±0.25 pF 50V
C237	2113930F15	3.3 pF 50V ±0.25 pF 50V
C238	2113930F51	100 pF
C239 (R1)	2113930F27	10 pF
C239 (R2)	2113930F24	7.5 pF 50V ±0.25 pF 50V
C240	2113906C02	4.5 pF Laser Trim
C243 (R1)	2113930F25	8.2 pF 50V ±0.25 pF 50V
C243 (R2)	2113930F24	7.5 pF 50V ±0.25 pF 50V
C244	2109720D09	.022 µF
C245	2113931F25	1 nF
C246	2109720D09	.022 µF
C247	2311049A05	0.47 µF
C250	2113931F25	1 nF
C253	2311049J23	10 µF
C254	2311049A56	4.7 µF
C255	2113932E07	.022 µF 10% 16V
C256, C257	2113931F49	10 nF
C258	2311049J11	4.7 µF
C260	2113932K07	.047 µF +80/-20% 16V
C266, C267	2113931F49	10 nF
C270	2113932E07	.022 µF 10% 16V
C271	2311049A56	4.7 µF
C274	2113931F49	10 nF
C275	2113932K15	0.1 µF +80/-20% 16V
C279, C280	2113932K15	0.1 µF +80/-20% 16V
C282	2113932K15	0.1 µF +80/-20% 16V
C284	2113743A23	0.22 µF 10%
C289, C290	2113930F51	100 pF
C292 (R1)	2113930F03	1.0 pF 50V ±0.1 pF 50V
C292 (R2)	2113930F51	100 pF
C294	2113930F51	100 pF
C299	2113931F41	4.7 nF
C303	2113932E07	.022 µF 10% 16V
C304	2311049J11	4.7 µF
C308, C309	2113932E07	.022 µF 10% 16V
C310	2311049J11	4.7 µF
C313	----------	Not Placed
C314, C315	2113930F51	100 pF
C317	2113930F51	100 pF
C401	2113932K03	.033 µF +80/-20% 16V
C402	2113930F39	33 pF
C403	2113743A13	.047 µF
C404	2113932K15	0.1 µF +80/-20% 16V
C405	2311049A42	3.3 µF
C406, C407	2113931F49	10 nF
C408	2113931F25	1 nF
C409	2113931F21	680 pF
C410	2113930F48	75 pF
C413	2113931F49	10 nF
C414	2113931F45	6.8 nF
C415	2113932K15	0.1 µF +80/-20% 16V
C416	2113931F49	10 nF
C417, C418	2311049A42	3.3 µF
C419	2113932K15	0.1 µF +80/-20% 16V
C420	2113930F33	18 pF
C421	2113931F49	10 nF
C422	2113930F41	39 pF
C423, C424	2113930F45	56 pF
C425	2113930F11	2.2 pF 50V ±0.25 pF 50V
C426	2113743A23	0.22 µF 10%
C427	2113931F41	4.7 nF
C428	2311049A40	2.2 µF
C429	2113932K15	0.1 µF +80/-20% 16V
C430	2311049J23	10 µF
C431, C432	2113930F39	33 pF
C433	2113932K15	0.1 µF +80/-20% 16V
C434	2113931F49	10 nF
C438	2113932K15	0.1 µF +80/-20% 16V
C442	----------	Not Placed
C450	2311049J23	10 µF
C500 thru C504	2113930F47	68 pF
C505	2113931F41	4.7 nF
C506, C507	2113930F47	68 pF
C511, C512	2113932K15	0.1 µF +80/-20% 16V
C513	2113930F51	100 pF
C514, C515	2113932K15	0.1 µF +80/-20% 16V
C530	2113931F25	1 nF
C531	2113931F41	4.7 nF
C601, C602	2113932K15	0.1 µF +80/-20% 16V
C603, C604	2113740F19	4.7 pF
C605	2113930F18	4.3 pF 50V ±0.25 pF 50V
C606	2113930F27	10 pF
C609	2113740F17	3.9 pF
C610	2113740F23	6.8 pF
C611	2113930F27	10 pF
C614	2113740F19	4.7 pF
C702	2113932K15	0.1 µF +80/-20% 16V
		DIODE: See Note 1.
CR5 thru CR9	4862824C01	Varactor
CR101	4805129M67	Dual
CR103	4805129M67	Dual
CR108, CR109	4802482J02	PIN
CR201	4802245J29	Varactor
CR202	4862824C01	Varactor
CR203	4862824C03	Varactor
CR204, CR205	4802233J09	Triple
CR205	4802233J09	TRIPLE
CR206	4805129M06	Dual
CR207 thru CR209	4802245J29	Varactor
		CORE:
E1, E2	2484657R01	Bead, Inductor
E101	2484657R01	Bead, Inductor
E104	----------	Not Placed
		FUSE:
F1	6505757V02	Surface Mount, 2 Amp
		FILTER: See Note 2.
FL1, FL2	4805245J33	Crystal, Mono, 73.35 MHz
FL401, FL402	9105398W01	450 kHz
		CONTACT GROUND
G1 thru G5	3905643V01	Contact Ground
		JACK:
J1	----------	Not Placed
J2	0905304Z01	Connector, Coaxial
J3	----------	Not Placed
		COIL, RF:
L6 (R1)	2462587T41	39 nH
L6 (R2)	2462587T38	22 nH
L7 (R1)	2462587T40	33 nH
L7 (R2)	2462587T38	22 nH
L8 (R1)	2462587T42	47 nH
L8 (R2)	2462587T20	270 nH
L9 (R1)	2462587T40	33 nH
L9 (R2)	2462587T38	22 nH
L10 (R1)	2462587T42	47 nH
L10 (R2)	2462587T05	15 nH
L11	2460591B04	11.03 nH
L12	2460591M32	27.42 nH
L13	2460591B80	19.61 nH
L14, L15	2460591B04	11.03 nH
L25	2462587Q48	1.2 µH
L30 (R1), L31 (R2)	2460591B22	8.67 nH
L30 (R1), L31 (R2)	2460591A01	4.22 nH
L32	2460591B04	11.03 nH
L34 (R1), L35 (R2)	2460591B22	8.67 nH
L34 (R2), L35 (R2)	2460591A01	4.22
L37	2460591B04	11.03
L100	2462587T20	270 nH
L102	----------	Not Placed
L103	2462587T20	270 nH
L105	2462587T20	270 nH
L107, L108	2462587T17	150 nH
L121, L122	2462587T20	270 nH
L123	2462587V38	220 nH
L126 thru L128	2460591B04	11.03 nH
L201 (R1)	2462587T38	22 nH
L201 (R2)	2462587T37	18 nH
L202	2462587Q20	2.2 µH
L204	2462587Q42	390 nH
L205 (R1)	2462587V27	27 nH
L205 (R2)	2462587V26	22 nH
L207 (R1)	2462587V38	220 nH
L207 (R2)	2462587V36	150 nH
L208, L209	2462587T22	390 nH
L210 (R1)	2405619V01	14.9 nH
L210 (R2)	2405619V03	15.1 nH
L211 (R1)	2405619V05	11.3 nH
L211 (R2)	2405619V07	9 nH
L212 (R1)	2462587V26	22 nH
L212 (R2)	2462587V25	18 nH
L213 (R1)	2462587T15	100 nH
L213 (R2)	2462587T22	390 nH
L215	2462587T22	390 nH
L216	2462587T05	15 nH
L218	2462587T22	390 nH
L219	2462587T37	18 nH
L220 (R1)	2462587T39	27 nH
L220 (R2)	2462587T12	56 nH
L221	2462587T22	390 nH
L223	2462587Q42	390 nH
L224 (R1)	2462587T40	33 nH
L224 (R2)	2462587T42	47 nH
L302	2462587Q42	390 nH
L401	2462575A16	3.9 µH
L402	2462587V37	180 nH
L530	2462587Q48	1.2 µH
L600, L601	2405452C59	910 nH
L602	2405452C64	1.5 µH
L603	2405452C61	1.1 µH
L605	2462587N65	750 nH
		PRINTED CIRCUIT BOARD
PCB	8405260Z08	Printed Circuit Board
		TRANSISTOR: See Note 1.
Q001	4805218N55	NPN
Q101	4805128M16	PNP
Q107	4805921T02	Switching
Q108	4802245J10	Dual NPN
Q110	4802245J12	PNP
Q111	4805128M16	PNP
Q201	4802245J15	JFET P-Channel
Q202, Q203	4805218N55	NPN
Q601	4882022N70	NPN
		RESISTOR, Fixed: Ω **±5%; 1/8W** unless otherwise stated
R7	0662057A25	100
R22, R23	0662057A73	10k
R26	----------	Not Placed
R27	0662057A01	10
R036	----------	Not Placed
R101	0662057A73	10k
R102	0662057A65	4.7k
R106	0662057A61	3.3k
R107	0662057A58	2.4k
R110	0662057A65	4.7k
R111, R112	0662057A49	1k
R113	0662057A73	10k
R114	0662057A77	15k
R115	0662057G27	182k
R116	0662057G19	130k
R118	0662057A97	100k
R125	0662057B22	1M
R126	0662057A18	51

R127	0662057A12	30
R128	0662057A89	47k
R129	0662057A65	4.7k
R130	0662057B47	0
R131	0662057B22	1 M
R203 (R1)	0662057A09	22
R203 (R2)	0662057A01	10
R204	0662057A73	10k
R205	0662057A77	15k
R206	0662057A73	10k
R207	0662057A93	68k
R208	0662057A58	2.4k
R209	0662057A41	470
R210	0662057A37	330
R211	0662057A27	120
R212, R213	0662057A46	750
R214	0662057A89	47k
R215	0662057A88	43k
R217	0662057A77	15k
R218	0662057A97	100k
R219 (R1)	0662057A01	10
R219 (R2)	0662057A09	22
R220	0662057A56	2k
R221	0662057A51	1.2k
R222	0662057A56	2k
R223	0662057A89	47k
R301	0662057B47	0
R401	0660079U18	5.1
R402	0662057B08	270k
R403	0662057A83	27k
R404	0662057A73	10k
R405	0662057A13	33
R406	0662057A69	6.8k
R407	0662057A17	47
R410, R411	0662057A21	68
R412	0662057A13	33
R413	0662057A35	270
R414	0662057A56	2k
R416	0662057A80	20k
R417	0662057A01	10
R418	0662057A53	1.5k
R419	0662057A89	47k
R420	0662057A86	36K
R421	0662057A56	2k
R510	0662057B47	0
R601	0662057A25	100
R602	0662057A56	2k
R603	0662057A85	33k
R604	0662057A75	12k
R605	0662057A61	3.3k
R606	0662057B22	1 M
		THERMISTOR:
RT101	0605621T02	50k
		SHIELD:
S201	2602657J02	VCO
S202 (R1)	2602674J03	VCO Back
S202 (R2)	2602674J02	VCO Back
S203	2602658J01	Pendulum
S204	2602675J01	Synthesizer, Back
S205	2602660J01	Harmonic Filter, UHF
S206	2602686J01	Coil
S207	2605547X01	Varactor
		TRANSFORMER:
T1	2505515V08	4:1
T2	2505515V11	16:1
		INTEGRATED CIRCUIT MODULE: See Note 1.
U1	5105329V20	RF Amplifier
U2	5105329V26	Mixer
U101	5105835U52	TX ALC
U102	5105835U51	D/A CONVERTER
U104	5102001J68	Coupler
U105 (R1)	5105385Y10	LDMOS RF PA UHF-1
U105 (R2)	5105385Y11	LDMOS RF PA UHF-2
U106	5105469E65	5V Regulator
U201	5102227J37	VCO Buffer
U202	5105469E65	5V Regulator
U203	5105385Y42	16.8 MHz Reference Oscillator
U204	5105457W81	Fractional-N Synthesizer
U401	5105835U90	ABACUS
		DIODE: See Note 1.
VR1	4813830A33	20V
VR3	4813830A33	20V
VR402	4805129M58	Varactor

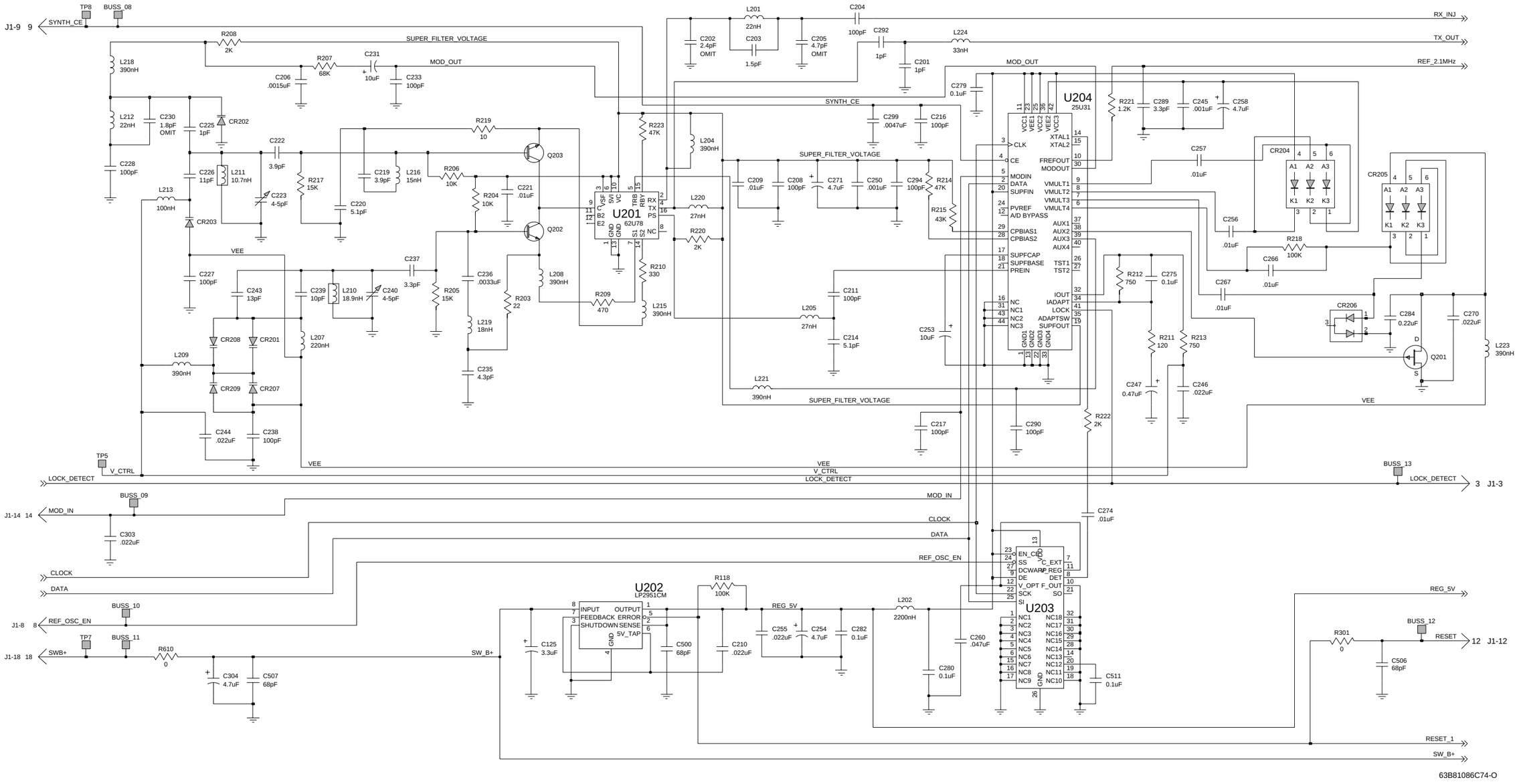
Notes:

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. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NLE4249 UHF RF Board uses a 6-layer printed circuit board.





NLE4250B UHF Range 2 RF Board Schematic Diagram, Sheet 1 of 3



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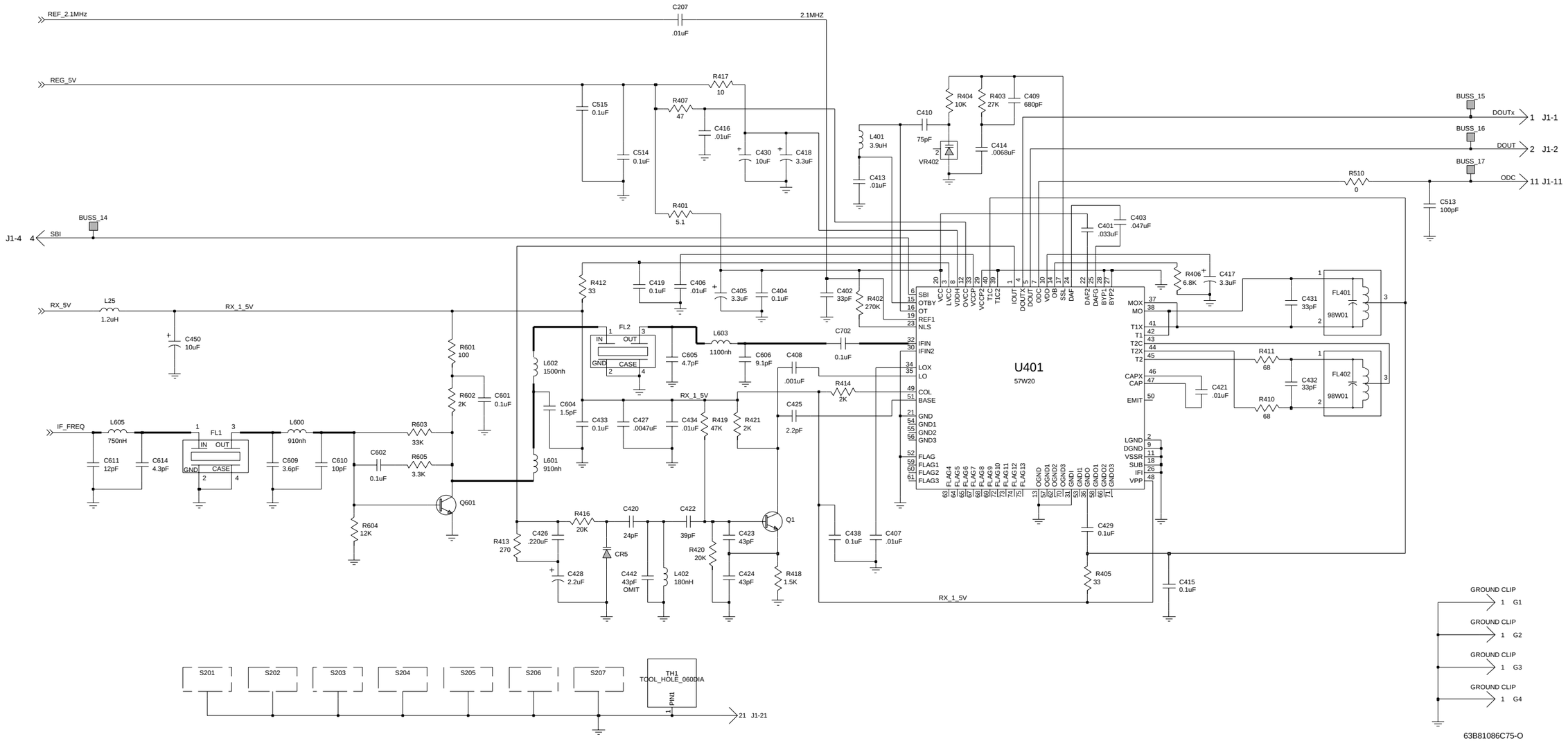
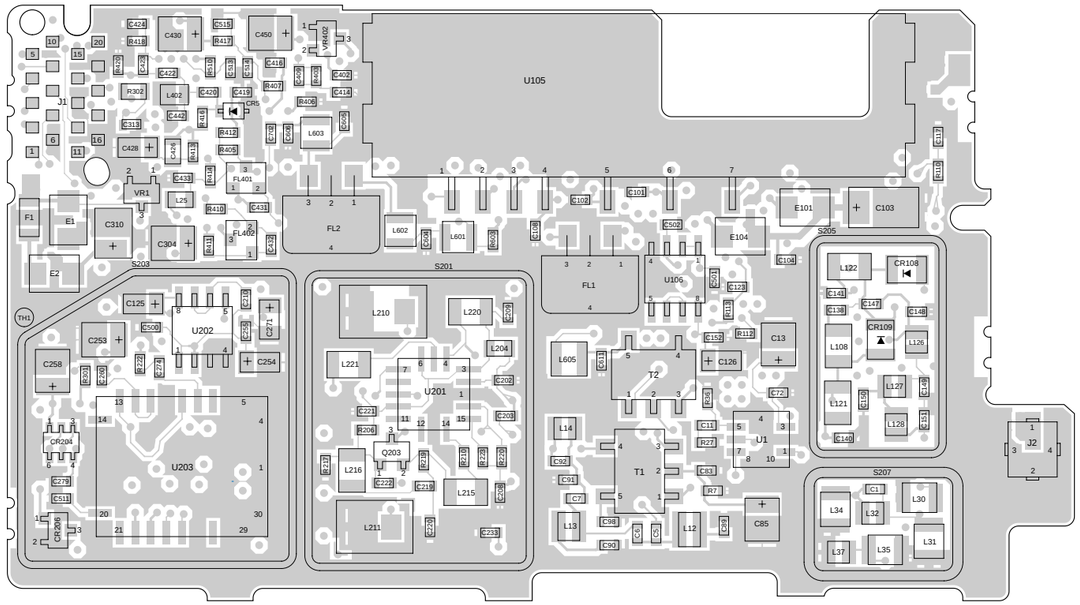
NLE4250B UHF Range 2 RF Board Schematic Diagram, Sheet 2 of 3



NLE4250B UHF Range 2 RF Board Schematic Diagram, Sheet 3 of 3

VIEWED FROM SIDE 1



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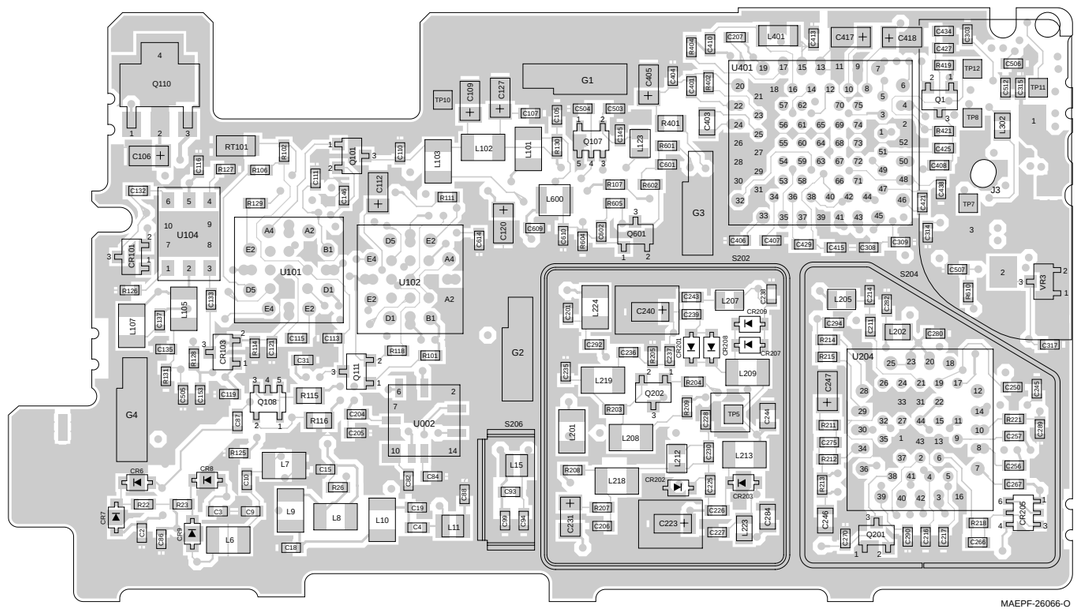
VIEWED FROM SIDE 2



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NLE4250B UHF Range 2 RF Board Component Location Detail and Parts List

NLE4250B UHF Range 2 RF Board Electrical Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: unless otherwise stated
C1	2113930F15	3.3 pF
C2, 3	2113930F12	2.4 pF
C4	2113930F36	24 pF
C5, 6	2113930F20	5.1 pF
C7	2113930F28	11 pF
C9	2113930F15	3.3 pF
C10	2113930F29	12 pF
C11	2113931F49	10 nF
C13	2311049A66	22 uF
C15	2113930F47	68 pF
C18	2113930F18	Not Placed
C19	2113930F19	4.7 pF
C31	2113931F49	10 nF
C72	2113930F51	100 pF
C82	2113931F49	10 nF
C83	2113930F51	100 pF
C84	2113931F49	10 nF
C85	2311049J23	10 uF
C86	2113930F47	68 pF
C87	2113930F51	100 pF
C88	2113930F45	56 pF
C89	2113930F19	4.7 pF
C90	2113930F26	9.1 pF
C91	2113930F28	11 pF
C92	2113930F09	1.8 pF
C93	2113930F17	3.9 pF
C94	2113930F27	10 pF
C98	2113930F51	100 pF
C99	2113930F21	5.6 pF
C101	2113930F51	100 pF
C102	2113930F51	Not Placed
C103	2311049J26	10 uF
C104, 105	2113930F51	100 pF
C106	2311049A56	4.7 uF
C107	2113930F51	100 pF
C108	2113930F51	Not Placed
C109	2311049A07	1 uF
C110	2113930F51	Not Placed
C111	2113930F51	100 pF
C112	2311049A07	1 uF
C113	2113930F51	100 pF
C115	2113932K07	.047 uF
C116	2113930F07	Not Placed
C117	2113930F51	100 pF
C119	2113930F51	100 pF
C120	2311049A42	Not Placed
C121	2113930F51	100 pF
C123	2113932K15	0.1 uF
C125, 126	2311049A54	3.3 uF
C127	2311049A54	Not Placed
C132	2113930F25	8.2 pF
C133	2113930F09	1.8 pF
C135	2113930F51	100 pF
C137, 138	2113930F51	100 pF
C140	2113931F41	CAP
C141	2113930F51	100 pF
C145	2113930F51	100 pF
C146	2113930F39	Not Placed
C147	2113930F51	100 pF
C148	2113930F11	2.2 pF
C149	2113930F27	10 pF
C150	2113930F25	8.2 pF
C151	2113930F18	4.3 pF
C152	2113932K15	0.1 uF
C153	2113930F47	68 pF
C201	2113930F41	Not Placed
C202	2113930F12	Not Placed
C203	2113930F07	1.5 pF
C204	2113930F51	100 pF
C205	2113930F19	Not Placed
C206	2113931F29	1.5 nF
C207	2113931F49	10 nF
C208	2113930F51	100 pF
C209	2113931F49	10 nF
C210	2113932E07	.022 uF
C211	2113930F51	100 pF
C214	2113930F14	3.0 pF
C216, 217	2113930F51	100 pF
C219	2113930F11	2.2 pF
C220	2113930F22	6.2 pF
C221	2113931F49	10 nF
C222	2113930F18	4.3 pF
C223	2113906C02	4 pF
C225	2113930F03	1 pF
C226	2113930F26	9.1 pF
C227, 228	2113930F51	100 pF
C230	2113930F09	Not Placed
C231	2311049A60	10 uF
C233	2113930F51	100 pF
C235	2113930F20	5.1 pF
C236	2113930F18	4.3 pF
C237	2113930F15	3.3 pF
C238	2113930F51	100 pF
C239	2113930F24	7.5 pF
C240	2113906C02	4 pF
C243	2113930F24	7.5 pF
C244	2109720D09	.022 uF
C245	2113931F25	1 nF
C246	2109720D09	.022 uF
C247	2311049A05	.47 uF
C250	2113931F25	1 nF
C253	2311049J23	10 uF
C254	2311049A56	4.7 uF
C255	2113932E07	.022 uF
C256, 257	2113931F49	10 nF
C258	2311049J11	4.7 uF
C260	2113932K07	.047 uF
C266, 267	2113931F49	10 nF
C270	2113932E07	.022 uF
C271	2311049A56	4.7 uF
C274	2113931F49	10 nF
C275	2113932K15	0.1 uF
C279, 280	2113932K15	0.1 uF
C282	2113932K15	0.1 uF
C284	2113743A23	.22 uF
C289, 290	2113930F51	100 pF
C292	2113930F51	100 pF
C294	2113930F51	100 pF
C299	2113931F41	4.7 nF
C303	2113932E07	.022 uF
C304	2311049J11	4.7 uF
C308	2113932E07	.022 uF
C309	2113932E07	.022 uF
C310	2311049J11	4.7 uF
C313	2113930F51	Not Placed
C314, 315	2113930F51	100 pF
C317	2113930F51	100 pF
C401	2113932K03	.033 uF
C402	2113930F39	33 pF

C403	2113743A13	.047 uF
C404	2113932K15	0.1 uF
C405	2311049A42	3.3 uF
C406, 407	2113931F49	10 nF
C408	2113931F25	1 nF
C409	2113931F21	680 pF
C410	2113930F48	75 pF
C413	2113931F49	10 nF
C414	2113931F45	6.8 nF
C415	2113932K15	0.1 uF
C416	2113931F49	10 nF
C417, 418	2311049A42	3.3 uF
C419	2113932K15	0.1 uF
C420	2113930F36	24 pF
C421	2113931F49	10 nF
C422	2113930F41	39 pF
C423, 424	2113930F42	43 pF
C425	2113930F11	2.2 pF
C426	2113743A23	.22 uF
C427	2113931F41	4.7 nF
C428	2311049A40	2.2 uF
C429	2113932K15	0.1 uF
C430	2311049J23	10 uF
C431, 432	2113930F39	33 pF
C433	2113932K15	0.1 uF
C434	2113931F49	10 nF
C438	2113932K15	0.1 uF
C442	2113930F42	Not Placed
C450	2311049J23	10 uF
C500 thru 504	2113930F47	68 pF
C505	2113931F41	4.7 nF
C506, 507	2113930F47	68 pF
C511, 512	2113932K15	0.1 uF
C513	2113930F51	100 pF
C514, 515	2113932K15	0.1 uF
C601, 602	2113932K15	0.1 uF
C604	2113930F10	2 pF
C605	2113930F17	3.9 pF
C606	2113930F27	10 pF
C609	2113930F18	4.3 pF
C610	2113930F33	18 pF
C611	2113930F34	20 pF
C614	2113930F14	3 pF
C702	2113932K15	0.1 uF
		DIODE: See Note 1.
CR5 thru 9	4862824C01	Varactor
CR101	4805129M67	Dual
CR103	4805129M67	Dual
CR108, 109	4802482J02	PIN
CR201	4802245J29	Varactor
CR202	4862824C01	Varactor
CR203	4862824C03	Varactor
CR204, 205	4802233J09	Triple
CR206	4805129M06	Triple
CR207 thru 209	4802245J29	Varactor
		CORE:
E1, 2	2484657R01	Ferrite Bead
E101	2484657R01	Ferrite Bead
E104	2484657R01	Not Placed
		FUSE:
F1	6505757V02	2 Amp

		FILTER: See Note 2.
FL1, 2	4805245J33	73.35 MHz
FL401, 402	9105398W01	450 kHz
		JACK:
J2	0905304Z01	Connector, RF Coax
		COIL, RF: unless otherwise stated
L6, 7	2462587T38	22 nH
L8	2462587T20	270 nH
L9	2462587T38	22 nH
L10	2462587T05	15 nH
L11	2460591B04	11.03 nH
L12	2460591M32	27.42 nH
L13	2460591B80	19. 61 nH
L14, 15	2460591B04	11.03 nH
L25	2462587Q48	1200 nH
L30, 31	2460591A01	4.22 nH
L32	2460591B04	11.03 nH
L34, 35	2460591A01	4.22 nH
L37	2460591B04	11.03 nH
L102	2462587T20	Not Placed
L103	2462587T20	270 nH
L105	2462587T20	270 nH
L107, 108	2462587T17	150 nH
L121, 122	2462587T20	270 nH
L123	2462587V38	220 nH
L126 thru 128	2460591B04	11.03 nH
L201	2462587T37	18 nH
L202	2462587Q20	2200 nH
L204	2462587Q42	390 nH
L205	2462587V26	22 nH
L207	2462587V36	150 nH
L208, 209	2462587T22	390 nH
L210	2405619V03	15.1 nH
L211	2405619V07	9 nH
L212	2462587V25	18 nH
L213	2462587T22	390 nH
L215	2462587T22	390 nH
L216	2462587T05	15 nH
L218	2462587T22	390 nH
L219	2462587T37	18 nH
L220	2462587T12	56 nH
L221	2462587T22	390 nH
L223	2462587Q42	390 nH
L224	2462587T42	47 nH
L302	2462587Q42	390 nH
L401	2462575A16	3900 nH
L402	2462587V37	180 nH
L600, 601	2405452C59	910 nH
L602	2405452C64	1500 nH
L603	2405452C61	1100 nH
L605	2462587N65	750 nH
		TRANSISTOR: See Note 1.
Q1	4805218N55	NPN
Q101	4805128M16	PNP
Q107	4805921T02	Switching
Q108	4802245J10	Dual NPN
Q110	4802245J12	PNP
Q111	4805128M16	PNP
Q201	4802245J15	JFET P-channel
Q202, 203	4805218N55	NPN
Q601	4882022N70	NPN

		RESISTOR; Ω:
R7	0662057A25	100
R22, 23	0662057A73	10K
R26	0662057A61	Not Placed
R27	0662057A01	10
R36	0662057A93	Not Placed
R100	0611077A68	560
R101	0662057A73	10K
R102	0662057A65	4.7K
R106	0662057A61	3.3K
R107	0662057A58	2.4K
R110	0662057A65	4.7K
R111, 112	0662057A49	1K
R113	0662057A73	10K
R114	0662057A77	15K
R115	0662057G27	182K
R116	0662057G19	130K
R118	0662057A97	100K
R125	0662057B22	1M
R126	0662057A18	51
R127	0662057A12	30
R128	0662057A89	47K
R129	0662057A65	4.7K
R130	0662057B47	0
R131	0662057B22	1M
R203	0662057A01	10
R204	0662057A73	10K
R205	0662057A77	15K
R206	0662057A73	10K
R207	0662057A93	68K
R208	0662057A58	2.4K
R209	0662057A41	470
R210	0662057A37	330
R211	0662057A27	120
R212, 213	0662057A46	750
R214	0662057A89	47K
R215	0662057A88	43K
R217	0662057A77	15K
R218	0662057A97	100K
R219	0662057A09	22
R220	0662057A56	2K
R221	0662057A51	1.2K
R222	0662057A56	2K
R223	0662057A89	47K
R301	0662057B47	0
R302	0662057C01	0
R401	0660079U18	5.1
R402	0662057B08	270K
R403	0662057A83	27K
R404	0662057A73	10K
R405	0662057A13	33
R406	0662057A69	6.8K
R407	0662057A17	47
R410	0662057A21	68
R411	0662057A21	68
R412	0662057A13	33
R413	0662057A35	270
R414	0662057A56	2K
R416	0662057A80	20K
R417	0662057A01	10
R418	0662057A53	1.5K
R419	0662057A89	47K
R420	0662057A80	20K
R421	0662057A56	2K
R510	0662057B47	0
R601	0662057A25	100
R602	0662057A56	2K
R603	0662057A85	33K

R604	0662057A75	12K
R605	0662057A61	3.3K
R610	0662057B47	0
		THERMISTOR:
RT501	0605621T02	50k
		TRANSFORMER:
T1	2505515V08	4:1
T2	2505515V11	16:1
		INTEGRATED CIRCUIT MODULE: See Note 1.
U1	5105329V20	RF Amplifier
U101	5105662U72	TX ALC
U102	5105662U70	D/A Converter
U104	5102001J68	Coupler
U105	5105385Y11	LDMOS RF PA
U106	5105469E71	5V Regulator
U2	5105329V26	Mixer
U201	5105662U78	VCO Buffer
U202	5105469E71	5V Regulator
U203	5102845C08	16.8 MHz Ref. Oscillator
U204	5105457W73	Frac-N Synthesizer
U401	5105457W20	ABACUS
		DIODE: See Note 1.
VR1	4813830A33	20V
VR3	4813830A33	20V
VR402	4805129M58	VARACTOR
		MISCELLANEOUS:
G1 thru 4	3905643V01	Ground Contact
S201	2602657J02	Shield, VCO
S202	2602674J02	Shield, VCO Back
S203	2602658J01	Shield, Pendulum
S204	2602675J01	Shield, Synthesizer
S205	2602660J01	Shield, Harmonic Filter
S206	2602686J01	Shield, Coil
S207	2605547X01	Shield, Varactor
	8405260Z02	PC Board

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. Part value notations:

   $p=10^{-12}$

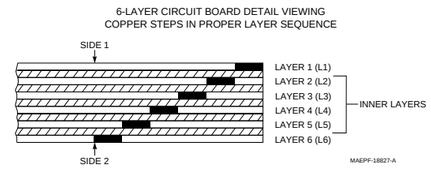
   $n=10^{-9}$

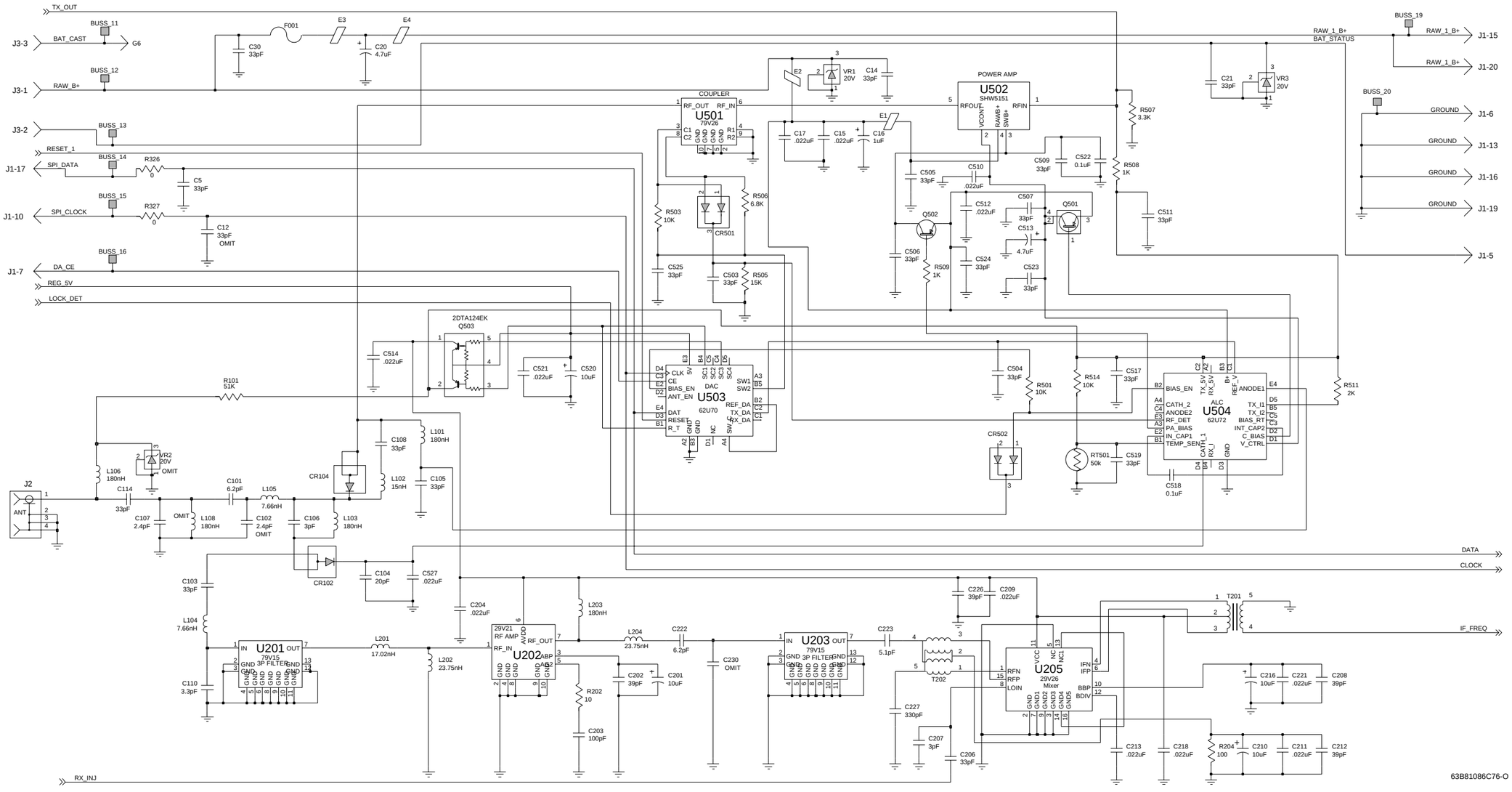
   $\mu=10^{-6}$

   $m=10^{-3}$

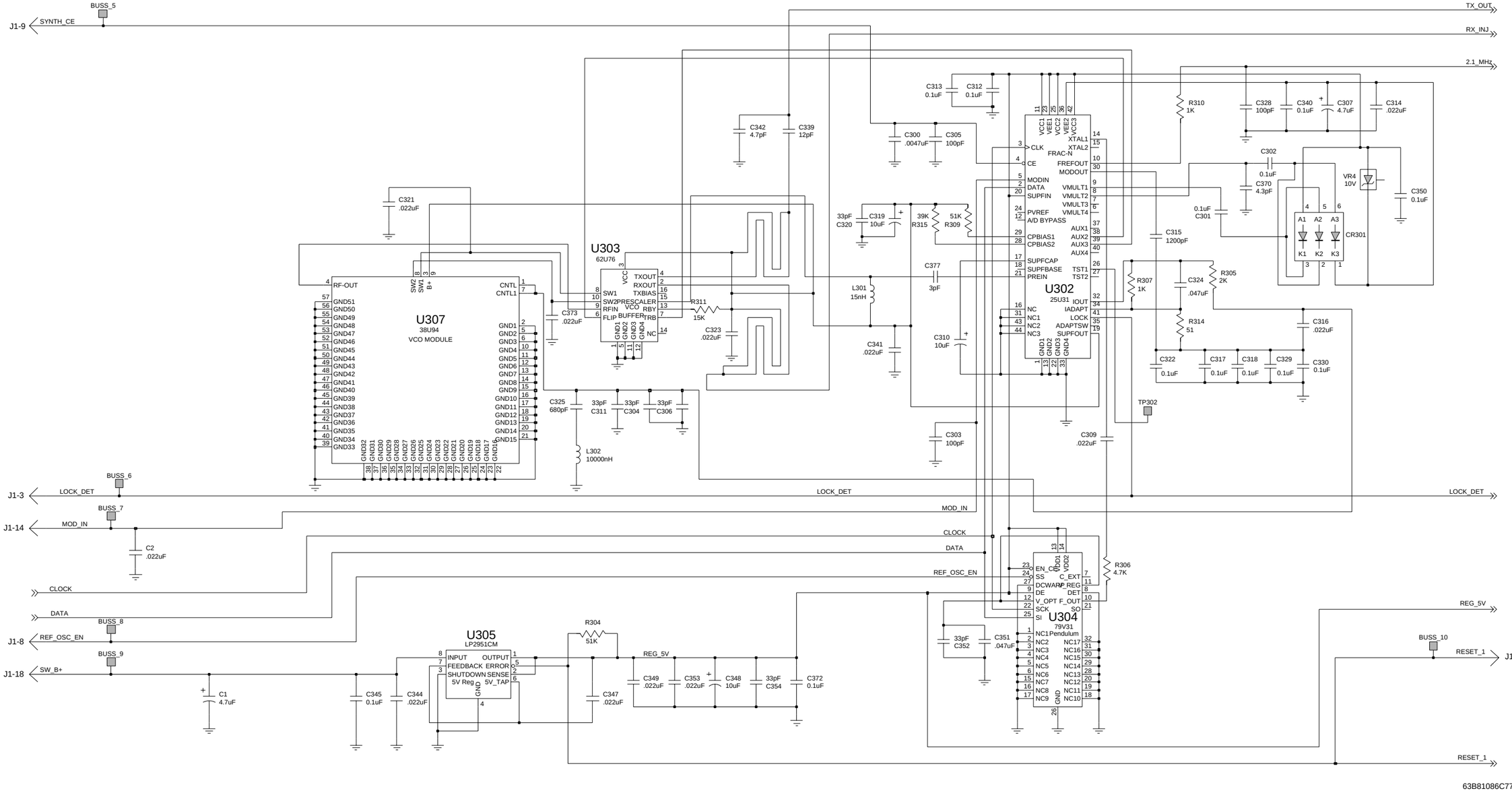
   $k=10^{3}$

   $M=10^{6}$
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NLE4250 UHF Range 2 RF Kit uses a 6-layer printed circuit board.

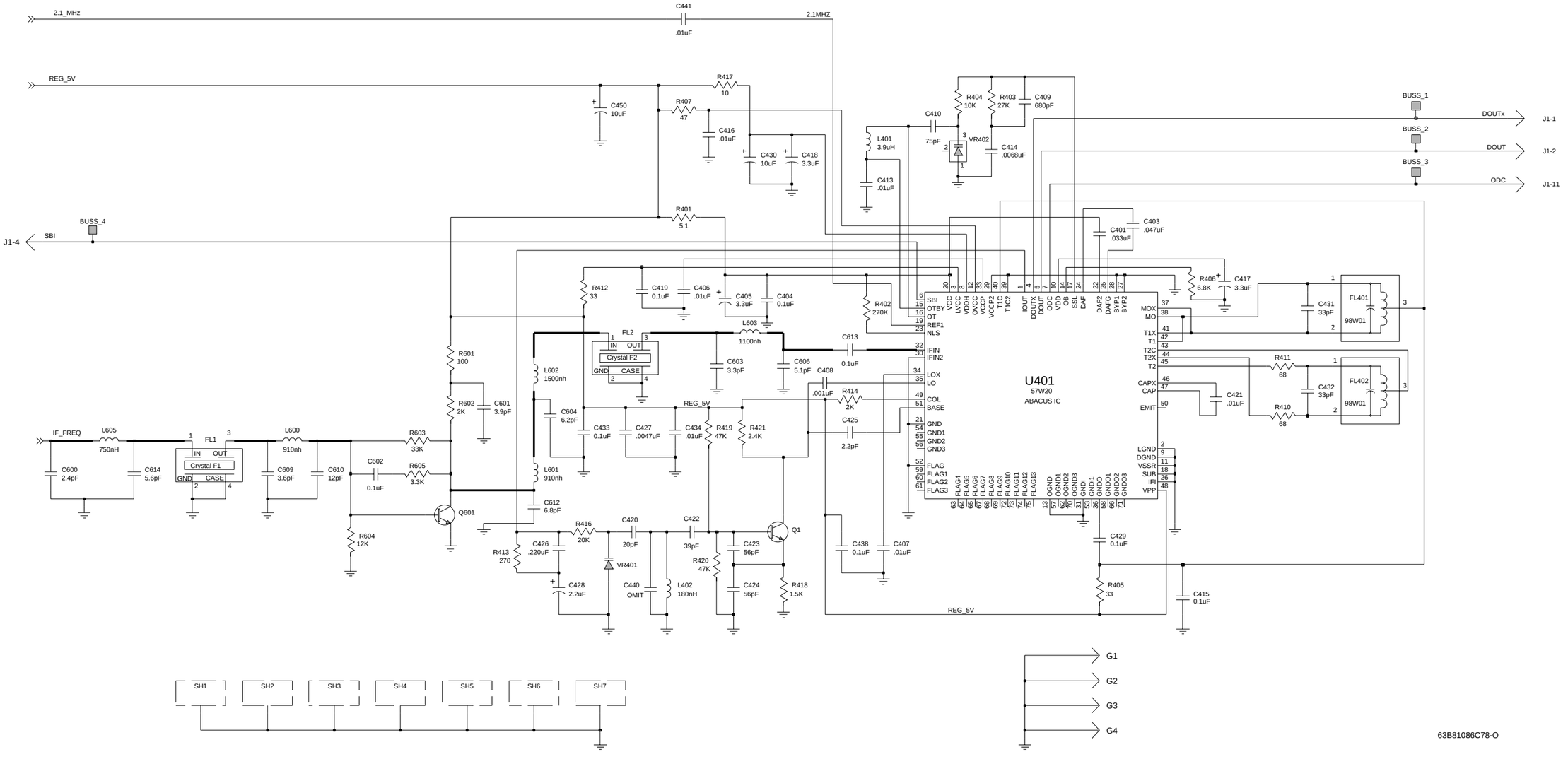




NUF6472B 800 MHz RF Board Schematic Diagram, Sheet 1 of 3

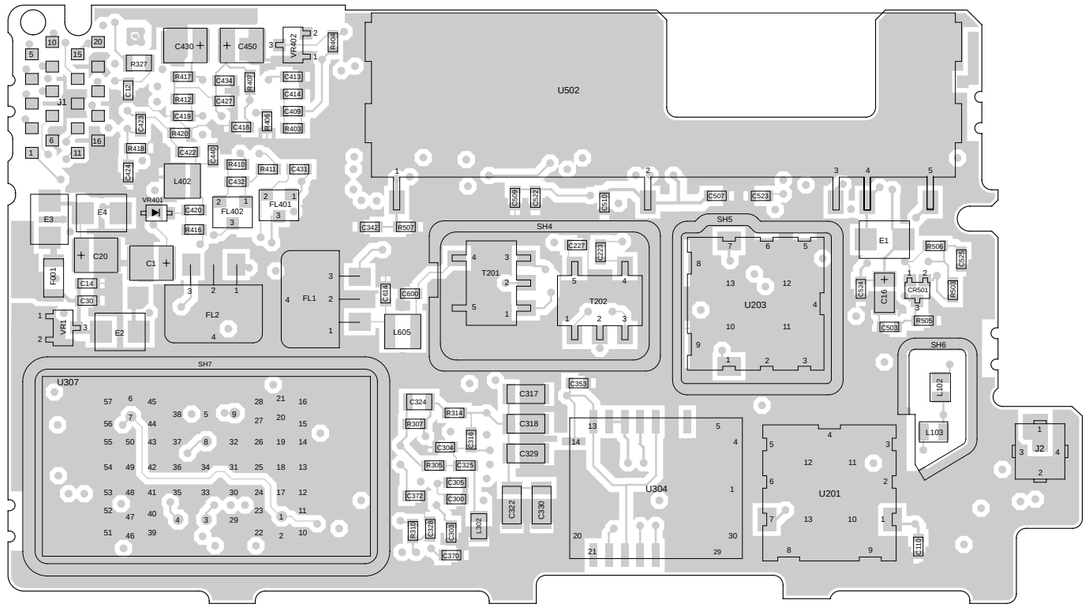


NUF6472B 800 MHz RF Board Schematic Diagram, Sheet 2 of 3



NUF6472B 800 MHz RF Board Schematic Diagram, Sheet 3 of 3

VIEWED FROM SIDE 1



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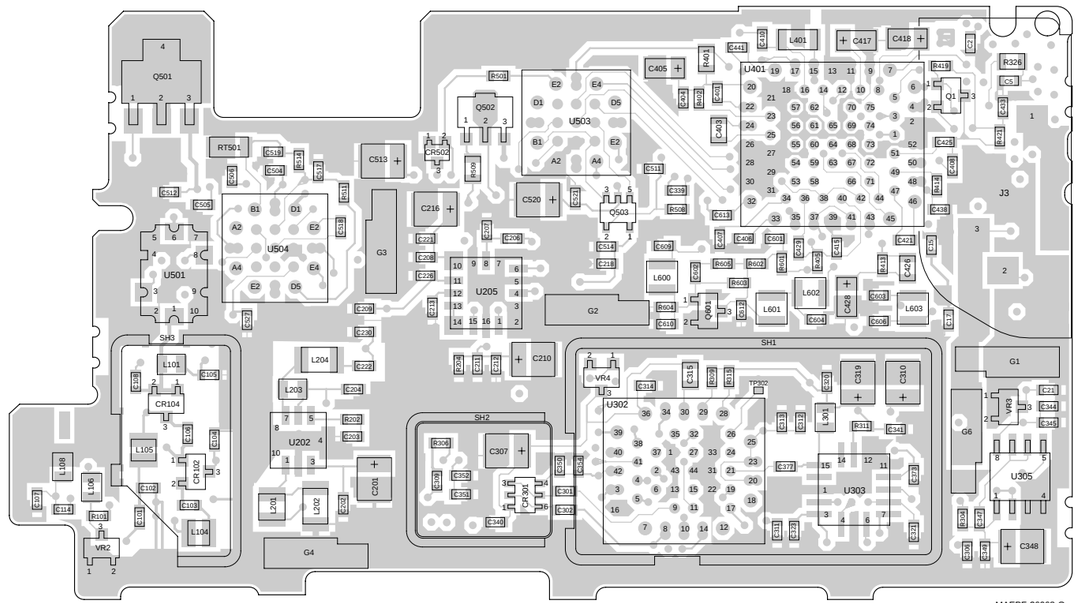
VIEWED FROM SIDE 2



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NUF6472B 800 MHz RF Board Component Location Detail and Parts List

NUF6472B 800 MHz Transceiver Board Electrical Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: unless otherwise stated
C1	2311049J12	4.7 uF
C2	2113932E07	22 nF
C5	2113930F39	33 pF
C12	2113930F39	Not Placed
C14	2113930F39	33 pF
C15	2113932E07	22 nF
C16	2311049A07	1 uF
C17	2113932E07	22 nF
C20	2311049J11	4.7 uF
C21	2113930F39	33 pF
C30	2113930F39	33 pF
C101	2113930F22	6.2 pF
C102	2113930F12	Not Placed
C103	2113930F39	33 pF
C104	2113930F34	20 pF
C105	2113930F39	33 pF
C106	2113930F14	3.0 pF
C107	2113930F12	2.4 pF
C108	2113930F39	33 pF
C110	2113930F15	3.3 pF
C114	2113930F39	33 pF
C201	2311049J23	10 uF
C202	2113930F41	39 pF
C203	2113930F51	100 pF
C204	2113932E07	22 nF
C206	2113930F39	33 pF
C207	2113930F14	3.0 pF
C208	2113930F41	39 pF
C209	2113932E07	22 nF
C210	2311049J23	10 uF
C211	2113932E07	22 nF
C212	2113930F41	39 pF
C213	2113932E07	22 nF
C216	2311049J23	10 uF
C218	2113932E07	22 nF
C221	2113932E07	22 nF
C222	2113930F22	6.2 pF
C223	2113930F20	5.1 pF
C226	2113930F41	39 pF
C227	2113931F13	330 pF
C230	2113932E07	22 nF
C300	2113931F41	4.7 nF
C301	2113932K15	.1 uF
C302	2113932K15	.1 uF
C303	2113930F51	100 pF
C304	2113930F39	33 pF
C305	2113930F51	100 pF
C306	2113930F39	33 pF
C307	2311049J12	4.7 uF
C309	2113932E07	22 nF
C310	2311049J23	10 uF
C311	2113930F39	33 pF
C312, 313	2113932K15	.1 uF
C314	2113932E07	22 nF
C315	2105248W02	1.2 nF
C316	2113932E07	22 nF
C317	2109720D14	.1 uF
C318	2109720D14	.1 uF
C319	2311049J23	10 uF
C320	2113930F39	33 pF
C321	2113932E07	22 nF
C322	2109720D14	.1 uF
C323	2113932E07	22 nF
C324	2113743A13	.047 uF
C325	2113931F21	680 pF
C328	2113930F51	100 pF
C329, 330	2109720D14	.1 uF
C339	2113930F29	12 pF
C340	2113932K15	.1 uF
C341	2113932E07	22 nF
C342	2113930F19	4.7 pF
C344	2113932E07	22 nF
C345	2113932K15	.1 uF
C347	2113932E07	22 nF
C348	2311049J23	10 uF
C349	2113932E07	22 nF
C350	2113932K15	.1 uF
C351	2113932K07	47 nF
C352	2113930F39	33 pF
C353	2113932E07	22 nF
C354	2113930F39	33 pF
C370	2113930F18	4.3 pF
C372	2113932K15	.1 uF
C373	2113932E07	22 nF
C377	2113930F14	3.0 pF
C401	2113932K03	33 nF
C403	2113743A13	.047 uF
C404	2113932K15	.1 uF
C405	2311049A42	3.3 uF
C406, 407	2113931F49	10 nF
C408	2113931F25	1 nF
C409	2113931F21	680 pF
C410	2113930F48	75 pF
C413	2113931F49	10 nF
C414	2113931F45	6.8 nF
C415	2113932K15	.1 uF
C416	2113931F49	10 nF
C417, 418	2311049A42	3.3 uF

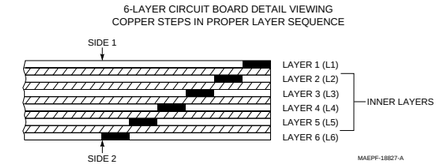
C419	2113932K15	.1 uF
C420	2113930F34	20 pF
C421	2113931F49	10 nF
C422	2113930F41	39 pF
C423, 424	2113930F45	56 pF
C425	2113930F11	2.2 pF
C426	2113743A23	.22 uF
C427	2113931F41	4.7 nF
C428	2311049A40	2.2 uF
C429	2113932K15	.1 uF
C430	2311049J23	10 uF
C431, 432	2113930F39	33 pF
C433	2113932K15	.1 uF
C434	2113931F49	10 nF
C438	2113932K15	.1 uF
C440	2113930F42	Not Placed
C441	2113931F49	10 nF
C450	2311049J23	10 uF
C503 thru 507	2113930F39	33 pF
C509	2113930F39	33 pF
C510	2113932E07	22 nF
C511	2113930F39	33 pF
C512	2113932E07	22 nF
C513	2311049A13	4.7 uF
C514	2113932E07	22 nF
C517	2113930F39	33 pF
C518	2113932K15	.1 uF
C519	2113930F39	33 pF
C520	2311049J23	10 uF
C521	2113932E07	22 nF
C522	2113932K15	.1 uF
C523 thru 525	2113930F39	33 pF
C527	2113932E07	22 nF
C600	2113930F12	2.4 pF
C601	2113930F17	3.9 pF
C601, 602	2113932K15	.1 uF
C603	2113930F15	3.3 pF
C604	2113930F22	6.2 pF
C606	2113930F20	5.1 pF
C609	2113930F16	3.6 pF
C610	2113930F29	12 pF
C612	2113930F23	6.8 pF
C613	2113932K15	.1 uF
C614	2113930F21	5.6 pF
		DIODE: See Note 1.
CR102	4805129M96	Dual
CR104	4805129M96	Dual
CR301	4802233J09	Triple
CR501, 502	4805218N57	Dual

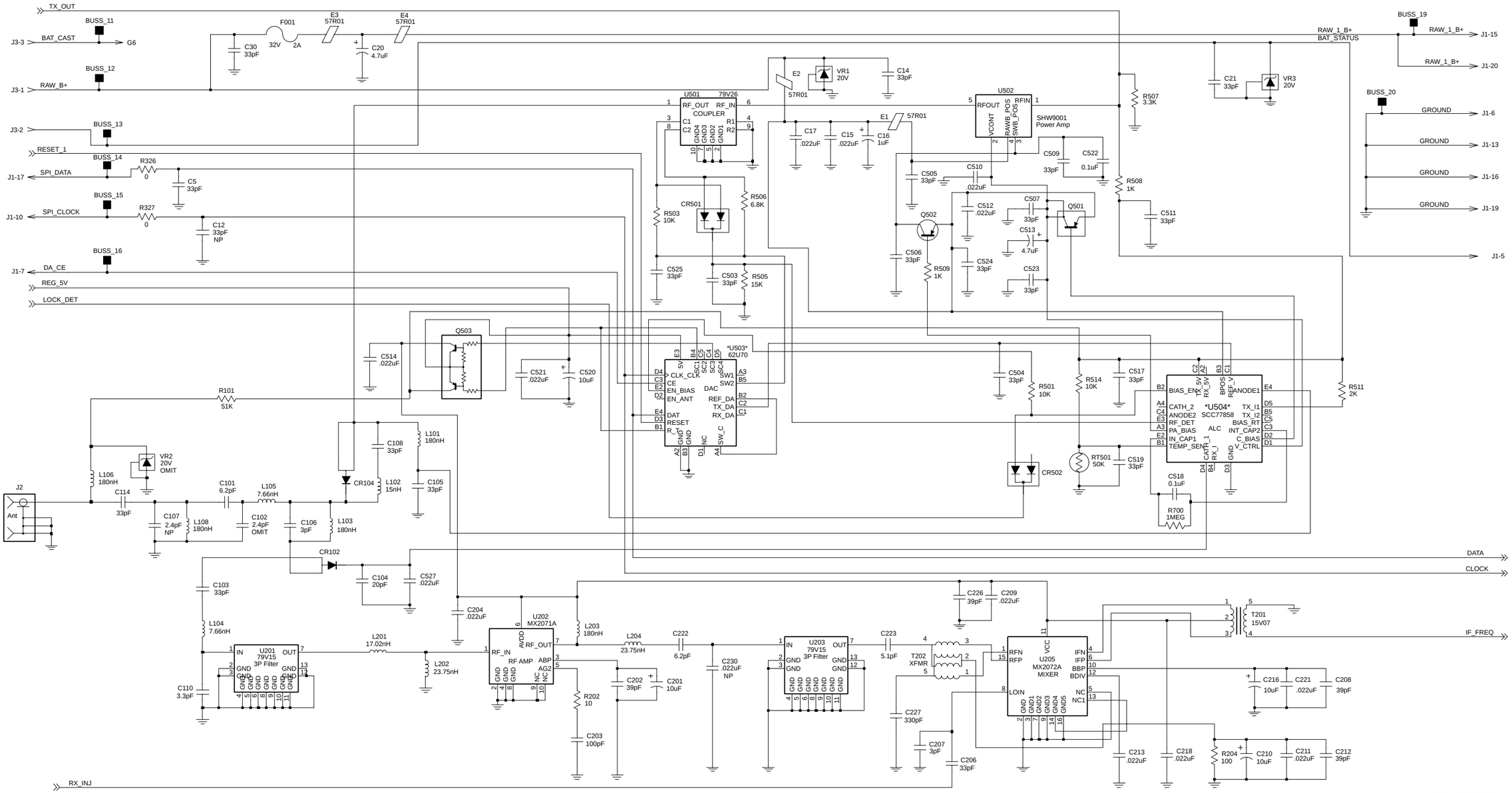
		CORE:
E1 thru 4	2484657R01	Ferrite Bead
		FUSE:
F1	6505757V02	2 Amp
		FILTER: See Note 2.
FL1, 2	4805245J33	73.35MHz
FL401, 402	9105398W01	450kHz
		JACK:
J2	0905304Z01	RF Coax Connector
		COIL, RF: unless otherwise stated
L101	2462587V37	180 nH
L102	2462587V24	15 nH
L103	2462587V37	180 nH
L104, 105	2460591A11	7.66 nH
L106	2462587V37	180 nH
L108	2462587V37	180 nH
L201	2460591C40	17.02 nH
L202	2460591E24	23.75 nH
L203	2462587V37	180 nH
L204	2460591E24	23.75 nH
L301	2462587V24	15 nH
L302	2462587Q59	10 uH
L401	2462575A16	3900 nH
L402	2462587N56	180 nH
L600, 601	2405452C59	910 nH
L602	2405452C64	1500 nH
L603	2405452C61	1100 nH
L605	2462587N65	750 nH
		TRANSISTOR: See Note 1.
Q1	4805218N55	NPN
Q501	4805218N45	NPN
Q502	4805128M27	PNP
Q503	4805921T06	Dual PNP
Q601	4882022N70	NPN
		RESISTOR; Ω:
R101	0662057A90	51K
R202	0662057A01	10
R204	0662057A25	100
R304	0662057A90	51K
R305	0662057A56	2K
R306	0662057A65	4.7K
R307	0662057A49	1K
R309	0662057A90	51K
R310	0662057A49	1K
R311	0662057A77	15K

R314	0662057A18	51
R315	0662057A87	39K
R326, 327	0662057C01	0
R401	0660079U18	5.1
R402	0662057B08	270K
R403	0662057A83	27K
R404	0662057A73	10K
R405	0662057A13	33
R406	0662057A69	6.8K
R407	0662057A17	47
R410, 411	0662057A21	68
R412	0662057A13	33
R413	0662057A35	270
R414	0662057A56	2K
R416	0662057A80	20K
R417	0662057A01	10
R418	0662057A53	1.5K
R419, 420	0662057A89	47K
R421	0662057A58	2.4K
R501	0662057A73	10K
R503	0662057A73	10K
R505	0662057A77	15K
R506	0662057A69	6.8K
R507	0662057A61	3.3K
R508	0662057A49	1K
R509	0662057C75	1K
R511	0662057A56	2K
R514	0662057A73	10K
R601	0662057A25	100
R602	0662057A56	2K
R603	0662057A85	33K
R604	0662057A75	12K
R605	0662057A61	3.3K
		THERMISTOR:
RT501	0605621T02	50k
		TRANSFORMER:
T201	2505515V07	25:1
T202	2505515V04	5:1
		INTEGRATED CIRCUIT MODULE: See Note 1.
U201	5105279V15	3-Pole Filter
U202	5105329V21	RF Amp
U203	5105279V15	3-Pole Filter
U205	5105329V26	Mixer
U302	5105457W73	Fractional-N-Synthesizer
U303	5105662U76	VCO Buffer
U304	5105279V31	16.8 MHz Reference Oscillator
U305	5105469E65	5 Volt Regulator
U307	5105238U94	VCO

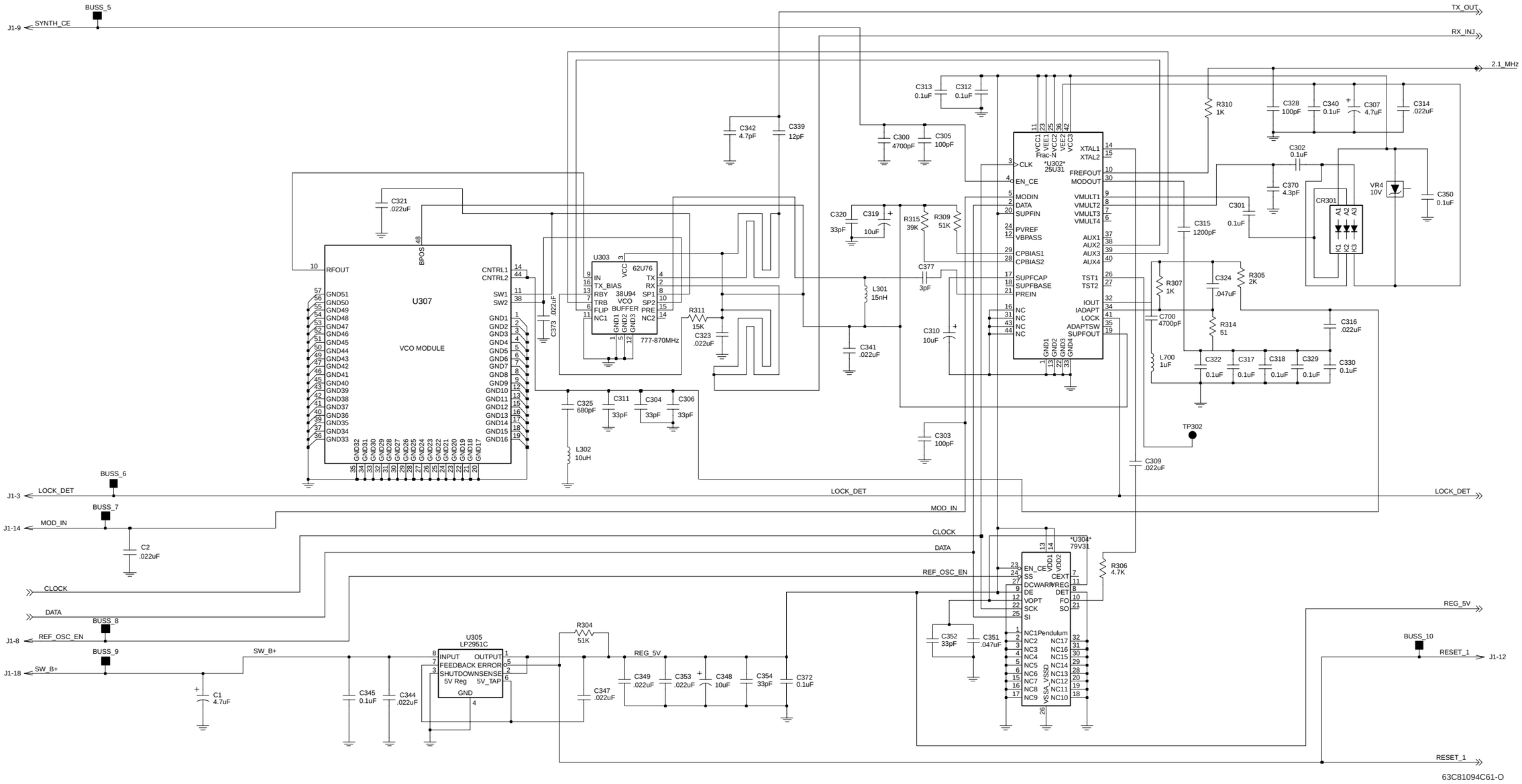
U401	5105457W20	ABACUS
U501	5105279V26	RF Coupler
U502	5105385Y12	LDMOS RF PA
U503	5105662U70	D/A Converter
U504	5105662U72	TX ALC
		DIODE: See Note 1.
VR1	4813830A33	Zener, 20V
VR2	4813830A33	Not Placed
VR3	4813830A33	Zener, 20V
VR4	4813830A23	Not Placed
VR401	4862824C01	Varactor
VR402	4805129M58	Varactor
		MISCELLANEOUS:
G1 thru 4	3905643V01	Ground Contact
G6	3905643V01	Ground Contact
SH1	2605258V01	Synthesizer Shield
SH2	2605259V01	Diode Shield
SH3	2605260V01	RF Switch Shield
SH4	2605418V01	Transformer Shield
SH5	2605263V01	3 Pole Filter Shield
SH6	2605634V01	Antenna Shield
SH7	2605890U03	VCO Shield
	3985661A01	VCO Metal Strip Contact
	8405431Z02	PC Board (prior to 4/1997)
	or 8405431Z03	PC Board (after 3/1997

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. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NUF6472 800MHz Transceiver Kit uses a 6-layer printed circuit board.

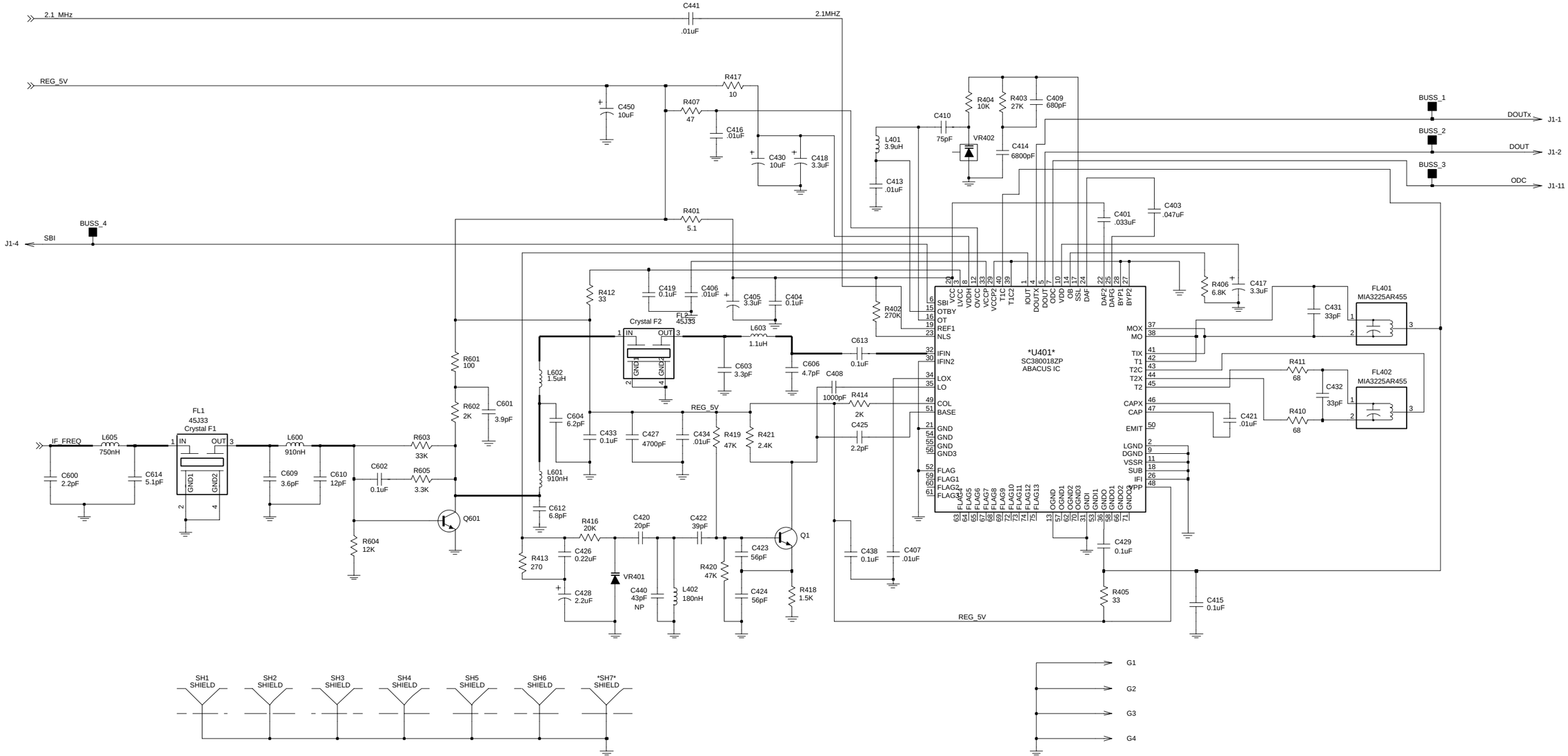




NUF6472D 800 MHz RF Board Schematic Diagram, Sheet 1 of 3

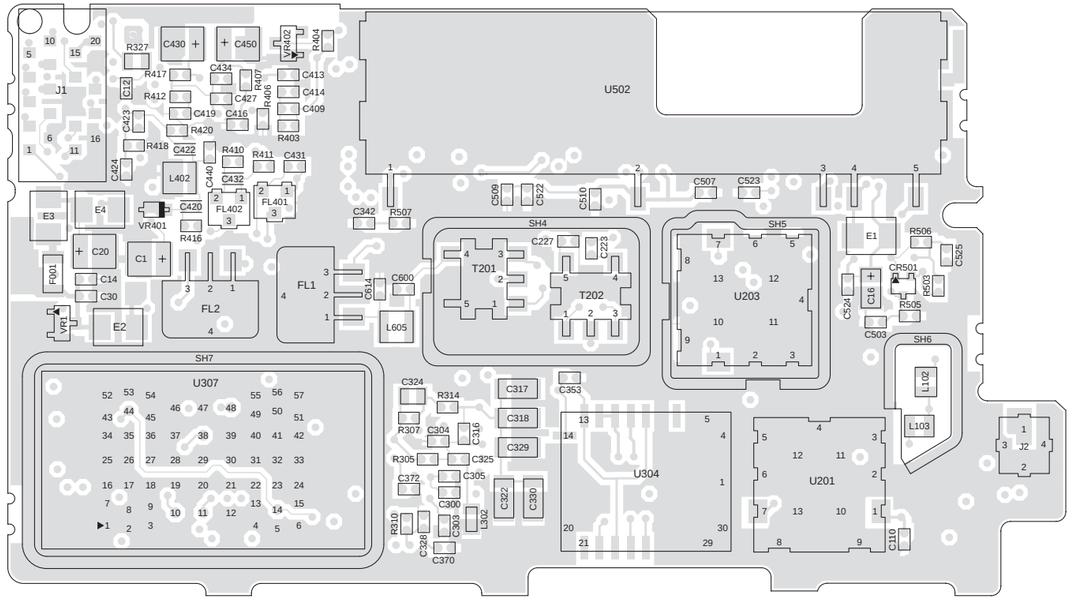


NUF6472D 800 MHz RF Board Schematic Diagram, Sheet 2 of 3



NUF6472D 800 MHz RF Board Schematic Diagram, Sheet 3 of 3

VIEWED FROM SIDE 1



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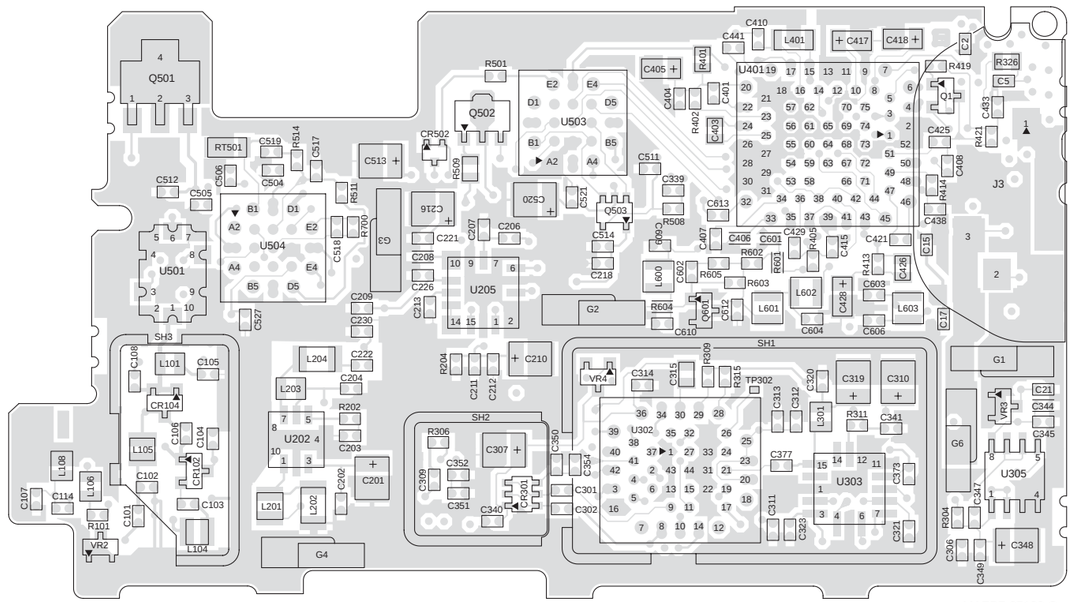
VIEWED FROM SIDE 2



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NUF6472D 800 MHz RF Board Component Location Detail and Parts List

NUF6472D 800 MHz RF Board Electrical Parts List

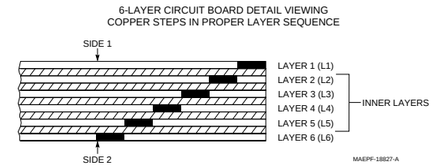
ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 50V unless otherwise stated
C1	2311049J12	4.7 µF
C2	2113932E07	22 nF 10% 16V
C5	2113930F39	33 PF 50V 5%
C12	----------	Not Placed
C14	2113930F39	33
C15	2113932E07	22 nF 10% 16V
C16	2311049A07	1 µF
C17	2113932E07	22 nF 10% 16V
C20	2311049J11	4.7 µF
C21	2113930F39	33
C30	2113930F39	33
C101	2113930F22	6.2 pF 50V ±0.25 pF 50V
C102	----------	Not Placed
C103	2113930F39	33
C104	2113930F34	20
C105	2113930F39	33
C106	2113930F14	3 pF 50V ±0.25 pF 50V
C107	----------	Not Placed
C108	2113930F39	33
C110	2113930F15	3.3 pF 50V ±0.25 pF 50V
C114	2113930F39	33
C201	2311049J23	10 µF
C202	2113930F41	39
C203	2113930F51	100
C204	2113932E07	22 nF 10% 16V
C206	2113930F39	33
C207	2113930F14	3 pF 50V ±0.25 pF 50V
C208	2113930F41	39
C209	2113932E07	22 nF 10% 16V
C210	2311049J23	10 µF
C211	2113932E07	22 nF 10% 16V
C212	2113930F41	39
C213	2113932E07	22 nF 10% 16V
C216	2311049J23	10 µF
C218	2113932E07	22 nF 10% 16V
C221	2113932E07	22 nF 10% 16V
C222	2113930F22	6.2 pF 50V ±0.25 pF 50V
C223	2113930F20	5.1 pF 50V ±0.25 pF 50V
C226	2113930F41	39
C227	2113931F13	330 pF
C230	----------	Not Placed
C300	2113931F41	4.7 nF
C301, C302	2113932K15	0.1 µF +80/-20% 16V
C303	2113930F51	100
C304	2113930F39	33
C305	2113930F51	100
C306	2113930F39	33
C307	2311049J12	4.7 µF
C309	2113932E07	22 nF 10% 16V
C310	2311049J23	10 µF
C311	2113930F39	33
C312, C313	2113932K15	0.1 µF +80/-20% 16V
C314	2113932E07	22 nF 10% 16V
C315	2105248W02	1.2 nF
C316	2113932E07	22 nF 10% 16V
C317, C318	2109720D14	0.1 µF
C319	2311049J23	10 µF
C320	2113930F39	33
C321	2113932E07	22 nF 10% 16V
C322	2109720D14	0.1 µF
C323	2113932E07	22 nF 10% 16V
C324	2113743A13	.047 µF
C325	2113931F21	680
C328	2113930F51	100
C329, C330	2109720D14	0.1 µF
C339	2113930F29	12
C340	2113932K15	0.1 µF +80/-20% 16V
C341	2113932E07	22 nF 10% 16V
C342	2113930F19	4.7 pF 50V ±0.25 pF 50V
C344	2113932E07	22 nF 10% 16V
C345	2113932K15	0.1 µF +80/-20% 16V
C347	2113932E07	22 nF 10% 16V
C348	2311049J23	10 µF
C349	2113932E07	22 nF 10% 16V
C350	2113932K15	0.1 µF +80/-20% 16V
C351	2113932K07	47 nF +80/-20% 16V
C352	2113930F39	33
C353	2113932E07	22 nF 10% 16V
C354	2113930F39	33
C370	2113930F18	4.3 pF 50V ±0.25 pF 50V
C372	2113932K15	0.1 µF +80/-20% 16V
C373	2113932E07	22 nF 10% 16V
C377	2113930F14	3 pF 50V ±0.25 pF 50V
C401	2113932K03	33 nF +80/-20% 16V
C403	2113743A13	.047 µF
C404	2113932K15	0.1 µF +80/-20% 16V
C405	2311049A42	3.3 µF
C406, C407	2113931F49	10 nF
C408	2113931F25	1 nF
C409	2113931F21	680 pF
C410	2113930F48	75
C413	2113931F49	10 nF
C414	2113931F45	6.8 nF
C415	2113932K15	0.1 µF +80/-20% 16V
C416	2113931F49	10 nF
C417, C418	2311049A42	3.3 µF
C419	2113932K15	0.1 µF +80/-20% 16V
C420	2113930F34	20
C421	2113931F49	10 nF
C422	2113930F41	39
C423, C424	2113930F45	56
C425	2113930F11	2.2 pF 50V ±0.25 pF 50V
C426	2113743A23	0.22 µF 10%
C427	2113931F41	4.7 nF
C428	2311049A40	2.2 µF
C429	2113932K15	0.1 µF +80/-20% 16V
C430	2311049J23	10 µF

C431, C432	2113930F39	33
C433	2113932K15	0.1 µF +80/-20% 16V
C434	2113931F49	10 nF
C438	2113932K15	0.1 µF +80/-20% 16V
C440	----------	Not Placed
C441	2113931F49	10 nF
C450	2311049J23	10 µF
C503 thru C507	2113930F39	33
C509	2113930F39	33
C510	2113932E07	22 nF 10% 16V
C511	2113930F39	33
C512	2113932E07	22 nF 10% 16V
C513	2311049A13	4.7 µF
C514	2113932E07	22 nF 10% 16V
C517	2113930F39	33
C518	2113932K15	0.1 µF +80/-20% 16V
C519	2113930F39	33
C520	2311049J23	10 µF
C521	2113932E07	22 nF 10% 16V
C522	2113932K15	0.1 µF +80/-20% 16V
C523 thru C525	2113930F39	33
C527	2113932E07	22 nF 10% 16V
C600	2113930F11	2.2 pF 50V ±0.25 pF 50V
C601	2113930F17	3.9 pF 50V ±0.25 pF 50V
C602	2113932K15	0.1 µF +80/-20% 16V
C603	2113930F15	3.3 pF 50V ±0.25 pF 50V
C604	2113930F22	6.2 pF 50V ±0.25 pF 50V
C606	2113930F19	4.7 pF 50V ±0.25 pF 50V
C609	2113930F16	3.6 pF 50V ±0.25 pF 50V
C610	2113930F29	12
C612	2113930F23	6.8 pF 50V ±0.25 pF 50V
C613	2113932K15	0.1 µF +80/-20% 16V
C614	2113930F20	5.1 pF 50V ±0.25 pF 50V
		DIODE: See Note 1.
CR102	4805129M96	Dual
CR104	4805129M96	Dual
CR301	4802233J09	Triple
CR501, CR502	4805218N57	Dual
		CORE:
E1 thru E4	2484657R01	Bead, Ferrite
		FUSE:
F1	6505757V02	2 Amp
		FILTER: See Note 2.
FL1, FL2	4805245J33	73.35 MHz
FL401, FL402	9105398W01	450 kHz
		CONTACT:
G1 thru G4	3905643V01	Ground
G6	3905643V01	Ground
		JACK:
J1	----------	Not Placed
J2	0905304Z01	RF Coaxial Connector
J3	----------	Not Placed

		COIL, RF:
L101	2462587V37	180 nH
L102	2462587V24	15 nH
L103	2462587V37	180 nH
L104, L105	2460591A11	7.66 nH
L106	2462587V37	180 nH
L108	2462587V37	180 nH
L201	2460591C40	17.02 nH
L202	2460591E24	23.75 nH
L203	2462587V37	180 nH
L204	2460591E24	23.75 nH
L301	2462587V24	15 nH
L302	2462587Q59	10 µH
L401	2462575A16	3.9 µH 10 MHz
L402	2462587N56	180 nH
L600, L601	2405452C59	910 nH
L602	2405452C64	1.5 µH
L603	2405452C61	1.1 µH
L605	2462587N65	750 nH
		TRANSISTOR: See Note 1
Q1	4805218N55	NPN
Q501	4805218N45	NPN
Q502	4805128M27	PNP
Q503	4805921T06	Dual PNP
Q601	4882022N70	NPN
		RESISTOR, Fixed: Ω **±5%; 1/8W** unless otherwise stated
R101	0662057A90	51k
R202	0662057A01	10
R204	0662057A25	100
R304	0662057A90	51k
R305	0662057A56	2k
R306	0662057A65	4.7k
R307	0662057A49	1k
R309	0662057A90	51k
R310	0662057A49	1k
R311	0662057A77	15k
R314	0662057A18	51
R315	0662057A87	39k
R326, R327	0662057C01	0
R401	0660079U18	5.1
R402	0662057B08	270k
R403	0662057A83	27k
R404	0662057A73	10k
R405	0662057A13	33
R406	0662057A69	6800
R407	0662057A17	47
R410, R411	0662057A21	68
R412	0662057A13	33
R413	0662057A35	270
R414	0662057A56	2k
R416	0662057A80	20k
R417	0662057A01	10
R418	0662057A53	1.5k
R419, R420	0662057A89	47k
R421	0662057A58	2.4k
R501	0662057A73	10k

R503	0662057A73	10k
R505	0662057A77	15k
R506	0662057A69	6.8k
R507	0662057A61	3.3k
R508	0662057A49	1k
R509	0662057C75	1k
R511	0662057A56	2k
R514	0662057A73	10k
R601	0662057A25	100
R602	0662057A56	2k
R603	0662057A85	33k
R604	0662057A75	12k
R605	0662057A61	3.3k
R700	0662057B22	1 M
		THERMISTOR:
RT501	0605621T02	50K
		SHIELD:
SH001	2605258V01	SYNTHESIZER
SH002	2605259V01	DIODE
SH003	2605260V01	RF SW
SH004	2605418V01	TRANSFORMER
SH005	2605263V01	3-POLE FILTER
SH006	2605634V01	ANTENNA
SH007	2605890U03	VCO
		TRANSFORMER:
T201	2505515V07	25:1
T202	2505515V04	5:1
		INTEGRATED CIRCUIT MODULE: See Note 1.
U201	5105279V15	3-Pole Filter
U202	5105329V21	RF Amp
U203	5105279V15	3-Pole Filter
U205	5105329V26	Mixer
U302	5105457W81	Fractional-N Synthesizer
U303	5105662U76	VCO Buffer
U304	5105385Y61	16.8 MHz Reference Oscillator
U305	5105469E65	5 Volt Regulator
U307	5105238U94	VCO
U401	5105835U90	ABACUS
U501	5105279V26	RF Coupler
U502	5105385Y83	LDMOS 800 RF PA
U503	5105835U51	D/A Converter
U504	5105835U52	TX ALC
		DIODE: See Note 1:
VR1	4813830A33	Zener, 20V
VR2	----------	Not Placed
VR3	4813830A33	Zener, 20V
VR4	----------	Not Placed
VR401	4862824C01	Varactor
VR402	4805129M58	Varactor

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. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NUF6472 800MHz Transceiver Kit uses a 6-layer printed circuit board.



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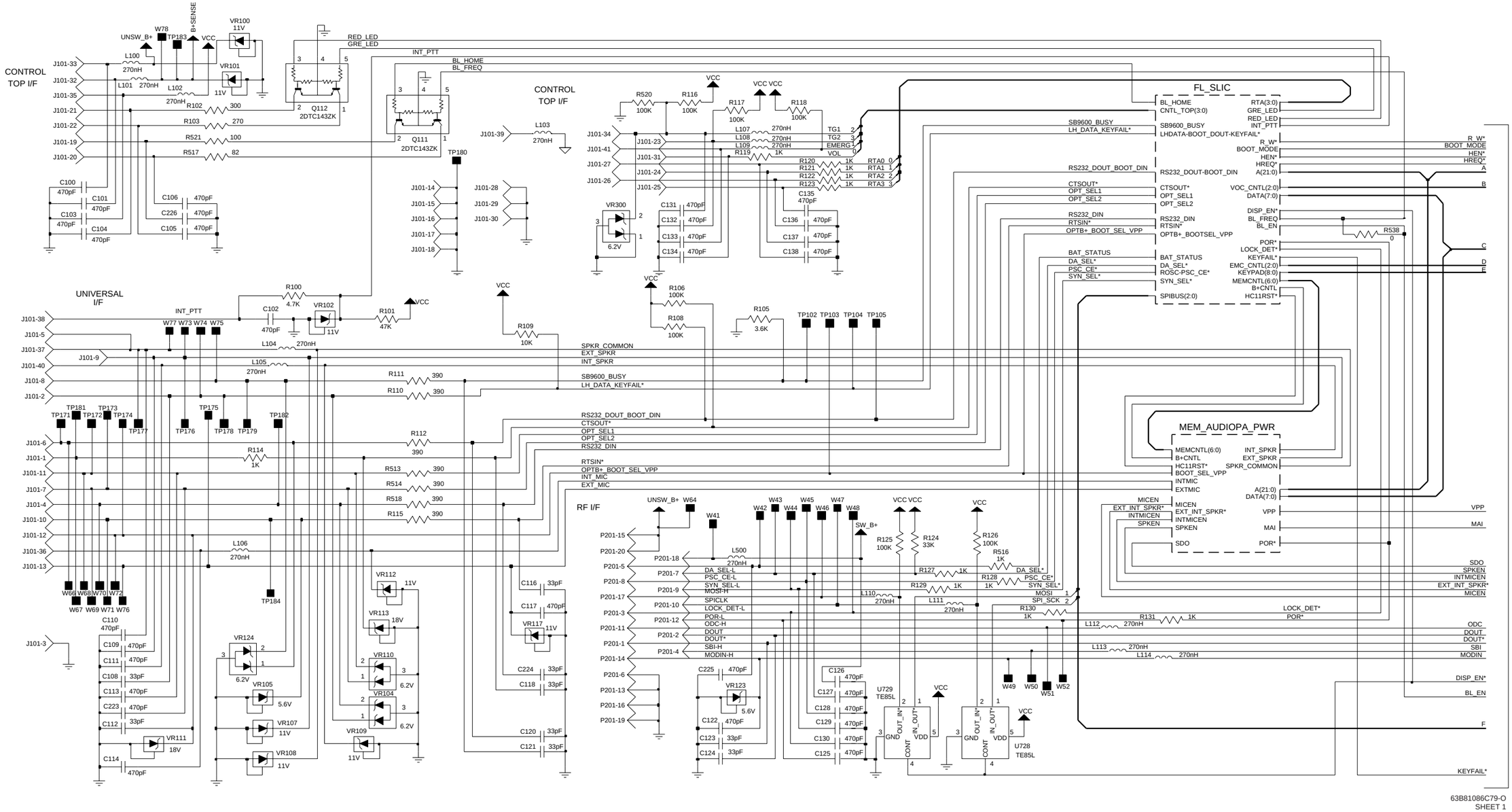
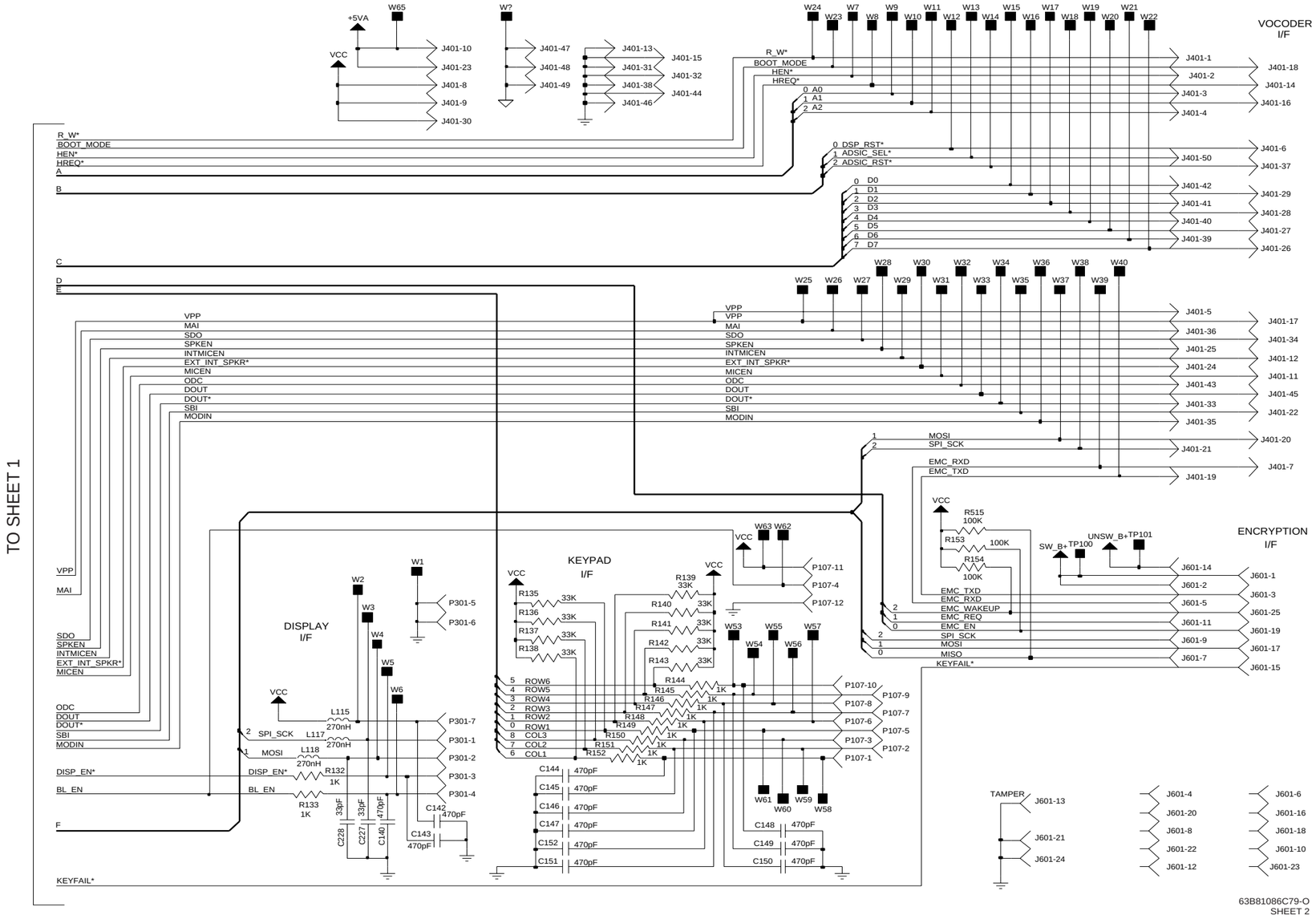
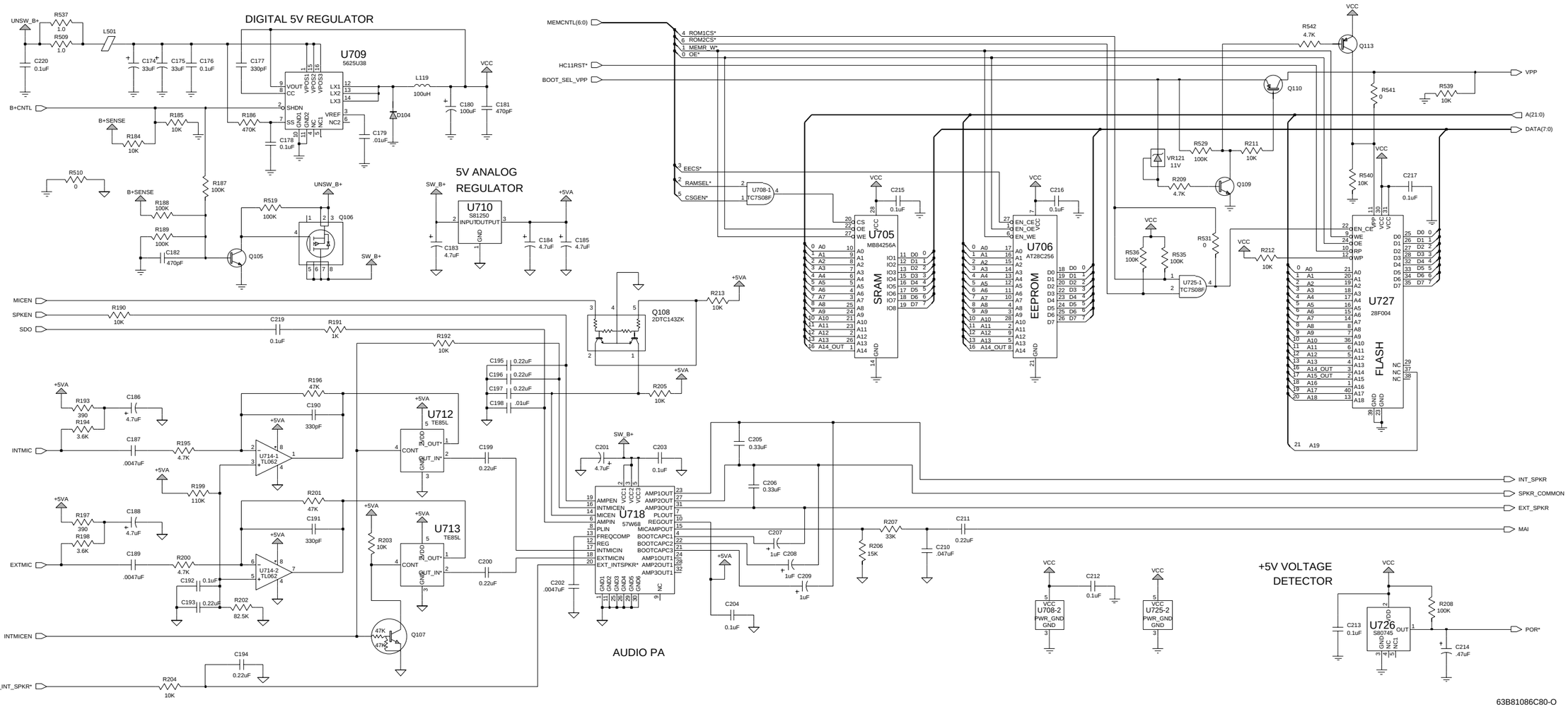


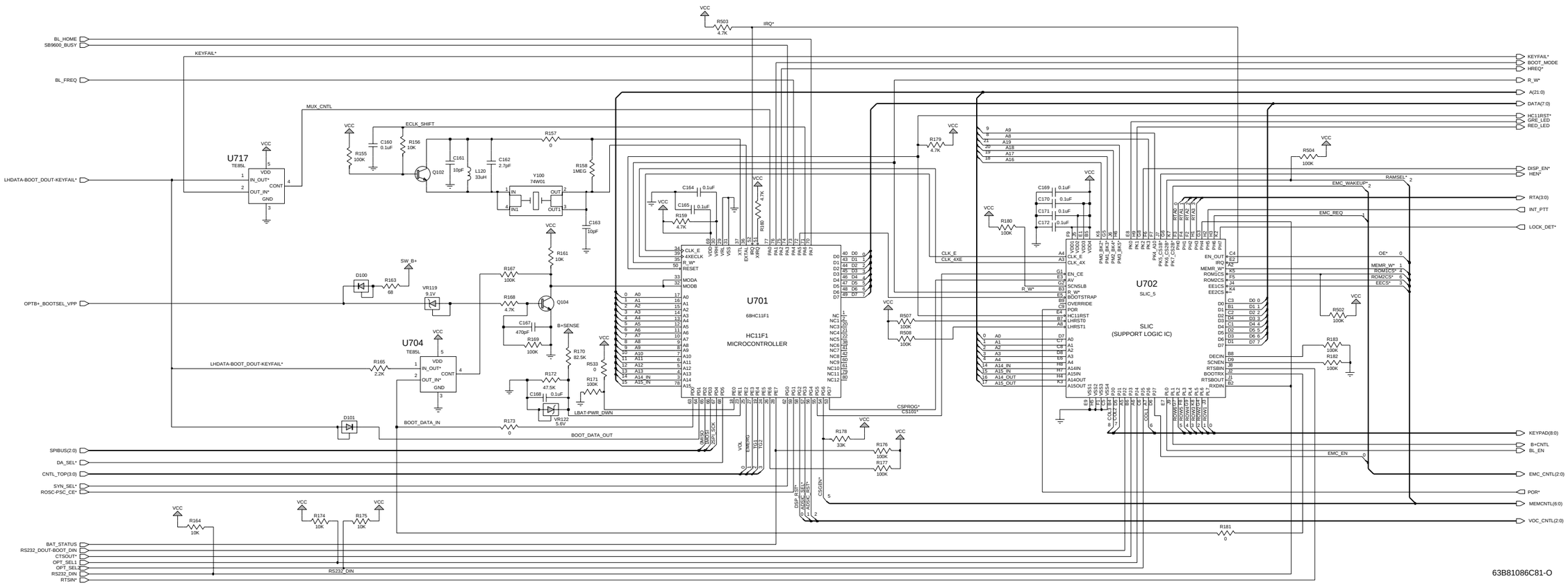
NCN6128B Controller Board Schematic Diagram, Sheet 1 of 4



NCN6128B Controller Board Schematic Diagram, Sheet 2 of 4

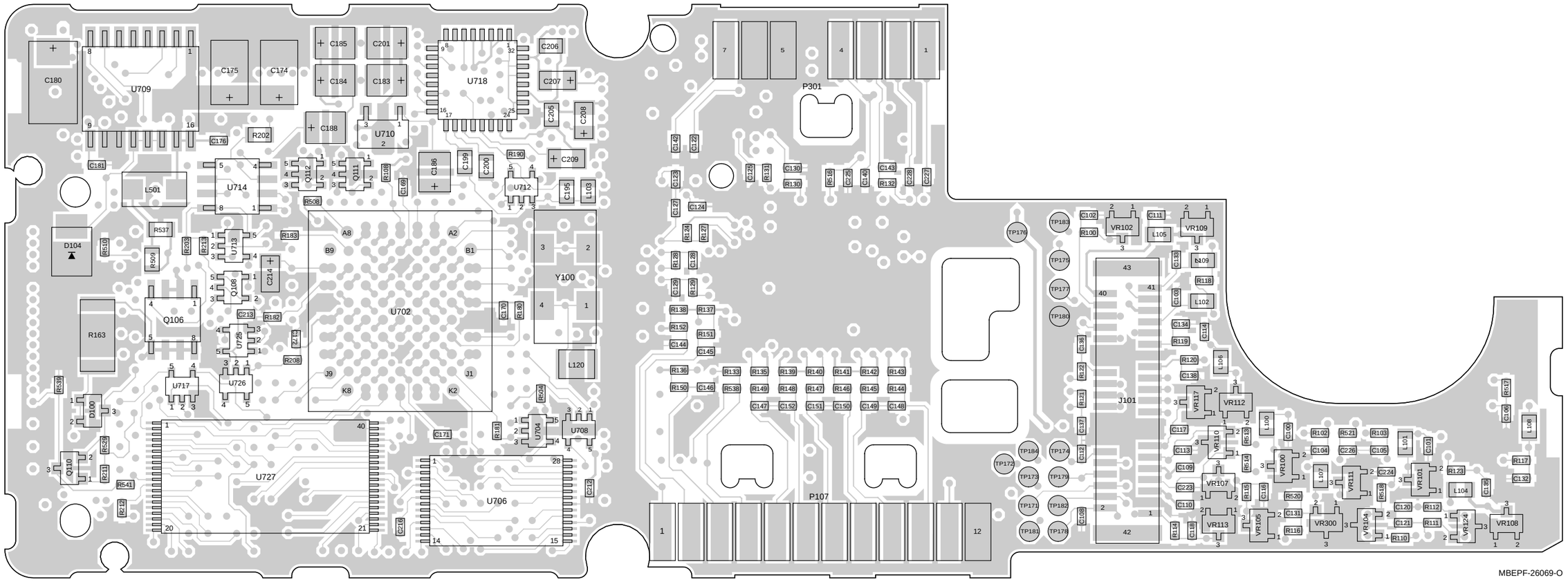


NCN6128B Controller Board Schematic Diagram, Sheet 3 of 4



NCN6128B Controller Board Schematic Diagram, Sheet 4 of 4

VIEWED FROM SIDE 1



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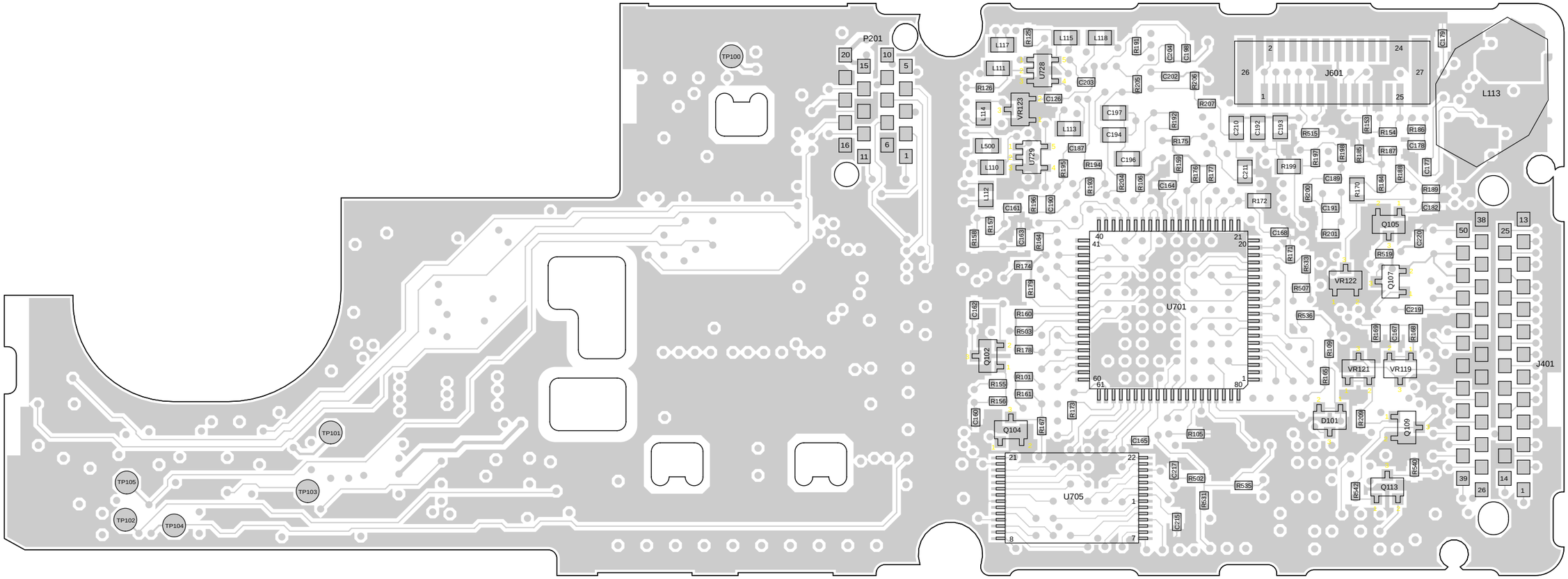
NCN6128B Controller Board Component Location Detail, Sheet 1 of 2

VIEWED FROM SIDE 2



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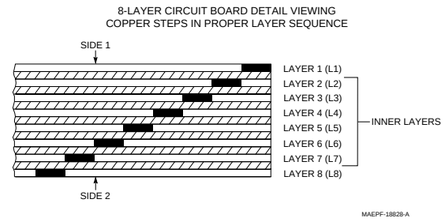
NCN6128B Controller Board Component Location Detail, Sheet 2 of 2

NCN6128B Controller Board Electrical Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: unless otherwise stated
C100 thru 106	2113931F17	470 pF
C108	2113930F39	33 pF
C109 thru 111	2113931F17	470 pF
C112	2113930F39	33 pF
C113, 114	2113931F17	470 pF
C116	2113930F39	33 pF
C117	2113931F17	470 pF
C118	2113930F39	33 pF
C120, 121	2113930F39	33 pF
C122	2113931F17	470 pF
C123, 124	2113930F39	33 pF
C125 thru 138	2113931F17	470 pF
C140	2113931F17	470 pF
C142 thru 152	2113931F17	470 pF
C160	2113932K15	.1 µF
C161	2113930F27	10 pF
C162	2113930F13	Not Placed
C163	2113930F27	10 pF
C164, 165	2113932K15	.1 µF
C167	2113931F17	470 pF
C168 thru 172	2113932K15	.1 µF
C174, 175	2311049A97	33 µF
C176	2113932K15	.1 µF
C177	2113931F13	330 pF
C178	2113932K15	.1 µF
C179	2113931F49	.01 µF
C180	2311049C07	100 µF
C181, 182	2113931F17	470 pF
C183 thru 186	2311049J12	4.7 µF
C187	2113931F41	4700 pF
C188	2311049J12	4.7 µF
C189	2113931F41	4700 pF
C190, 191	2113931F13	33 pF
C192	2113743A19	.1 µF
C193 thru 197	2113743A23	.22 µF
C198	2113931F49	.01 µF
C199, 200	2113743A23	.22 µF
C201	2311049J12	4.7 µF
C202	2113931F41	4700 pF
C203, 204	2113932K15	.1 µF
C205, 206	2113743F12	.33 µF
C207 thru 209	2311049A07	1 µF
C210	2113743A13	.047 µF
C211	2113743A23	.22 µF
C212, 213	2113932K15	.1 µF
C214	2311049A05	.47 µF
C215 thru 217	2113932K15	.1 µF
C219, 220	2113932K15	.1 µF
C223	2113931F17	470 pF
C224	2113930F39	33 pF
C225, 226	2113931F17	470 pF
C227, 288	2113930F39	33 pF
		DIODE: See Note 1.
D100	4884939C35	Hot Carrier, 4V
D101	4884939C35	Hot Carrier, 4V
D104	4813833B09	Schottky, 30V
		JACK:
J101	0913915A15	Controls Flex Assembly Connector
J601	0913915A11	Encryption Board Connector
		COIL, RF: unless otherwise stated
L100 thru 115	2462587Q40	270 nH
L117, 118	2462587Q40	270 nH
L119	2405528W04	100 uH
L120	2460578C43	33 uH
L500	2462587Q40	270 nH
L501	2405688Z01	Ferrite Bead
		TRANSISTOR: See Note 1.
Q102	4805128M12	NPN
Q104, 105	4805128M12	NPN
Q106	4805718V01	MOSFET Switch
Q107	4880048M01	NPN
Q108	4805921T09	Dual NPN
Q109	4805128M12	NPN
Q110	4805128M40	PNP
Q111, 112	4805921T09	Dual NPN
Q113	4805128M40	Not Placed
		RESISTOR:
R100	0662057A65	4.7K
R101	0662057A89	47K
R102	0662057A36	300
R103	0662057A35	270
R105	0662057A62	3.6K
R106	0662057A97	100K
R108	0662057A97	100K
R109	0662057A73	10K
R110 thru 112	0662057A39	390
R114	0662057A49	1K
R115	0662057A39	390
R116 thru 118	0662057A97	100K
R119 thru 123	0662057A49	1K
R124	0662057A85	33K
R125, 126	0662057A97	100K
R127 thru 133	0662057A49	1K
R135 thru 143	0662057A85	33K
R144 thru 152	0662057A49	1K
R153 thru 155	0662057A97	100K
R156	0662057A73	10K
R157	0662057B47	0
R158	0662057B22	1M
R159, 160	0662057A65	4.7K
R161	0662057A73	10K
R163	0683962T45	68
R164	0662057A73	10K
R165	0662057A57	2.2K
R167	0662057A97	100K
R168	0662057A65	4.7K
R169	0662057A97	100K
R170	0662057G08	82.5K
R171	0662057A97	100K
R172	0662057R92	47.5K
R173	0662057B47	0
R174, 175	0662057A73	10K
R176, 177	0662057A97	100K
R178	0662057A85	33K
R179	0662057A65	4.7K
R180	0662057A97	100K
R181	0662057B47	0
R182, 183	0662057A97	100K
R184, 185	0662057A73	10K
R186	0662057B14	470K
R187 thru 189	0662057A97	100K
R190	0662057A73	10K
R191	0662057A49	1K
R192	0662057A73	10K
R193	0662057A39	390
R194	0662057A62	3.6K
R195	0662057A65	4.7K
R196	0662057A89	47K
R197	0662057A39	390
R198	0662057A62	3.6K
R199	0662057G14	110K
R200	0662057A65	4.7K
R201	0662057A89	47K
R202	0662057G08	82.5K
R203 thru 205	0662057A73	10K
R206	0662057A77	15K
R207	0662057A85	33K
R208	0662057A97	100K
R209	0662057A65	4.7K
R211 thru 213	0662057A73	10K
R502	0662057A97	100K
R503	0662057A65	4.7K
R504	0662057A97	100K
R507, 208	0662057A97	100K
R509	0662057C03	1
R510	0662057B47	0
R513, 514	0662057A39	390
R515	0662057A97	100K
R516	0662057A49	1K
R517	0662057A23	82
R518	0662057A39	390
R519, 520	0662057A97	100K
R521	0662057A25	100
R529	0662057A97	100K
R531	0662057B47	Not Placed
R533	0662057B47	Not Placed
R535, 536	0662057A97	100K
R537	0662057C03	1
R538	0662057B47	Not Placed
R539	0662057A73	10K
R540	0662057A73	Not Placed
R541	0662057B47	0
R542	0662057A65	Not Placed
		INTEGRATED CIRCUIT MODULE: See Note 1.
U701	5113802A33	HC11F1 MCU (QFP)
U702	5105457W33	SLIC 5 (OMPAC)
U704	5105750U28	CMOS Switch (MUX)
U705	5105662U54	32K X 8 SRAM
U706	5105625U33	32K X 8 EEPROM
U708	5105279V65	AND GATE
U709	5105625U38	5V Digital Switching Regulator
U710	5105625U41	5V Analog Regulator
U712, 713	5105750U28	CMOS Switch (MUX)
U714	5105364W01	DUAL OP-AMP
U717	5105750U28	CMOS Switch (MUX)
U718	5105457W68	AUDIO PA (QFP)
U725	5105279V65	AND GATE
U726	5105492X73	4.2V Voltage Detector
U727	5105109Z25	1M X 8 FLASH ROM
U728, 729	5105750U28	CMOS Switch (MUX)
		DIODE: See Note 1.
VR100 thru 102	4813830A24	Zener, 11V
VR104	4805117Y01	Dual Zener, 6.2V
VR105	4813830A15	Zener, 5.6V
VR107 thru 109	4813830A24	Zener, 11V
VR110	4805117Y01	Dual Zener, 6.2V
VR111	4813830A31	Zener, 18V
VR112	4813830A24	Zener, 11V
VR113	4813830A31	Zener, 18V
VR117	4813830A24	Zener, 11V
VR119	4813830A22	Zener, 9.1V
VR121	4813830A24	Zener, 11V
VR122, 123	4813830A15	Zener, 5.6V
VR124	4805117Y01	Dual Zener, 6.2V
VR300	4805117Y01	Dual Zener, 6.2V
		CRYSTAL: See Note 2
Y100	4805574W01	7.3728 MHz CRYSTAL
		MISCELLANEOUS:
	8405259Z03	PC Board

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. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NCN6128 Controller Kit uses an 8-layer printed circuit board.



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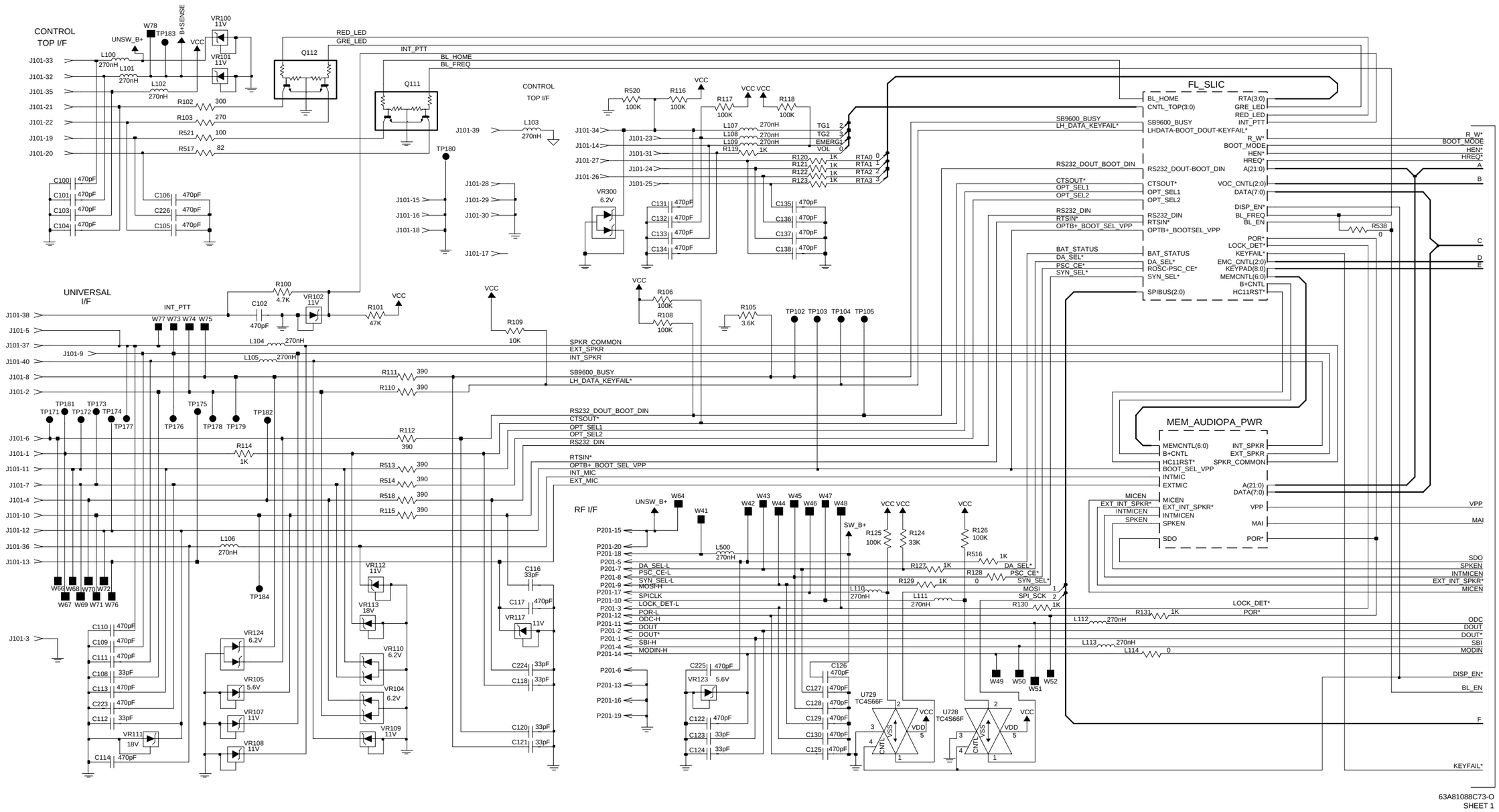
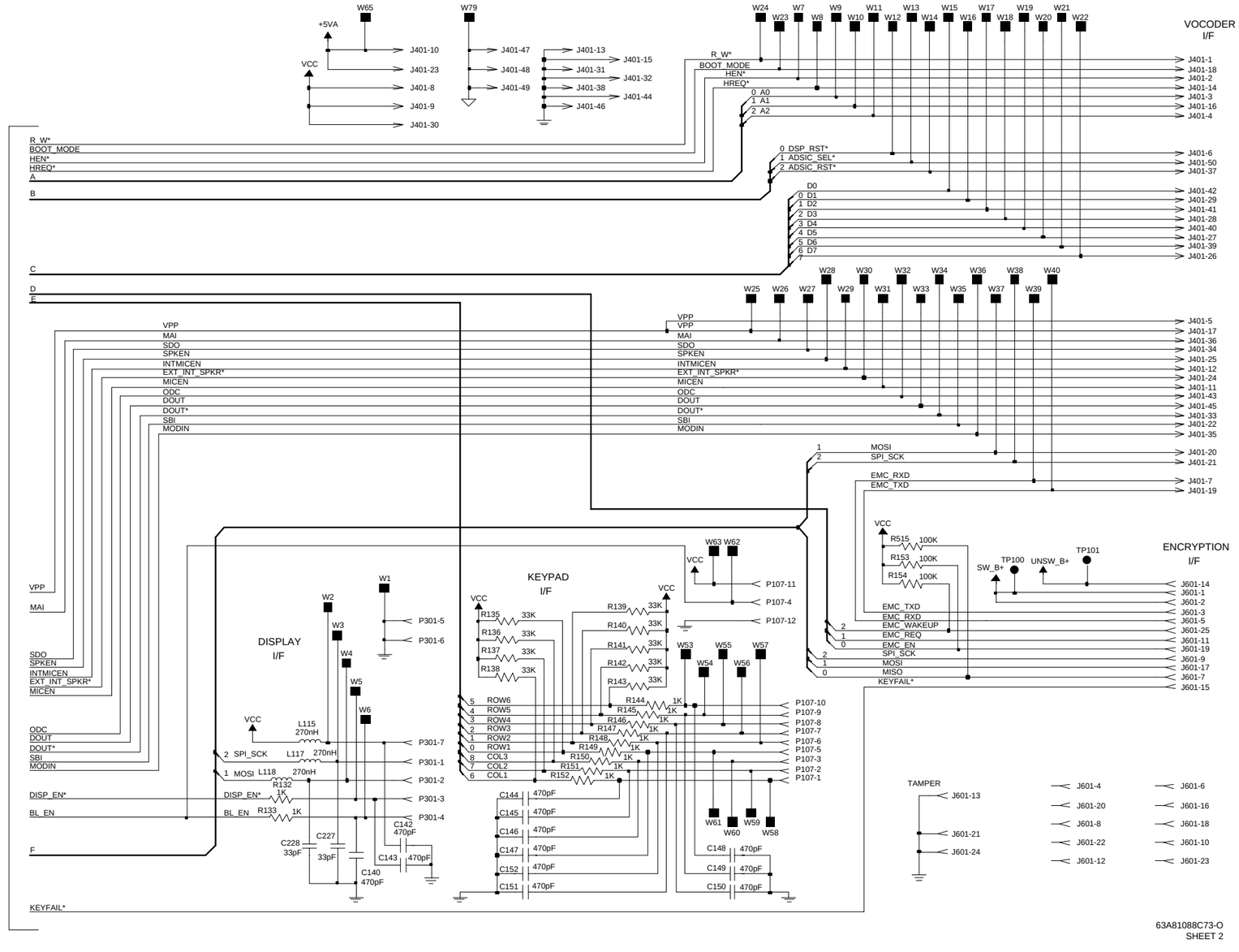
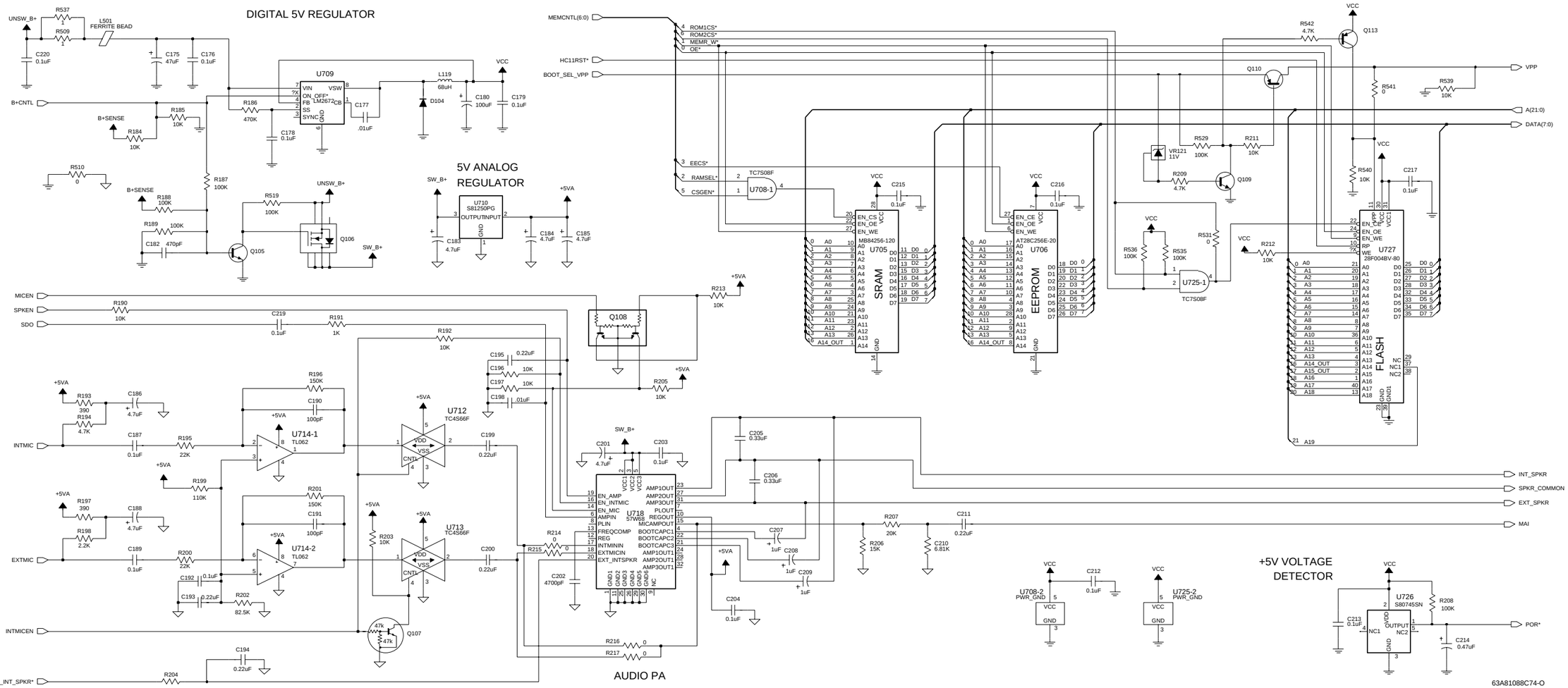


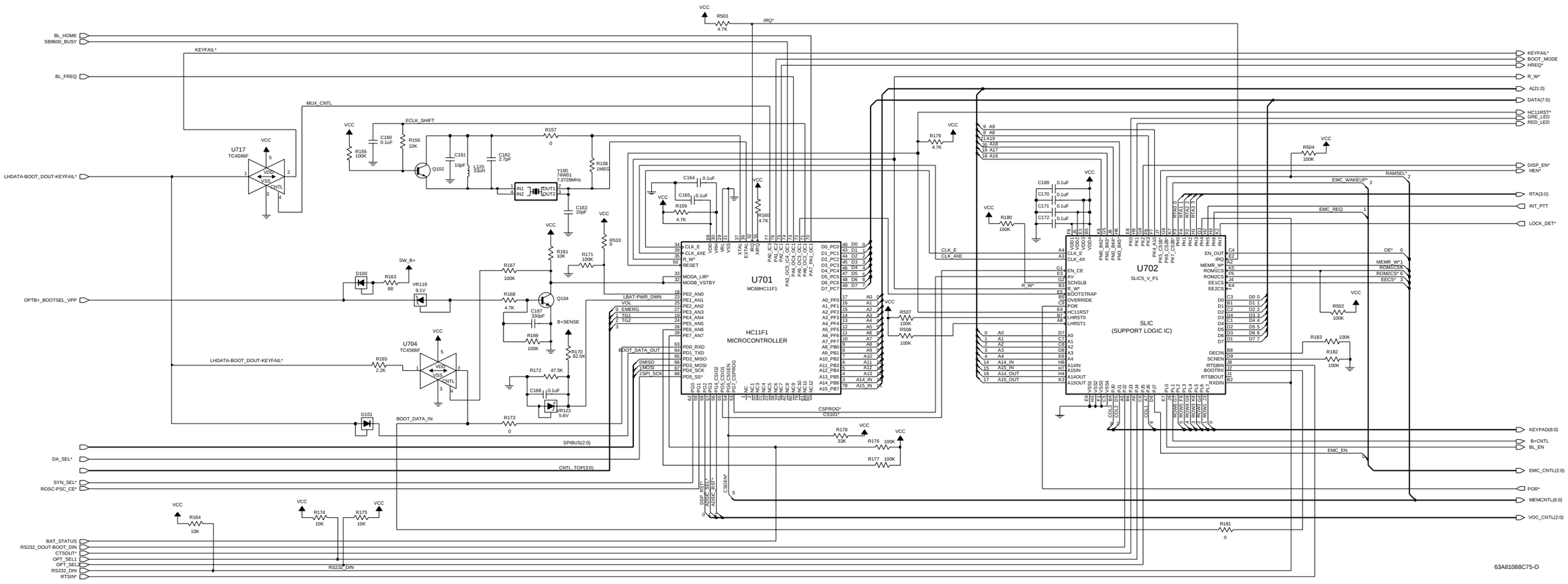
NCN6167A Controller Board Schematic Diagram, Sheet 1 of 4



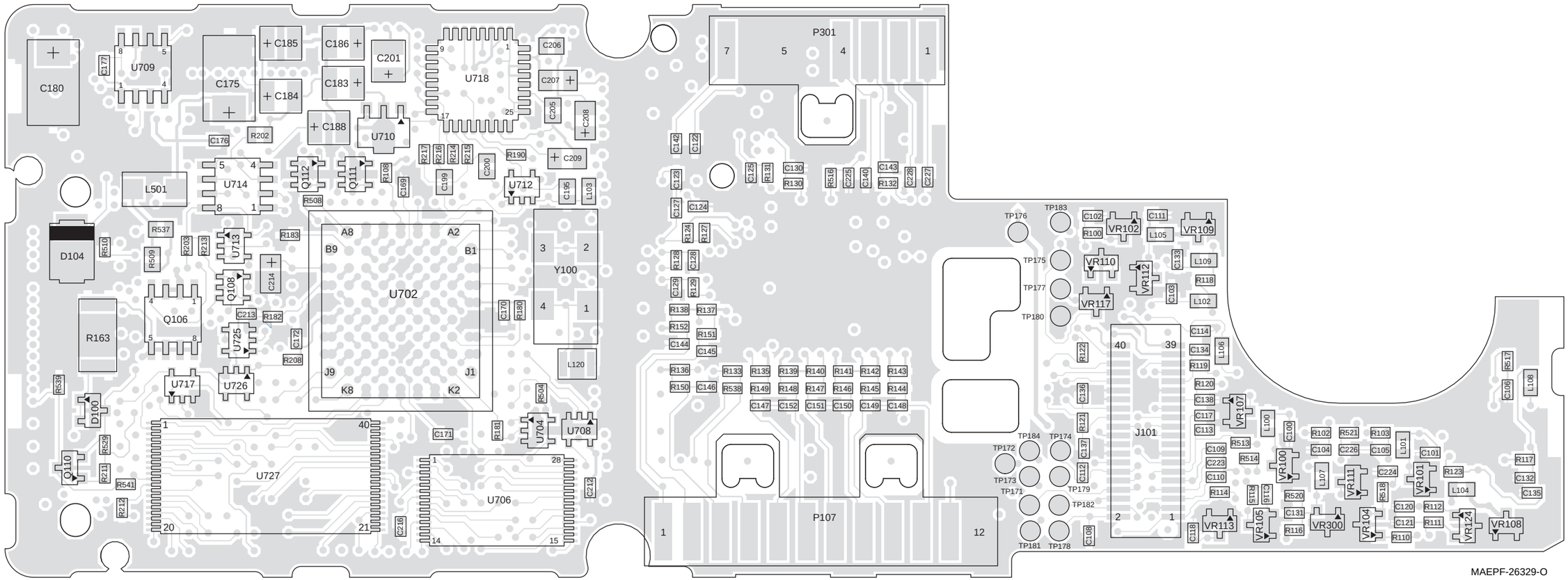
NCN6167A Controller Board Schematic Diagram, Sheet 2 of 4



NCN6167A Controller Board Schematic Diagram, Sheet 3 of 4


BL_HOME
SB9600_BUSY
KEYFAIL*
BL_FREQ
MUX_CNTL
LHDATA-BOOT_DOUT-KEYFAIL*
OPTB+_BOOTSEL_VPP
DA_SEL*
SYN_SEL*
ROSC-FSC_CE*
BAT_STATUS
RS232_DOUT-BOOT_DIN
CTSOUT*
OPT_SEL1
OPT_SEL2
RS232_DIN
RTSIN*
U717
TC4S66F
U704
TC4S66F
ECLK_SHIFT
SW_B+
B+SENSE
LBAT-PWR_DWN
BOOT_DATA_OUT
BOOT_DATA_IN
SPIBUS(2:0)
CNTL_TOP(3:0)
U701
MC68HC11F1
HC11F1
MICROCONTROLLER
U702
SLIC5_V_P1
SLIC
(SUPPORT LOGIC IC)
IRQ*
CLK_E
CLK_4XE
R_W*
CSPROG*
CS101*
CSSEL*
EMC_WAKEUP*
EMC_REQ
RAMSEL*
EMC_EN
KEYFAIL*
BOOT_MODE
HREQ*
R_W*
A(21:0)
DATA(7:0)
HC11RST*
GRE_LED
RED_LED
DISP_EN*
HEN*
RTA(3:0)
INT_PTT
LOCK_DET*
KEYPAD(8:0)
B+CNTL
BL_EN
EMC_CNTL(2:0)
POR*
MEMCNTL(6:0)
VOC_CNTL(2:0)
63A81088C75-O

VIEWED FROM SIDE 1



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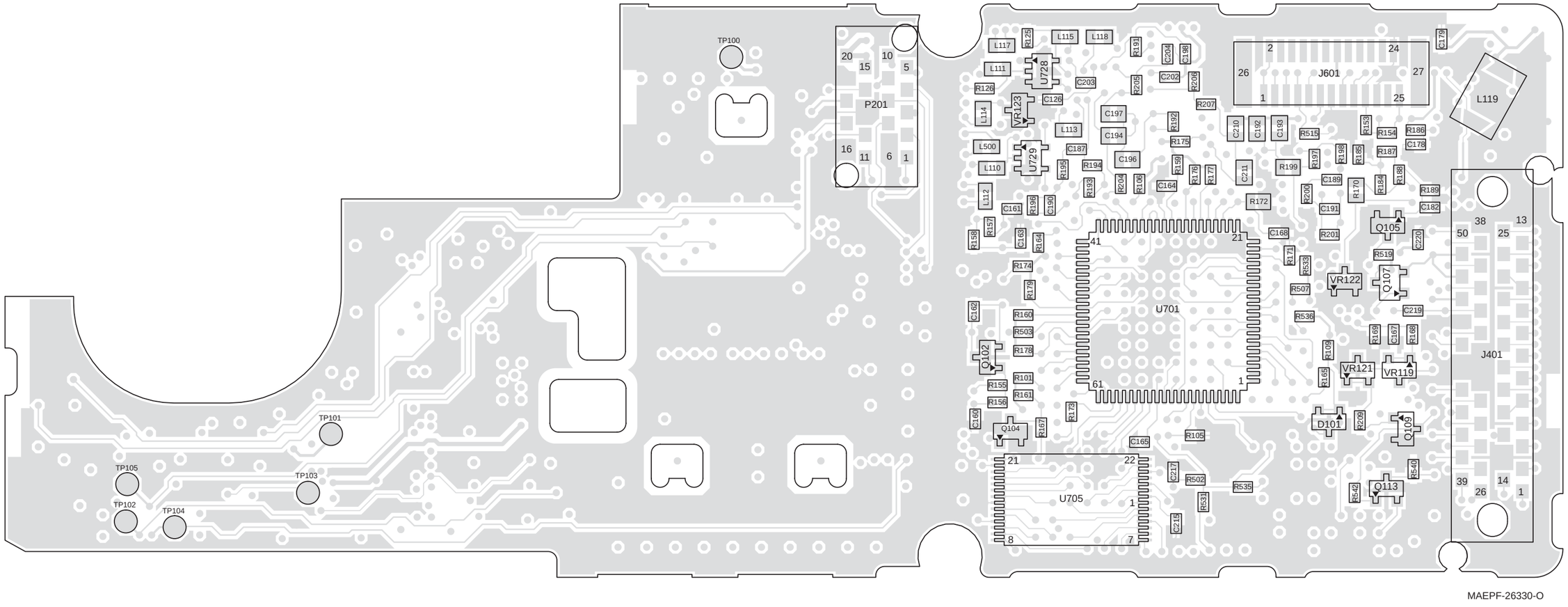
NCN6167A Controller Board Component Location Detail, Sheet 1 of 2

VIEWED FROM SIDE 2



MAEPF-26330-O

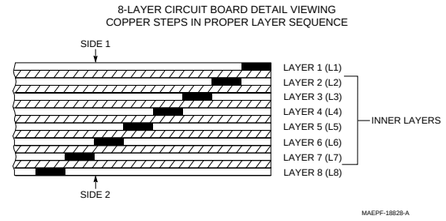
NCN6167A Controller Board Component Location Detail, Sheet 2 of 2

NCN6167A Controller Board Electrical Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: unless otherwise stated
C100 thru 106	2113931F17	470 pF
C108	2113930F39	33 pF
C109 thru 111	2113931F17	470 pF
C112	2113930F39	33 pF
C113, 114	2113931F17	470 pF
C116	2113930F39	33 pF
C117	2113931F17	470 pF
C118	2113930F39	33 pF
C120, 121	2113930F39	33 pF
C122	2113931F17	470 pF
C123, 124	2113930F39	33 pF
C125 thru 138	2113931F17	470 pF
C140	2113931F17	470 pF
C142 thru 152	2113931F17	470 pF
C160	2113932K15	0.1 µF
C161	2113930F27	10 pF
C162	- - - - - - - - -	Not Placed
C163	2113930F27	10 pF
C164, 165	2113932K15	0.1 µF
C167	2113931F17	470 pF
C168 thru 172	2113932K15	0.1 µF
C175	2311049C05	47 µF
C176	2113932K15	0.1 µF
C177	2113931F49	.01 µF
C178, 179	2113932K15	0.1 µF
C180	2311049C07	100 µF
C182	2113931F17	470 pF
C183 thru 186	2311049J12	4.7 µF
C187	2113743E20	0.1 µF
C188	2311049J12	4.7 µF
C189	2113743E20	0.1 µF
C190, 191	2113930F51	100 pF
C192	2113743A19	0.1 µF
C193 thru 195	2113743A23	.22 µF
C196, 197	0662057R60	Resistor, 10k Ω
C198	2113931F49	.01 µF
C199, 200	2113743A23	.22 µF
C201	2311049J12	4.7 µF
C202	2113931F41	4700 pF
C203, 204	2113932K15	0.1 µF
C205, 206	2113743F12	.33 µF
C207 thru 209	2311049A07	1 µF
C210	2113743A13	.047 µF
C211	2113743A23	.22 µF
C212, 213	2113932K15	0.1 µF
C214	2311049A05	.47 µF
C215 thru 217	2113932K15	0.1 µF
C219	2113932K15	0.1 µF
C220	0662057R54	Resistor, 6.8kΩ
C223	2113931F17	470 pF
C224	2113930F39	33 pF
C225, 226	2113931F17	470 pF
C227, 288	2113930F39	33 pF
		DIODE: See Note 1.
D100	4884939C35	Hot Carrier, 4V
D101	4884939C35	Hot Carrier, 4V
D104	4813833B09	Schottky, 30V
		JACK:
J101	0980423L02	Controls Flex Assembly Connector
J601	0913915A11	Encryption Board Connector
		COIL, RF: unless otherwise stated
L100 thru 113	2462587Q40	270 nH
L114	0662057C01	Resistor, 0Ω
L115	2462587Q40	270 nH
L117, 118	2462587Q40	270 nH
L119	2485853A01	68 uH
L120	2460578C43	33 uH
L500	2462587Q40	270 nH
L501	2405688Z01	Ferrite Bead
		TRANSISTOR: See Note 1.
Q102	4805128M12	NPN
Q104, 105	4805128M12	NPN
Q106	4805718V01	MOSFET Switch
Q107	4880048M01	NPN
Q108	- - - - - - - - -	Not Placed
Q109	4805128M12	NPN
Q110	4805128M40	PNP
Q111, 112	4805921T09	Dual NPN
Q113	- - - - - - - - -	Not Placed
		RESISTOR:
R100	0662057A65	4.7k
R101	0662057A89	47k
R102	0662057A36	300
R103	0662057A35	270
R105	0662057A62	3.6k
R106	0662057A97	100k
R108	0662057A97	100k
R109	0662057A73	10k
R110 thru 112	0662057A39	390
R114	0662057A49	1k
R115	0662057A39	390
R116 thru 118	0662057A97	100k
R119 thru 123	0662057A49	1k
R124	0662057A85	33k
R125, 126	0662057A97	100k
R127	0662057A49	1k
R128	0662057B47	0
R129 thru 133	0662057A49	1k
R135 thru 143	0662057A85	33k
R144 thru 152	0662057A49	1k
R153 thru 155	0662057A97	100k
R156	0662057A73	10k
R157	0662057B47	0
R158	0662057B22	1M
R159, 160	0662057A65	4.7k
R161	0662057A73	10k
R163	0683962T45	68
R164	0662057A73	10k
R165	0662057A57	2.2k
R167	0662057A97	100k
R168	0662057A65	4.7k
R169	0662057A97	100k
R170	0662057G08	82.5k
R171	0662057A97	100k
R172	0662057R92	47.5k
R173	0662057B47	0
R174, 175	0662057A73	10k
R176, 177	0662057A97	100k
R178	0662057A85	33k
R179	0662057A65	4.7k
R180	0662057A97	100k
R181	0662057B47	0
R182, 183	0662057A97	100k
R184, 185	0662057A73	10k
R186	0662057B14	470k
R187 thru 189	0662057A97	100k
R190	0662057A73	10k
R191	0662057A49	1k
R192	- - - - - - - - -	Not Placed
R193	0662057A39	390
R194	0662057A65	4.7k
R195	0662057A81	22k
R196	0662057B02	150k
R197	0662057A39	390
R198	0662057A57	2.2k
R199	0662057G14	110k
R200	0662057A81	22k
R201	0662057B02	150k
R202	0662057G08	82.5k
R203 thru 204	0662057A73	10k
R205, 206	- - - - - - - - -	Not Placed
R207	0662057A80	20k
R208	0662057A97	100k
R209	0662057A65	4.7k
R211 thru 212	0662057A73	10k
R213	- - - - - - - - -	Not Placed
R214, 215	0662057B47	0
R216, 217	- - - - - - - - -	Not Placed
R502	0662057A97	100k
R503	0662057A65	4.7k
R504	0662057A97	100k
R507, 208	0662057A97	100k
R509	0662057C03	1
R510	0662057B47	0
R513, 514	0662057A39	390
R515	0662057A97	100k
R516	0662057A49	1k
R517	0662057A23	82
R518	0662057A39	390
R519, 520	0662057A97	100k
R521	0662057A25	100
R529	0662057A97	100k
R531	- - - - - - - - -	Not Placed
R533	- - - - - - - - -	Not Placed
R535, 536	0662057A97	100k
R537	0662057C03	1
R538	- - - - - - - - -	Not Placed
R539	0662057A73	10k
R540	- - - - - - - - -	Not Placed
R541	0662057B47	0
R542	- - - - - - - - -	Not Placed
		INTEGRATED CIRCUIT MODULE: See Note 1.
U701	5113802A33	HC11F1 MCU (QFP)
U702	5105835U80	SLIC 5 (OMPAC)
U704	5105750U28	CMOS Switch (MUX)
U705	5185963A21	32k X 8 SRAM
U706	5105109Z72	32k X 8 EEPROM
U708	5105279V65	AND GATE
U709	5105109Z36	5V Digital Switching Regulator
U710	5105625U41	5V Analog Regulator
U712, 713	5105750U28	CMOS Switch (MUX)
U714	5105364W01	DUAL OP-AMP
U717	5105750U28	CMOS Switch (MUX)
U718	5105457W68	AUDIO PA (QFP)
U725	5105279V65	AND GATE
U726	5105492X73	4.2V Voltage Detector
U727	5105109Z25	1M X 8 FLASH ROM
U728, 729	5105750U28	CMOS Switch (MUX)
		DIODE: See Note 1.
VR100 thru 102	4813830A24	Zener, 11V
VR104	4805117Y01	Dual Zener, 6.2V
VR105	4813830A15	Zener, 5.6V
VR107 thru 109	4813830A24	Zener, 11V
VR110	4805117Y01	Dual Zener, 6.2V
VR111	4813830A31	Zener, 18V
VR112	4813830A24	Zener, 11V
VR113	4813830A31	Zener, 18V
VR117	4813830A24	Zener, 11V
VR119	4813830A22	Zener, 9.1V
VR121	4813830A24	Zener, 11V
VR122, 123	4813830A15	Zener, 5.6V
VR124	4805117Y01	Dual Zener, 6.2V
VR300	4805117Y01	Dual Zener, 6.2V
		CRYSTAL: See Note 2
Y100	4805574W01	7.3728 MHz CRYSTAL
		MISCELLANEOUS:
	8405259Z05	PC Board

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. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NCN6167 Controller Bd Kit uses an 8-layer printed circuit board.



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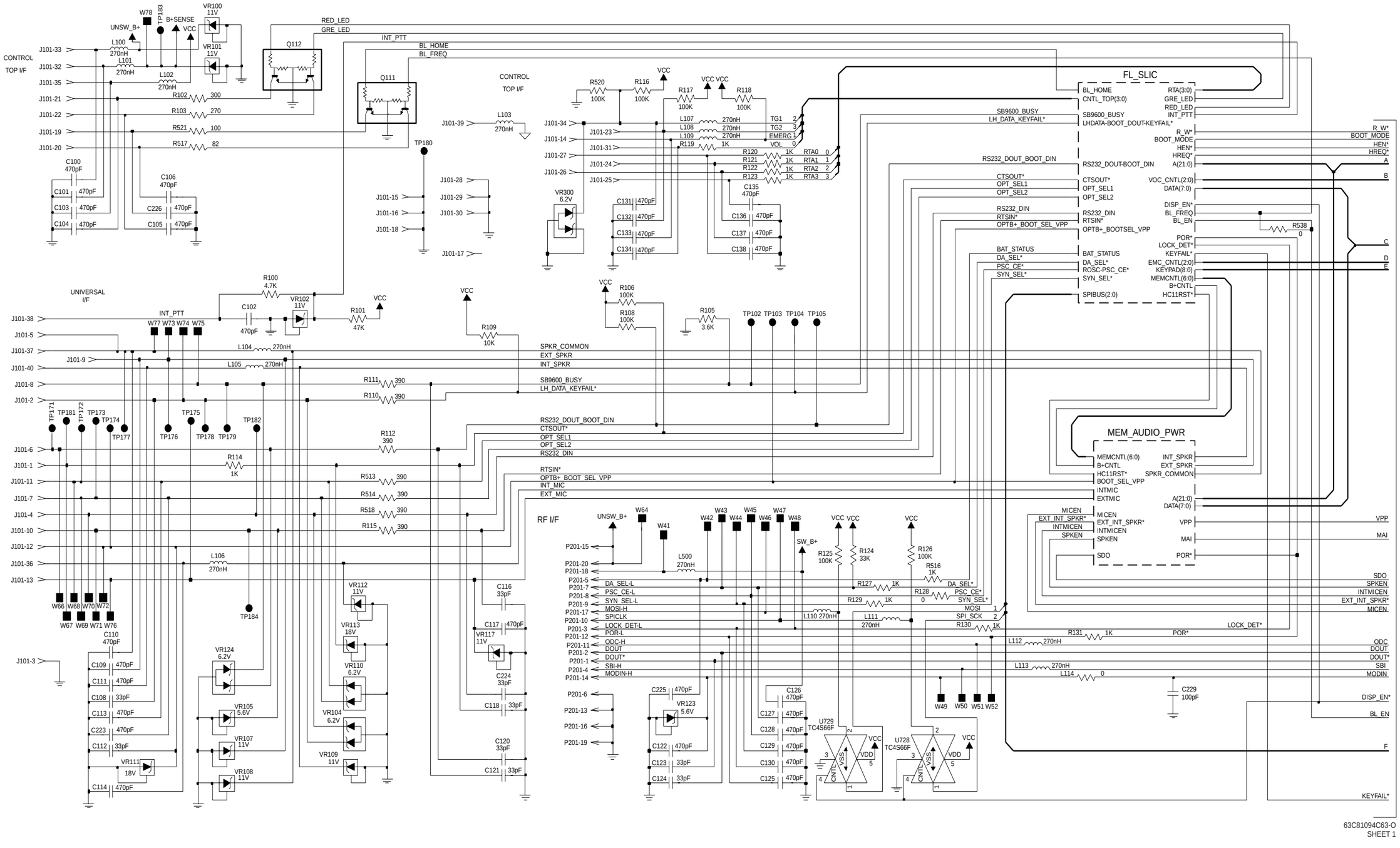
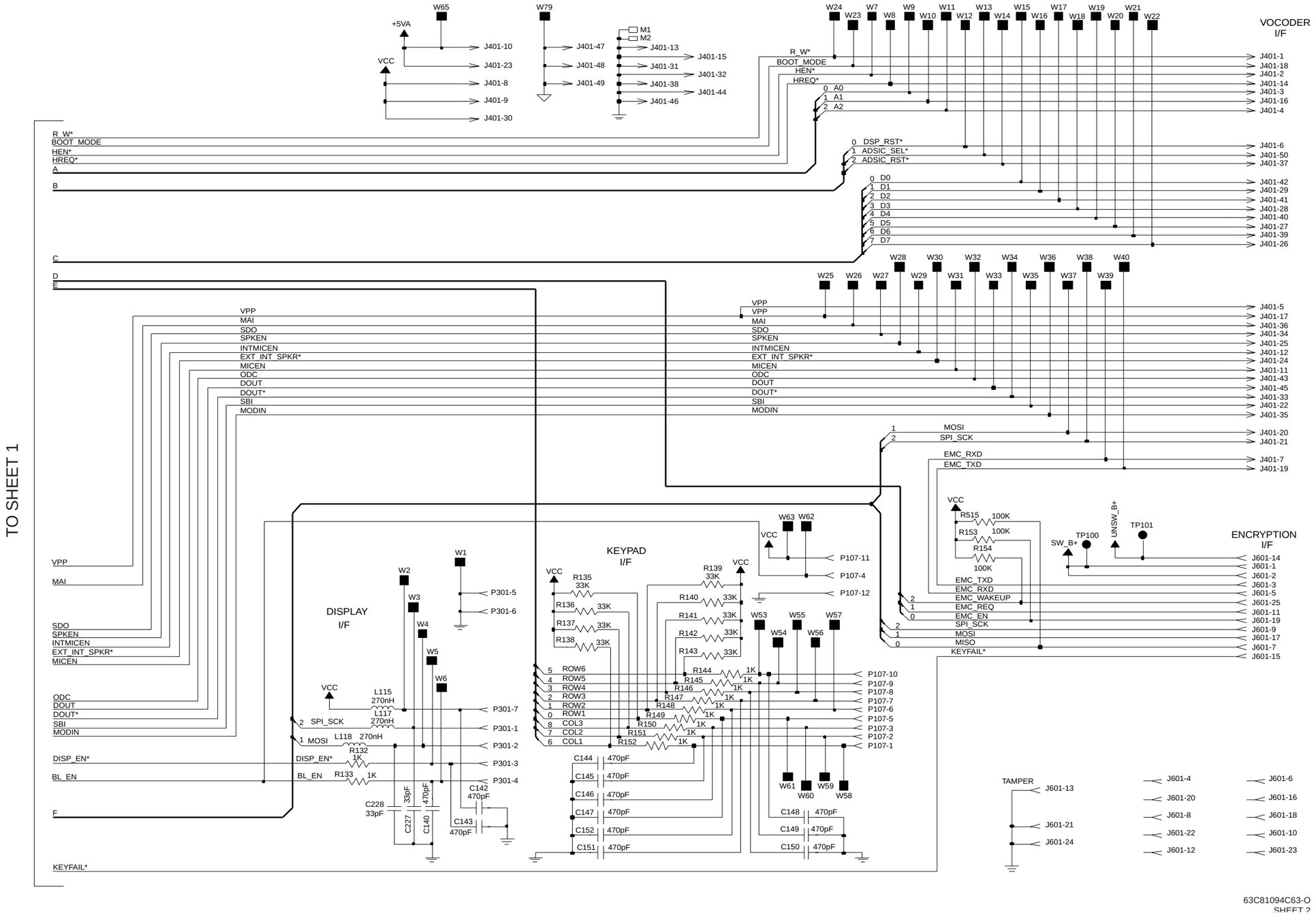
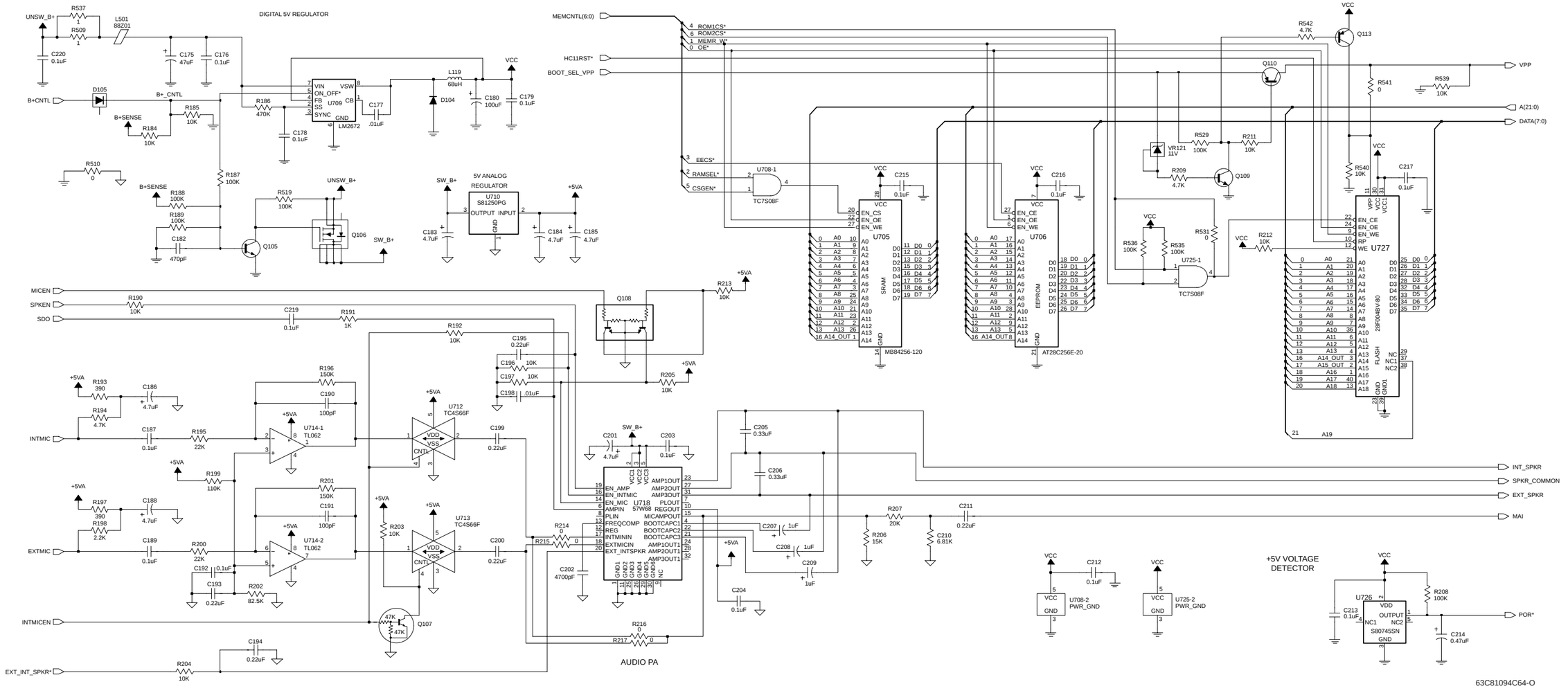


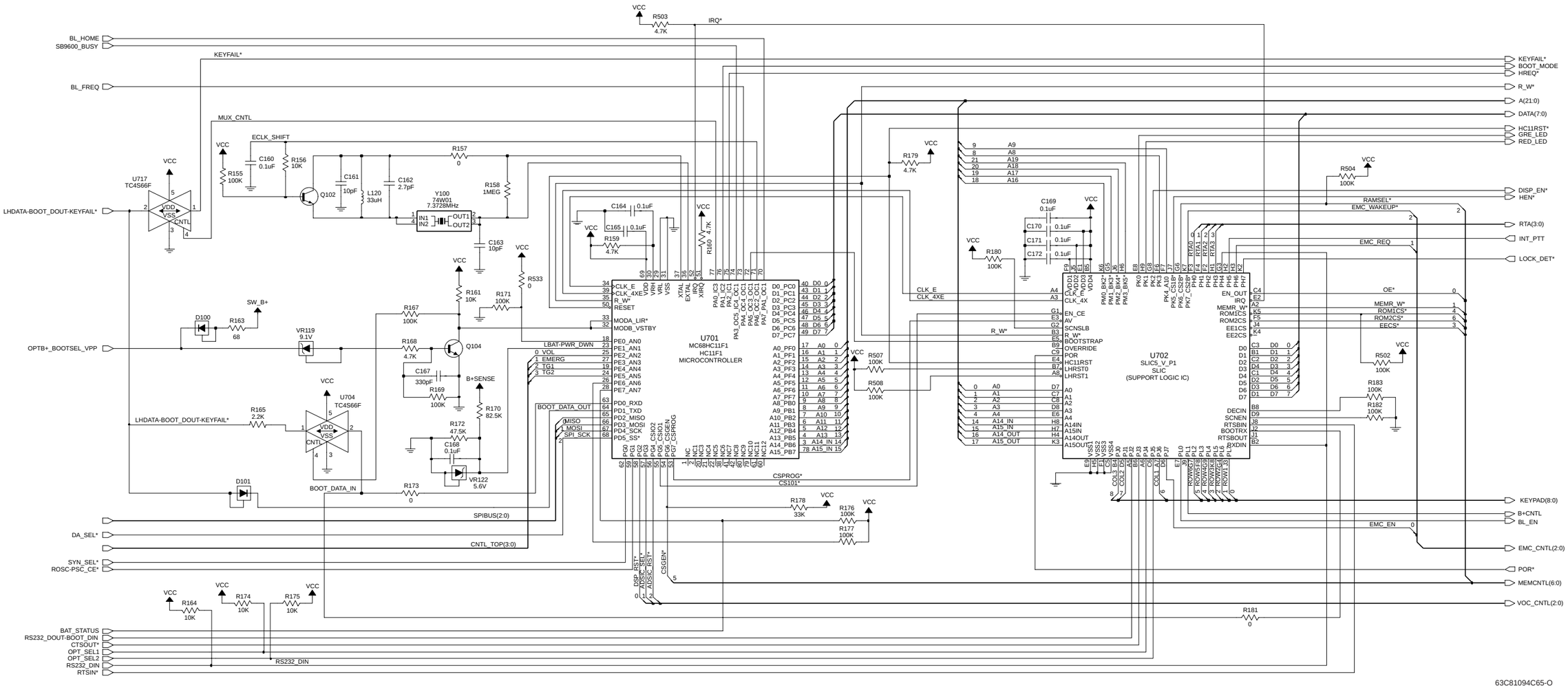
NCN6167C Controller Board Schematic Diagram, Sheet 1 of 4



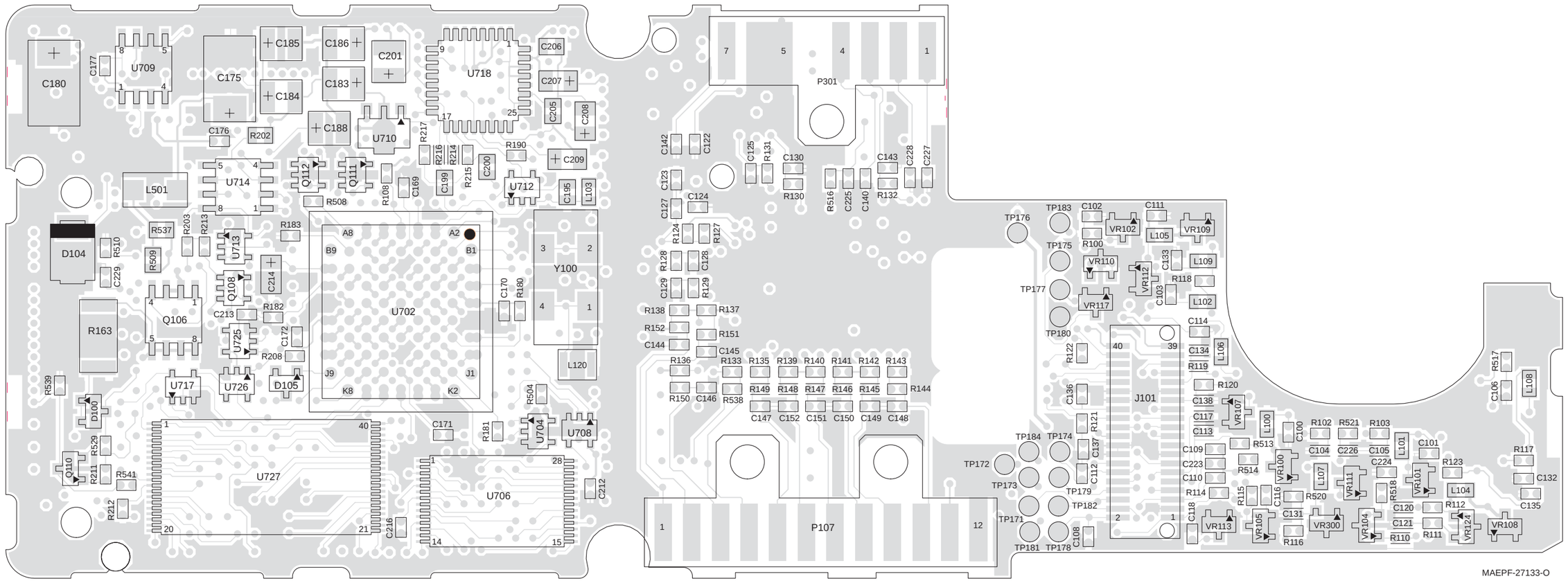
NCN6167C Controller Board Schematic Diagram, Sheet 2 of 4



NCN6167C Controller Board Schematic Diagram, Sheet 3 of 4


BL_HOME
SB9600_BUSY
KEYFAIL*
BL_FREQ
MUX_CNTL
ECLK_SHIFT
LHDATA-BOOT_DOUT-KEYFAIL*
OPTB+_BOOTSEL_VPP
LHDATA-BOOT_DOUT-KEYFAIL*
BOOT_DATA_IN
SPIBUS(2:0)
DA_SEL*
CNTL_TOP(3:0)
SYN_SEL*
ROSC-PSC_CE*
BAT_STATUS
RS232_DOUT-BOOT_DIN
CTSOUT*
OPT_SEL1
OPT_SEL2
RS232_DIN
RTSIN*
RS232_DIN
IRQ*
CSPROG*
CS101*
CLK_E
CLK_4XE
R_W*
LBAT-PWR_DWN
SW_B+
B+SENSE
U701
MC68HC11F1
HIGH PERFORMANCE
MICROCONTROLLER
U702
SLICS_V_P1
SLIC
(SUPPORT LOGIC IC)
U704
TC4S66F
U717
TC4S66F
Y100
74W01
7.3728MHz
VR119
9.1V
VR122
5.6V
D100
D101
Q102
Q104
KEYFAIL*
BOOT_MODE
HREQ*
R_W*
A(21:0)
DATA(7:0)
HC11RST*
GRE_LED
RED_LED
DISP_EN*
HEN*
RTA(3:0)
INT_PTT
LOCK_DET*
OE*
MEMR_W*
ROM1CS*
ROM2CS*
EECS*
KEYPAD(8:0)
B+CNTL
BL_EN
EMC_CNTL(2:0)
POR*
MEMCNTL(6:0)
VOC_CNTL(2:0)
RAMSEL*
EMC_WAKEUP*
EMC_REQ
EMC_EN
63C81094C65-O

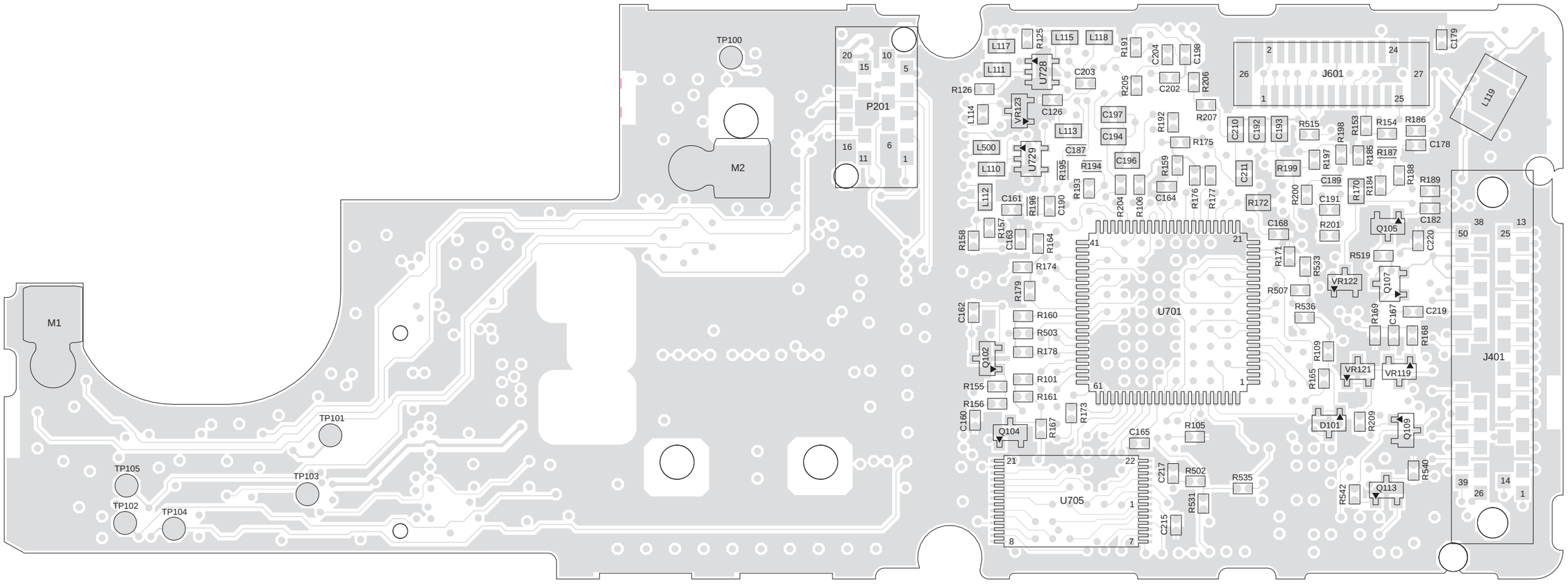
VIEWED FROM SIDE 1



MAEPF-27133-O

NCN6167C Controller Board Component Location Detail, Sheet 1 of 2

VIEWED FROM SIDE 2



MAEPF-27134-O

NCN6167C Controller Board Component Location Detail, Sheet 2 of 2

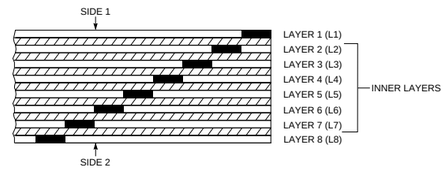
NCN6167C Controller Board Electrical Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 50V unless otherwise stated
C100 thru C106	2113931F17	470
C108	2113930F39	33
C109 thru C111	2113931F17	470
C112	2113930F39	33
C113, C114	2113931F17	470
C116	2113930F39	33
C117	2113931F17	470
C118	2113930F39	33
C120, C121	2113930F39	33
C122	2113931F17	470
C123, C124	2113930F39	33
C125 thru C138	2113931F17	470
C140	2113931F17	470
C142, C152	2113931F17	470
C160	2113932K15	0.1 µF +80/-20% 16V
C161	2113930F31	15
C162	----------	Not Placed
C163	2113930F31	15
C164, C165	2113932K15	0.1 µF +80/-20% 16V
C167	2113931F17	470
C168 thru C172	2113932K15	0.1 µF +80/-20% 16V
C175	2311049C05	47 µF
C176	2113932K15	0.1 µF +80/-20% 16V
C177	2113931F49	10 nF
C178	----------	Not Placed
C179	2113932K15	0.1 µF +80/-20% 16V
C180	2311049C07	100 µF 10V 10%
C182	2113931F17	470
C183 thru C186	2311049J12	4.7 µF
C187	2113932E20	0.1 µF 10% 16V
C188	2311049J12	4.7 µF
C189	2113932E20	0.1 µF 10% 16V
C190, C191	2113930F51	100
C191	2113930F51	100
C192	2113743A19	0.1 µF
C193, C195	2113743A23	0.22 µF
C196, C197	0662057R60	10k
C198	2113931F49	10 nF
C199, C200	2113743A23	0.22 µF
C201	2311049J12	4.7 µF
C202	2113931F41	4.7 nF
C203, C204	2113932K15	0.1 µF +80/-20% 16V
C205, C206	2113743F12	0.33 µF
C207 thru C209	2311049A07	1 µF
C210	0662057R54	6.81k
C211	2113743A23	0.22 µF
C212, C213	2113932K15	0.1 µF +80/-20% 16V
C214	2311049A05	0.47 µF
C215, C217	2113932K15	0.1 µF +80/-20% 16V
C219, C220	2113932K15	0.1 µF +80/-20% 16V
C223	2113931F17	470
C224	2113930F39	33
C225, C226	2113931F17	470
C227, C228	2113930F39	33
C229	2113931F17	470
		DIODE: See Note 1
D100, D101	4884939C35	Hot Carrier, 4V
D104	4813833B09	Schottky, 30V
D105	4884939C35	Hot Carrier, 4V
		JACK:
J101	0980423L02	Controls Flex Assembly Connector
J401	----------	Not Placed
J601	0913915A11	Encryption Board Connector
		COIL, RF: unless otherwise stated
L100 thru L115	2462587Q40	270 nH
L117, L118	2462587Q40	270 nH
L119	2485853A01	68 µH
L120	2460578C43	33 µH
L500	2462587Q40	270 nH
L501	2405688Z01	Ferrite Bead
		CONTACT:
M1, M2	3985951A01	Antenna Ground
		PLUG:
P107	----------	Not Placed
P201	----------	Not Placed
P301	----------	Not Placed
		TRANSISTOR: See Note 1.
Q102	4805128M12	NPN
Q104, Q105	4805128M12	NPN
Q106	4805718V01	MOSFET Switch
Q107	4880048M01	NPN
Q108	----------	Not Placed
Q109	4805128M12	NPN
Q110	4805128M40	PNP
Q111, Q112	4805921T09	Dual NPN
Q113	----------	Not Placed
		RESISTOR, Fixed: Ω **±5%; 1/8W** unless otherwise stated
R100	0662057A65	4700
R101	0662057A89	47k
R102	0662057A36	300
R103	0662057A35	270
R105	0662057A62	3.6k
R106	0662057A97	100k
R108	0662057A97	100k
R109	0662057A73	10k
R110 thru R112	0662057A39	390
R114	0662057A49	1k
R115	0662057A39	390
R116 thru R118	0662057A97	100k
R119 thru R123	0662057A49	1k
R124	0662057A85	33k
R125, R126	0662057A97	100k
R127	0662057A49	1k
R128	0662057B47	0
R129, R133	0662057A49	1k
R135, thru R143	0662057A85	33k
R144 thru R152	0662057A49	1k
R153 thru R155	0662057A97	100k
R156	0662057A73	10k
R157	0662057B47	0
R158	0662057B22	1 M
R159, R160	0662057A65	4.7k
R161	0662057A73	10k
R163	0683962T45	68
R164	0662057A73	10k
R165	0662057A57	2.2k
R167	0662057A97	100k
R168	0662057A65	4.7k
R169	0662057A97	100k
R170	0662057G08	82.5k 1%
R171	0662057A97	100k
R172	0662057R92	47.5k 1%
R173	0662057B47	0
R174, R175	0662057A73	10k
R176, R177	0662057A97	100k
R178	0662057A85	33k
R179	0662057A65	4.7k
R180	0662057A97	100k
R181	0662057B47	0
R182, R183	0662057A97	100k
R184, R185	0662057A73	10k
R186	----------	Not Placed
R187 thru R189	0662057A97	100k
R190	0662057A73	10k
R191	0662057A49	1k
R192	----------	Not Placed
R193	0662057A39	390
R194	0662057A59	2.7k
R195	0662057A81	22k
R196	0662057B02	150k
R197	0662057A39	390
R198	0662057A57	2.2k
R199	0662057G14	110
R200	0662057A81	22k
R201	0662057B02	150k
R202	0662057G08	82.5k
R203, R204	0662057A73	10k
R205, R206	----------	Not Placed
R207	0662057A80	20k
R208	0662057A97	100k
R209	0662057A65	4.7k
R211, R212	0662057A73	10k
R213 thru R215	----------	Not Placed
R216, R217	0662057B47	0
R502	0662057A97	100k
R503	0662057A65	4.7k
R504	0662057A97	100k
R507, R508	0662057A97	100k
R509	0662057C03	1
R510	0662057B47	0
R513, R514	0662057A39	390
R515	0662057A97	100k
R516	0662057A49	1k
R517	0662057A23	82
R518	0662057A39	390
R519, R520	0662057A97	100k
R521	0662057A25	100
R529	0662057A97	100k
R531	----------	Not Placed
R533	----------	Not Placed
R535, R536	0662057A97	100k
R537	0662057C03	1
R538	----------	Not Placed
R539	0662057A73	10k
R540	----------	Not Placed
R541	0662057B47	0
R542	----------	Not Placed
		INTEGRATED CIRCUIT MODULE: See Note 1.
U701	5113802A75	HC11F1 MCU (QFP)
U702	5185765B19	SSLIC (OMPAC)
U704	5105750U28	CMOS Switch (MUX)
U705	5185748L01	32k x8 SRAM
U706	5105109Z72	32k x 8 EEPROM
U708	5105279V65	AND GATE
U709	5105109Z36	5V Digital Switching Regulator
U710	5105625U41	5V Analog Regulator
U712, U713	5105750U28	CMOS Switch (MUX)
U714	5105364W01	DUAL OP-AMP
U717	5105750U28	CMOS Switch (MUX)
U718	5105457W68	Audio PA (QFP)
U725	5105279V65	AND GATE
U726	5105492X73	4.2V Voltage Detector
U727	5105109Z25	1M x 8 FLASH ROM
U728, U729	5105750U28	CMOS Switch (MUX)
		DIODE: See Note 1.
VR100 thru VR102	4813830A24	Zener 11V
VR104	4805117Y01	DUAL, 6.2V Zener
VR105	4813830A15	Zener, 5.6V
VR107 thru VR109	4813830A24	Zener, 11V
VR110	4805117Y01	DUAL, 6.2V Zener
VR111	4813830A31	Zener, 18V
VR112	4813830A24	Zener, 11V
VR113	4813830A31	Zener, 18V
VR117	4813830A24	Zener, 11V
VR119	4813830A22	Zener, 9.1V
VR121	4813830A24	Zener, 11V
VR122, VR123	4813830A15	Zener, 5.6V
VR124	4805117Y01	DUAL, 6.2V Zener
VR300	4805117Y01	DUAL, 6.2V Zener
		CRYSTAL: See Note 2.
Y100	4805574W01	7.3728 MHz

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. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NCN6167 Controller Bd Kit uses an 8-layer printed circuit board.

8-LAYER CIRCUIT BOARD DETAIL VIEWING
COPPER STEPS IN PROPER LAYER SEQUENCE



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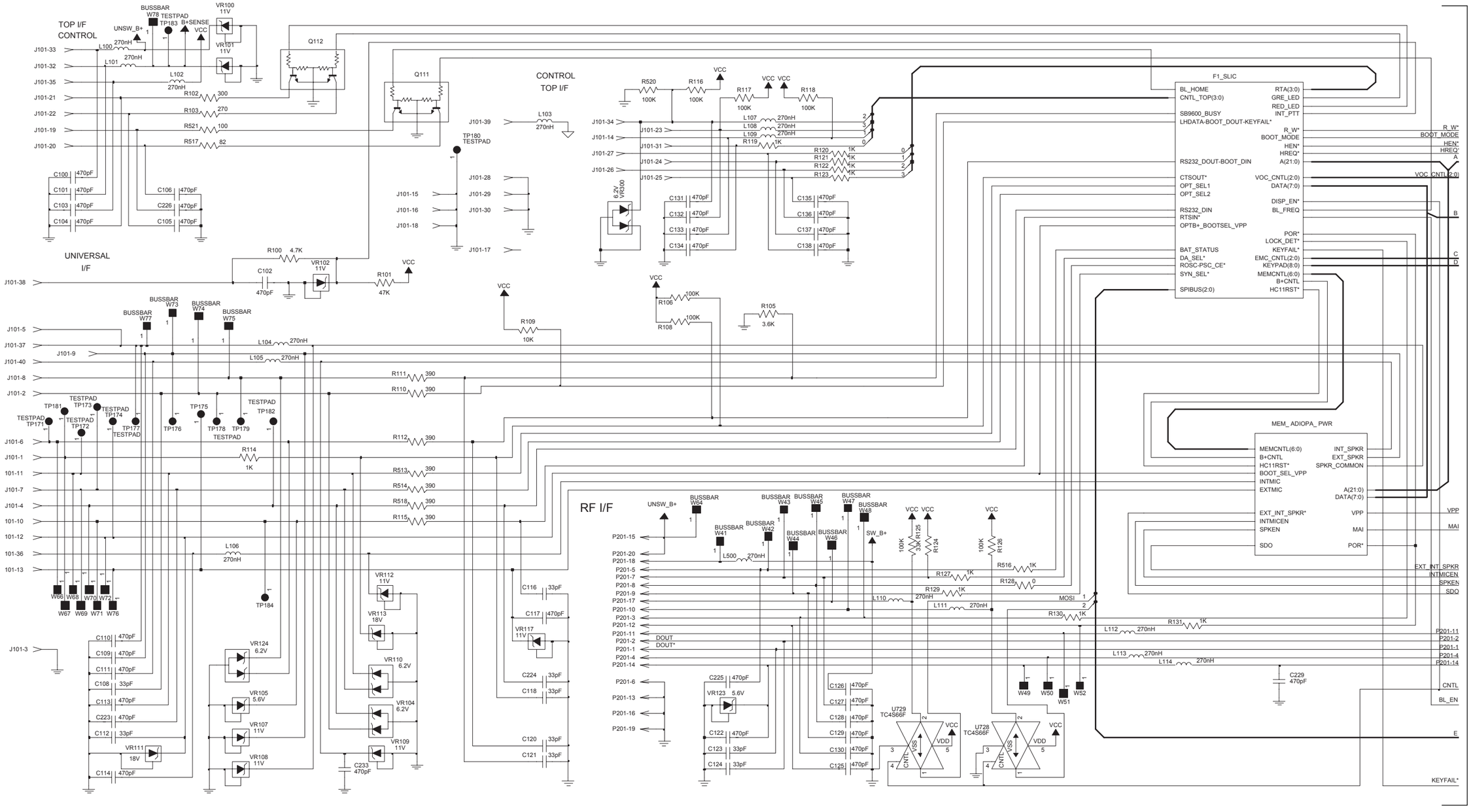
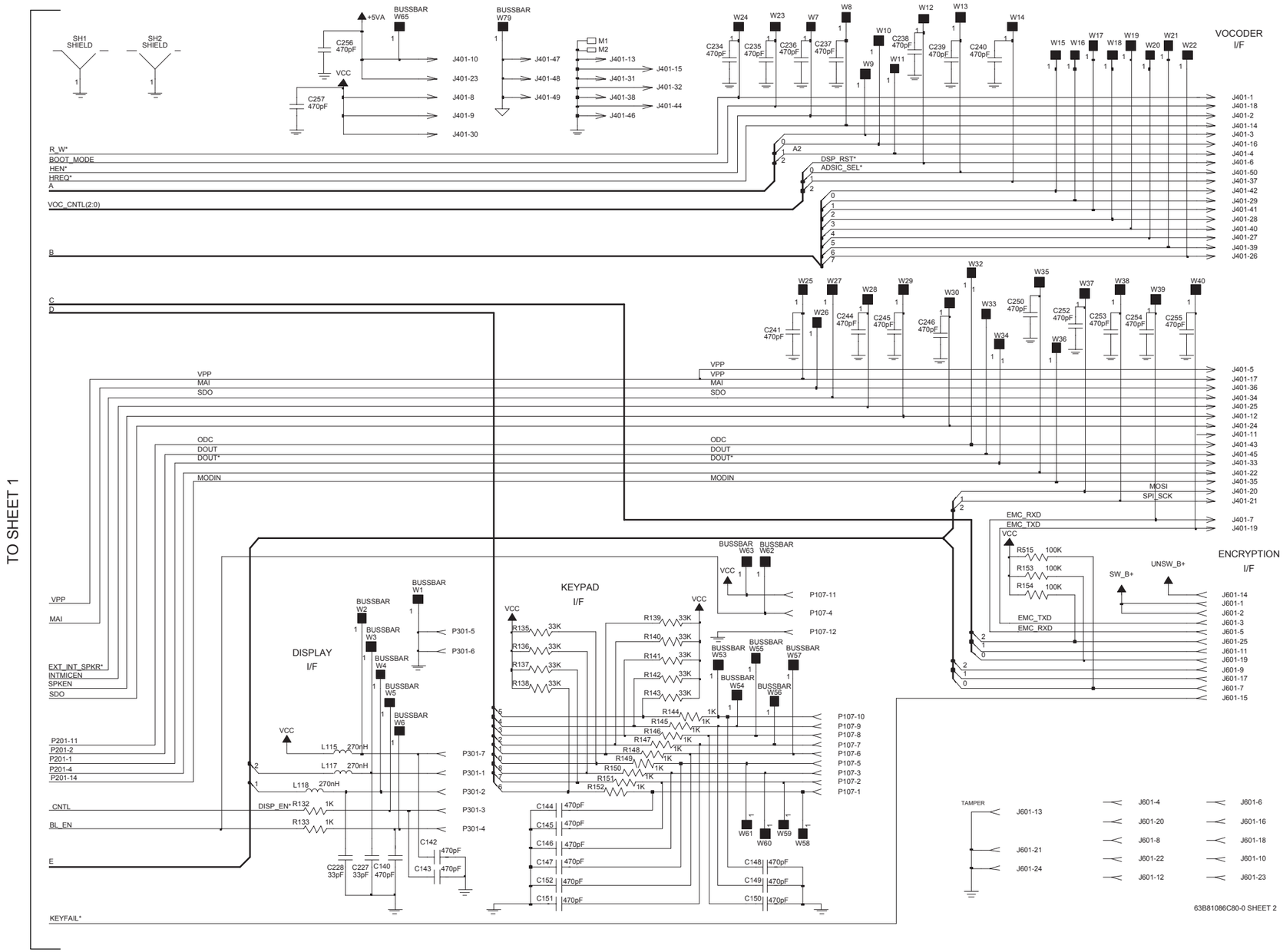
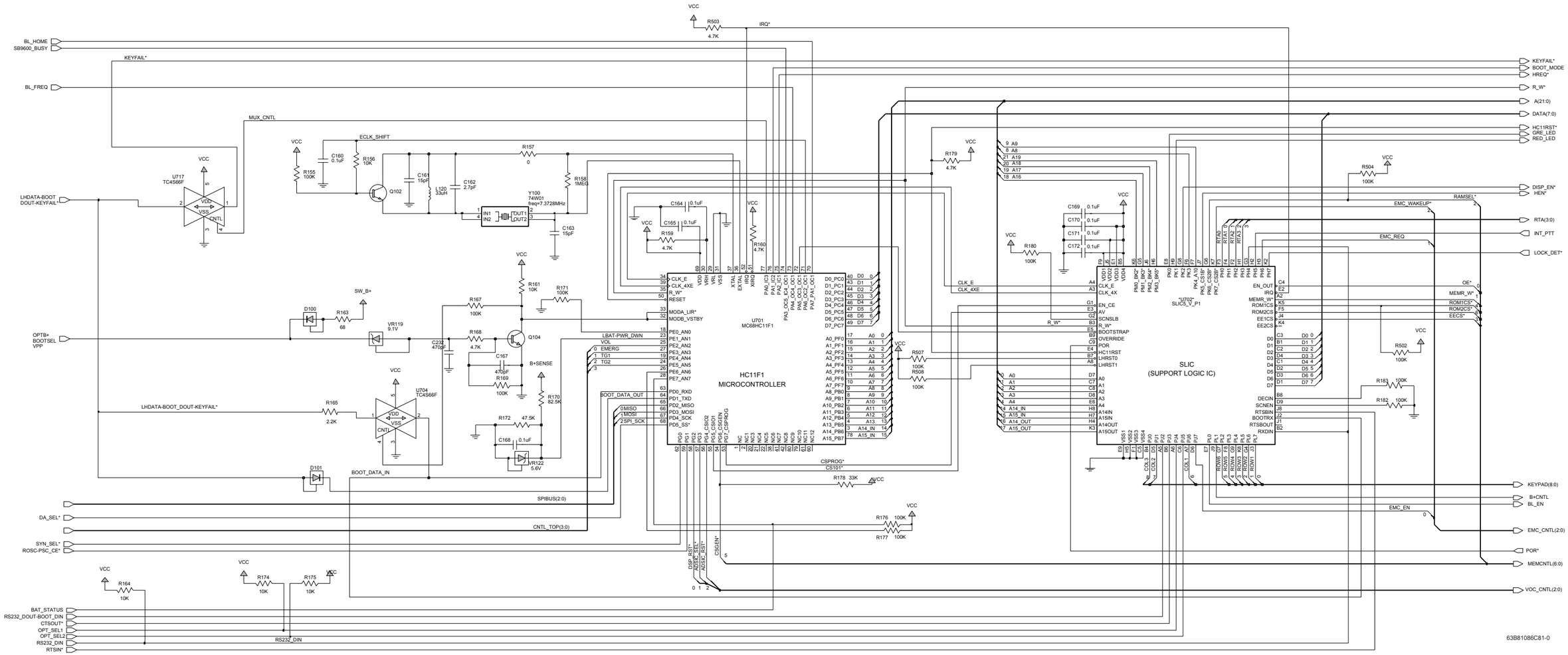


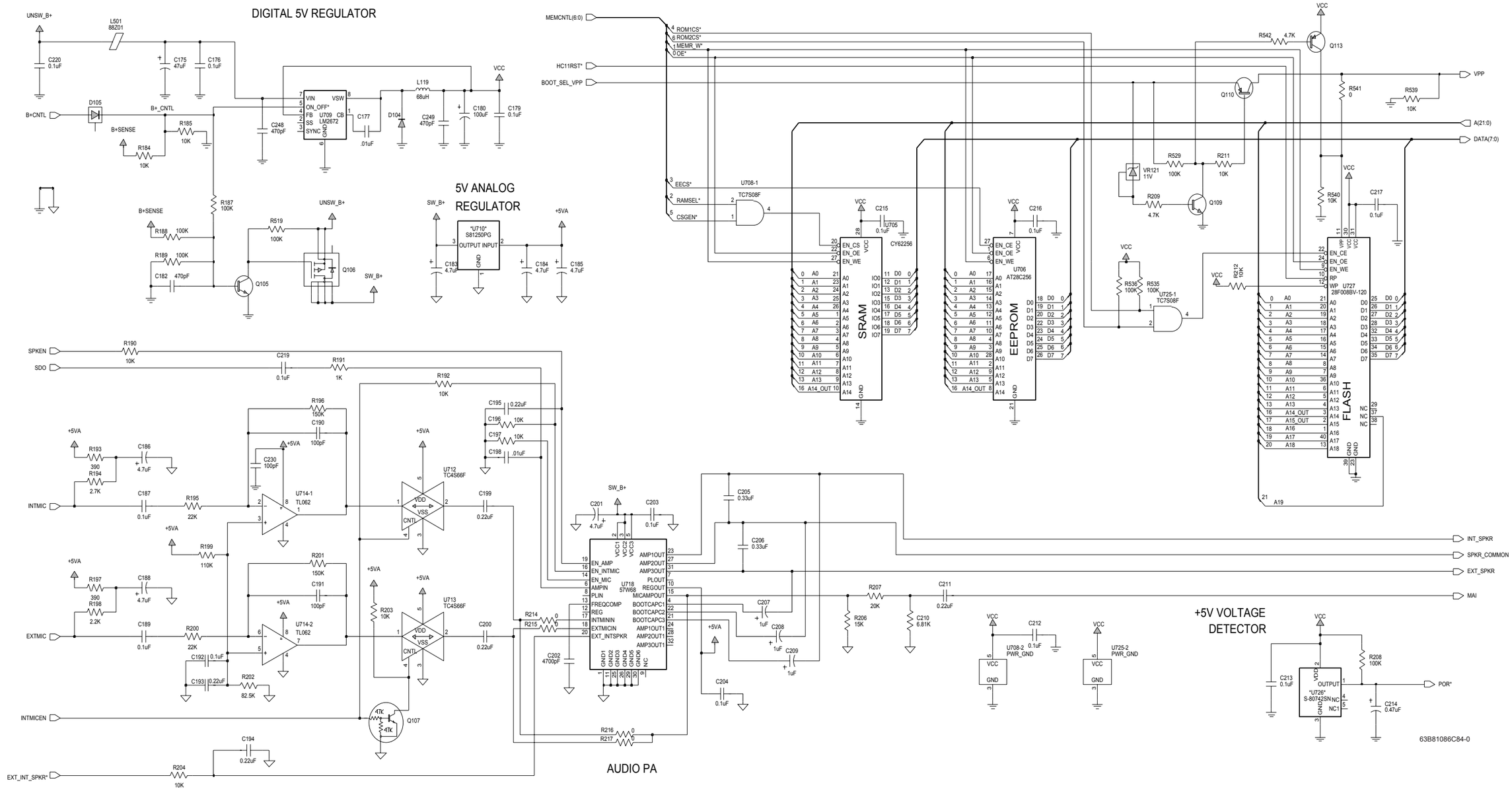
NCN6167H Controller Board Schematic Diagram, Sheet 1 of 4



NCN6167H Controller Board Schematic Diagram, Sheet 2 of 4

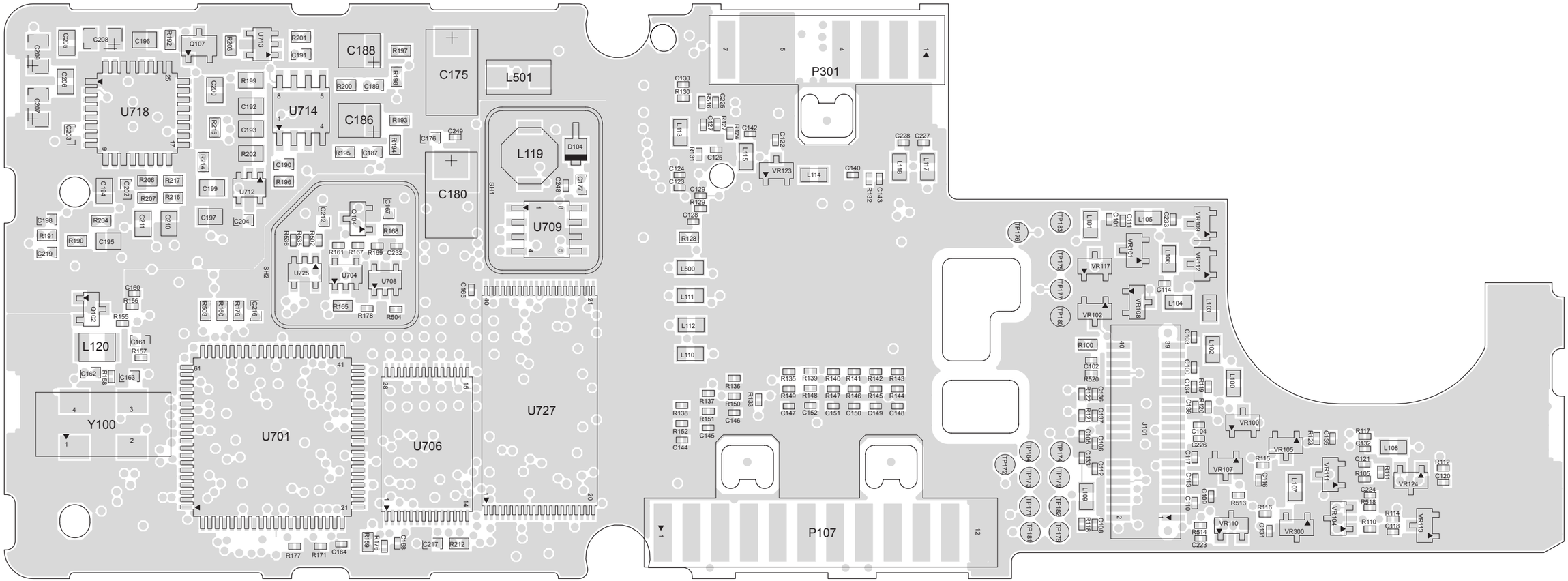


NCN6167H Controller Board Schematic Diagram, Sheet 3 of 4



NCN6167H Controller Board Schematic Diagram, Sheet 4 of 4

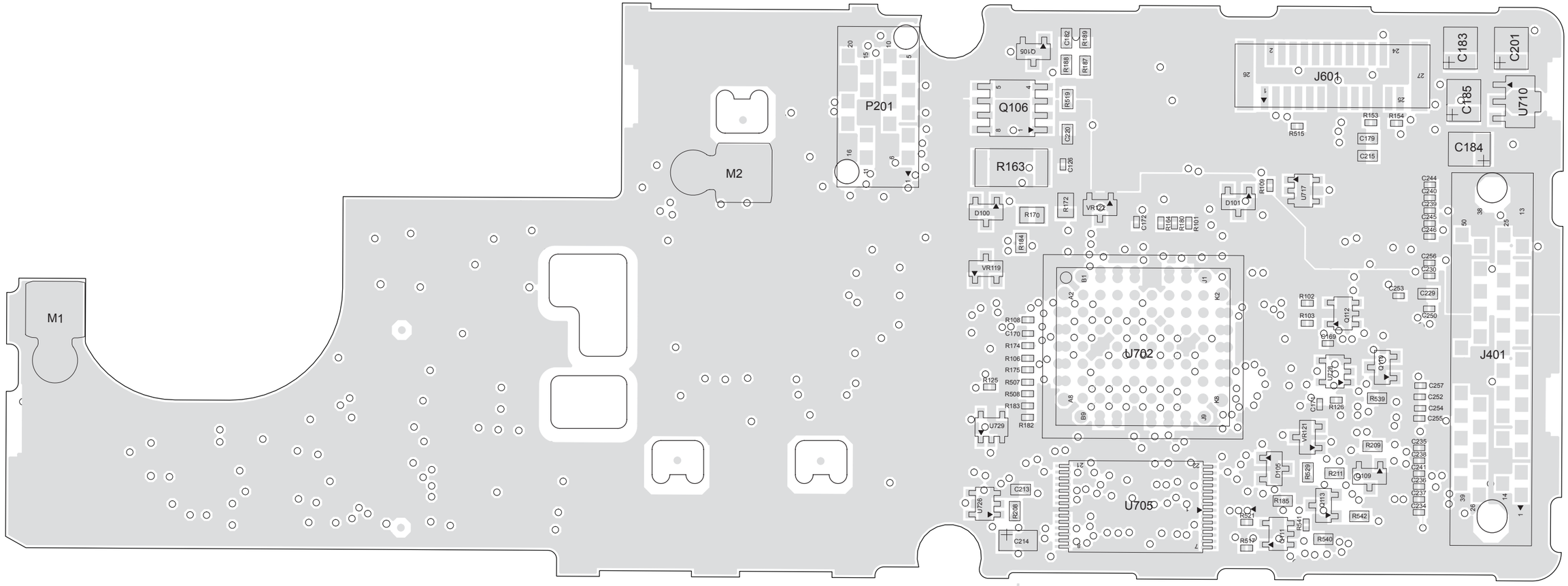
VIEWED FROM SIDE 1



MBEPF-26069-O

NCN6167H Controller Board Component Location Detail, Sheet 1 of 2

VIEWED FROM SIDE 2



MBEPF-26070-O

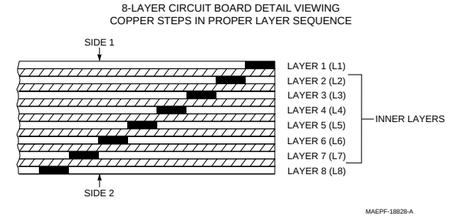
NCN6167H Controller Board Component Location Detail, Sheet 2 of 2

NCN6167H Controller Board Electrical Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 50V unless otherwise stated
C100 thru C106	2113743L09	470
C108	2113743N38	33
C109 thru C111	2113743L09	470
C112	2113743N38	33
C113, C114	2113743L09	470
C116	2113743N38	33
C117	2113743L09	470
C118	2113743N38	33
C120, C121	2113930F39	33
C122	2113743L09	470
C123, C124	2113743N38	33
C125 thru C138	2113743L09	470
C140	2113743L09	470
C142, C152	2113743L09	470
C160	2113743M24	0.1 µF +80/-20% 16V
C161	2113930F21	15
C162	2113930F13	2.7
C163	2113930F21	15
C164, C165	2113743M24	0.1 µF +80/-20% 16V
C167	2113931F17	470
C168 thru C172	2113743M24	0.1 µF +80/-20% 16V
C175	2311049C05	47 µF
C176	2113932K15	0.1 µF +80/-20% 16V
C177	2113931F49	10 nF
C178	----------	Not Placed
C179	2113932K15	0.1 µF +80/-20% 16V
C180	2311049C07	100 µF 10V 10%
C182	2113931F17	470
C183 thru C186	2311049J12	4.7 µF
C187	2113932E20	0.1 µF 10% 16V
C188	2311049J12	4.7 µF
C189	2113932E20	0.1 µF 10% 16V
C190, C191	2113930F51	100
C192	2113743A19	0.1 µF
C193, C195	2113743A23	0.22 µF
C196, C197	0662057R60	10k
C198	2113931F49	10 nF
C199, C200	2113743A23	0.22 µF
C201	2311049J12	4.7 µF
C202	2113931F41	4.7 nF
C203, C204	2113932K15	0.1 µF +80/-20% 16V
C205, C206	2113743F12	0.33 µF
C207 thru C209	2311049A07	1 µF
C210	0662057R54	6.81k
C211	2113743A23	0.22 µF
C212, C213	2113932K15	0.1 µF +80/-20% 16V
C214	2311049A05	0.47 µF
C215 thru C217	2113932K15	0.1 µF +80/-20% 16V
C219, C220	2113932K15	0.1 µF +80/-20% 16V
C223	2113743L09	470
C224	2113743N38	33
C225, C226	2113743L09	470
C227, C228	2113743N38	33
C229	2113931F17	470
C230	2113743N50	100
C232 thru C246	2113743L09	470
C248 thru C250	2113743L09	470
C252 thru C257	2113743L09	470
		DIODE: See Note 1
D100, D101	4884939C35	Hot Carrier, 4V
D104	4813833B09	Schottky, 30V
D105	4884939C35	Hot Carrier, 4V
		JACK:
J101	0980423L02	Controls Flex Assembly Connector
J401	----------	Not Placed
J601	0913915A11	Encryption Board Connector
		COIL, RF: unless otherwise stated
L100 thru L115	2462587Q40	270 nH
L117, L118	2462587Q40	270 nH
L119	2485821E01	68 µH
L120	2460578C43	33 µH
L500	2462587Q40	270 nH
L501	2405688Z01	Ferrite Bead
		CONTACT:
M1, M2	3985951A01	Antenna Ground
		PLUG:
P107	----------	Not Placed
P201	----------	Not Placed
P301	----------	Not Placed
		TRANSISTOR: See Note 1.
Q102	4805128M12	NPN
Q104, Q105	4805128M12	NPN
Q106	4805718V01	MOSFET Switch
Q107	4880048M01	NPN
Q108	----------	Not Placed
Q109	4805128M12	NPN
Q110	4805128M40	PNP
Q111, Q112	4805921T09	Dual NPN
Q113	4805128M40	PNP
		RESISTOR, Fixed: Ω **±5%; 1/8W** unless otherwise stated
R100	0662057A65	4700
R101	0662057N15	47k
R102	0662057A36	300
R103	0662057M60	270
R105	0662057M87	3.6k
R106	0662057N23	100k
R108	0662057N23	100k
R109	0662057M98	10k
R110 thru R112	0662057M64	390
R114	0662057M74	1k
R115	0662057M64	390
R116 thru R118	0662057M23	100k
R119 thru R123	0662057M74	1k
R124	0662057N11	33k
R125, R126	0662057N23	100k
R127	0662057M74	1k
R128	0662057B47	0
R129, R133	0662057M74	1k
R135, thru R143	0662057N11	33k
R144 thru R152	0662057M74	1k
R153 thru R155	0662057N23	100k
R156	0662057M98	10k
R157	0662057M01	0
R158	0662057N47	1 M
R159, R160	0662057A65	4.7k
R161	0662057M98	10k
R163	0683962T45	68
R164	0662057M98	10k
R165	0662057A57	2.2k
R167	0662057N23	100k
R168	0662057A65	4.7k
R169	0662057N23	100k
R170	0662057G08	82.5k 1%
R171	0662057N23	100k
R172	0662057R92	47.5k 1%
R174, R175	0662057M98	10k
R176, R177	0662057N23	100k
R178	0662057N11	33k
R179	0662057A65	4.7k
R180	0662057N23	100k
R182, R183	0662057N23	100k
R184, R185	0662057A73	10k
R186	----------	Not Placed
R187 thru R189	0662057A97	100k
R190	0662057A73	10k
R191	0662057A49	1k
R192	----------	Not Placed
R193	0662057A39	390
R194	0662057A59	2.7k
R195	0662057A81	22k
R196	0662057B02	150k
R197	0662057A39	390
R198	0662057A57	2.2k
R199	0662057G14	110
R200	0662057A81	22k
R201	0662057B02	150k
R202	0662057G08	82.5k
R203, R204	0662057A73	10k
R205, R206	----------	Not Placed
R207	0662057A80	20k
R208	0662057A97	100k
R209	0662057A65	4.7k
R211, R212	0662057A73	10k
R213 thru R215	----------	Not Placed
R216, R217	0662057B47	0
R502	0662057N23	100k
R503	0662057A65	4.7k
R504	0662057N23	100k
R507, R508	0662057N23	100k
R509	----------	Not Placed
R510	----------	Not Placed
R513, R514	0662057M64	390
R515	0662057N23	100k
R516	0662057M74	1k
R517	0662057M48	82
R518	0662057M64	390
R519	0662057A97	100k
R520	0662057N23	100k
R521	0662057M50	100
R529	0662057A97	100k
R531	----------	Not Placed
R533	----------	Not Placed
R535, R536	0662057N32	100k
R538	----------	Not Placed
R539	0662057A73	10k
R540	0662057M50	100
R541	----------	Not Placed
R542	0662057A65	4.7k
		SHIELD:
SH1	2685682E01	
SH2	2685683E01	
		INTEGRATED CIRCUIT MODULE: See Note 1.
U701	5113802A75	HC11F1 MCU (QFP)
U702	5185765B30	SSLIC (OMPAC)
U704	5105750U28	CMOS Switch (MUX)
U705	5185748L01	32k x8 SRAM
U706	5105109Z72	32k x 8 EEPROM
U708	5105279V65	AND GATE
U709	5105109Z36	5V Digital Switching Regulator
U710	5160880G01	5V Analog Regulator
U712, U713	5105750U28	CMOS Switch (MUX)
U714	5105364W01	DUAL OP-AMP
U717	5105750U28	CMOS Switch (MUX)
U718	5105457W68	Audio PA (QFP)
U725	5105279V65	AND GATE
U726	5105143E32	4.2V Voltage Detector
U727	5185143E78	1M x 8 FLASH ROM
U728, U729	5105750U28	CMOS Switch (MUX)
		DIODE: See Note 1.
VR100 thru VR102	4813830A24	Zener 11V
VR104	4805117Y01	DUAL, 6.2V Zener
VR105	4813830A15	Zener, 5.6V
VR107 thru VR109	4813830A24	Zener, 11V
VR110	4805117Y01	DUAL, 6.2V Zener
VR111	4813830A31	Zener, 18V
VR112	4813830A24	Zener, 11V
VR113	4813830A31	Zener, 18V
VR117	4813830A24	Zener, 11V
VR119	4813830A22	Zener, 9.1V
VR121	4813830A24	Zener, 11V
VR122, VR123	4813830A15	Zener, 5.6V
VR124	4805117Y01	DUAL, 6.2V Zener
VR300	4805117Y01	DUAL, 6.2V Zener
		CRYSTAL: See Note 2.
Y100	4805574W01	7.3728 MHz

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. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. The NCN6167 Controller Bd Kit uses an 8-layer printed circuit board.



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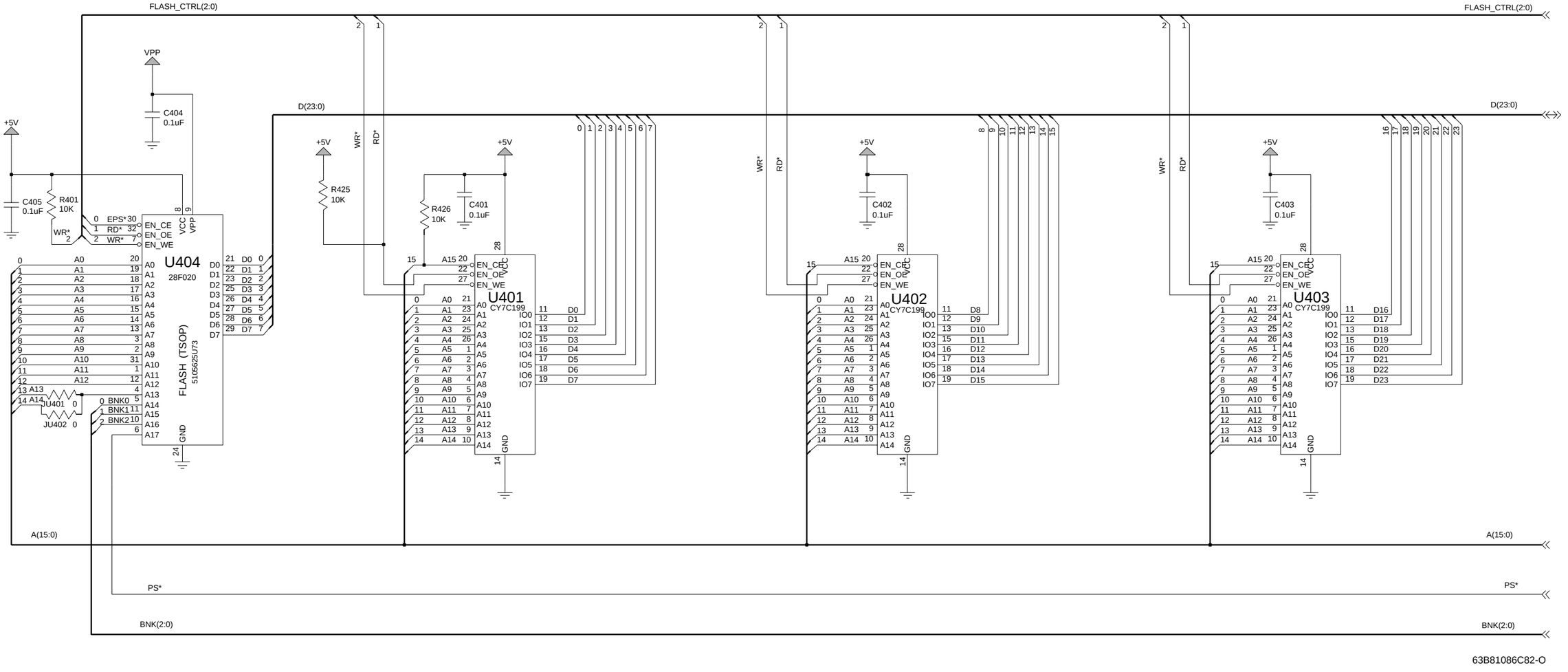

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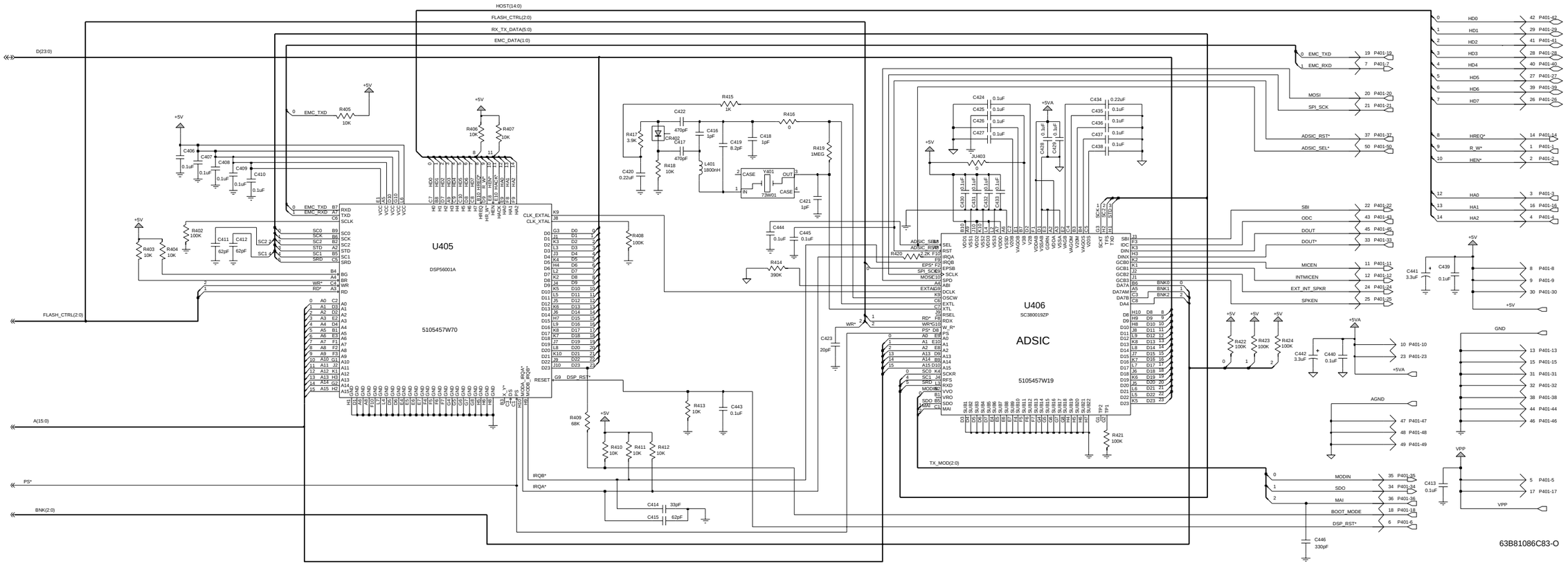
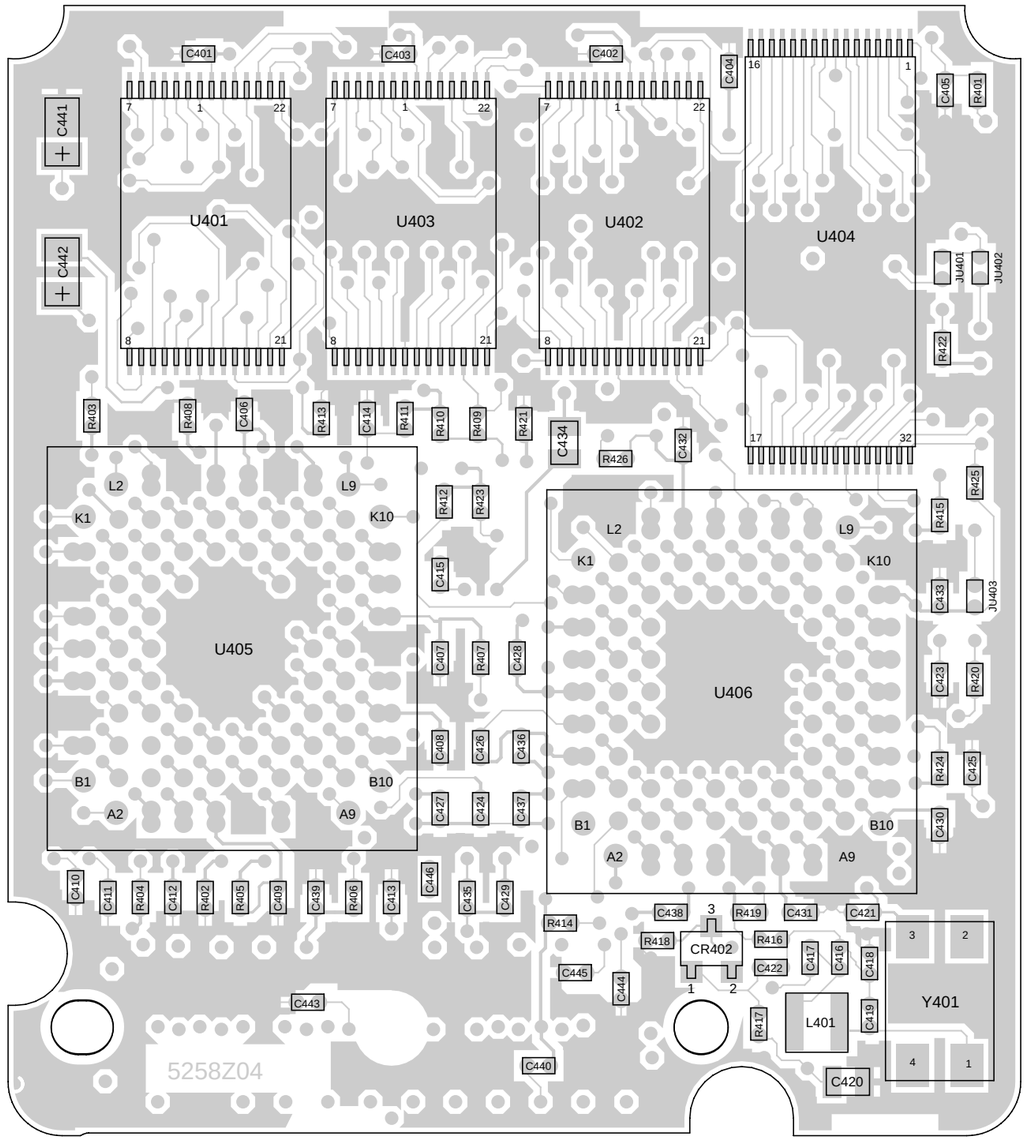


NTN8250C/D Vocoder Board Schematic Diagram, Sheet 2 of 2

VIEWED FROM SIDE 1



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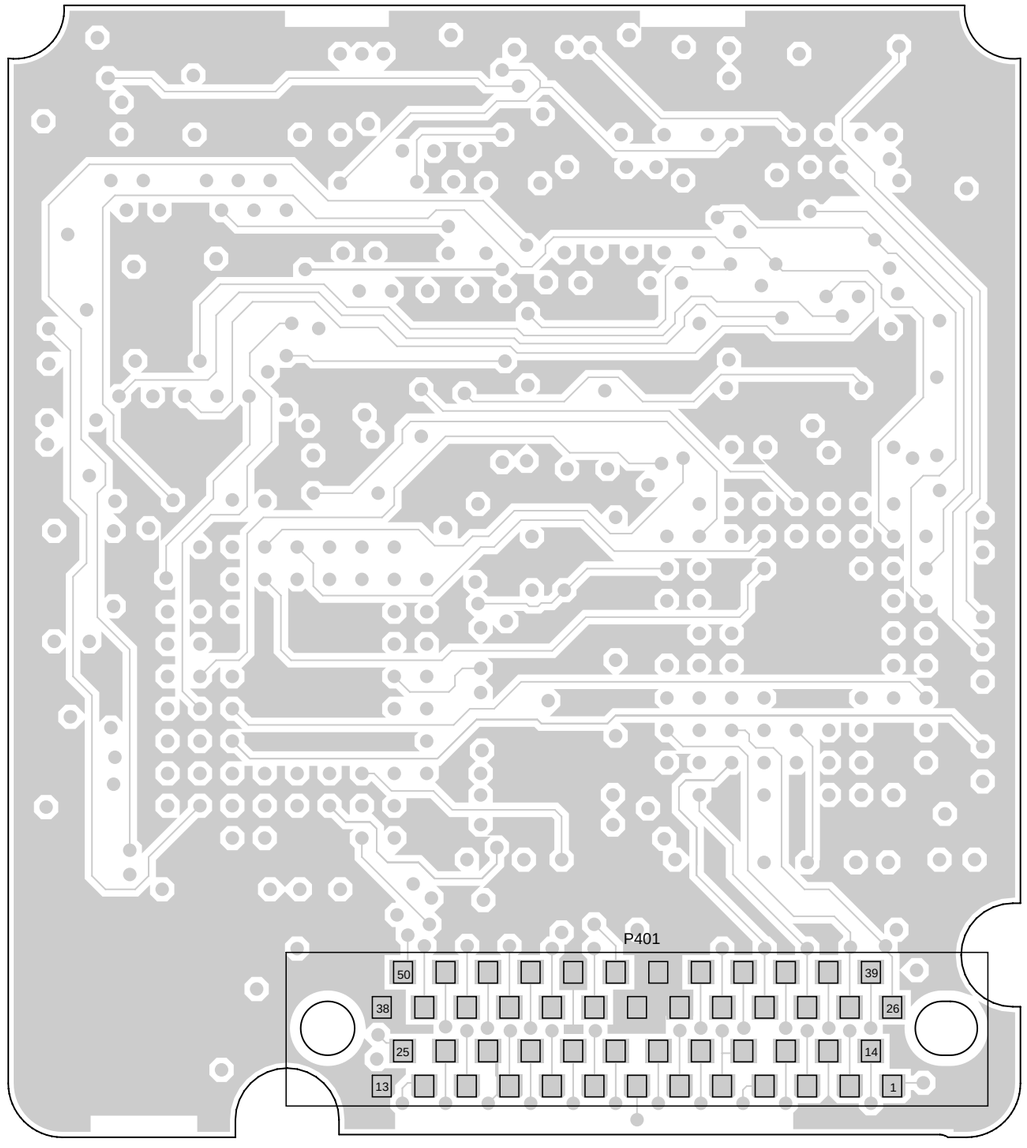
VIEWED FROM SIDE 2

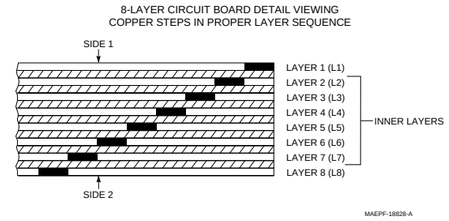


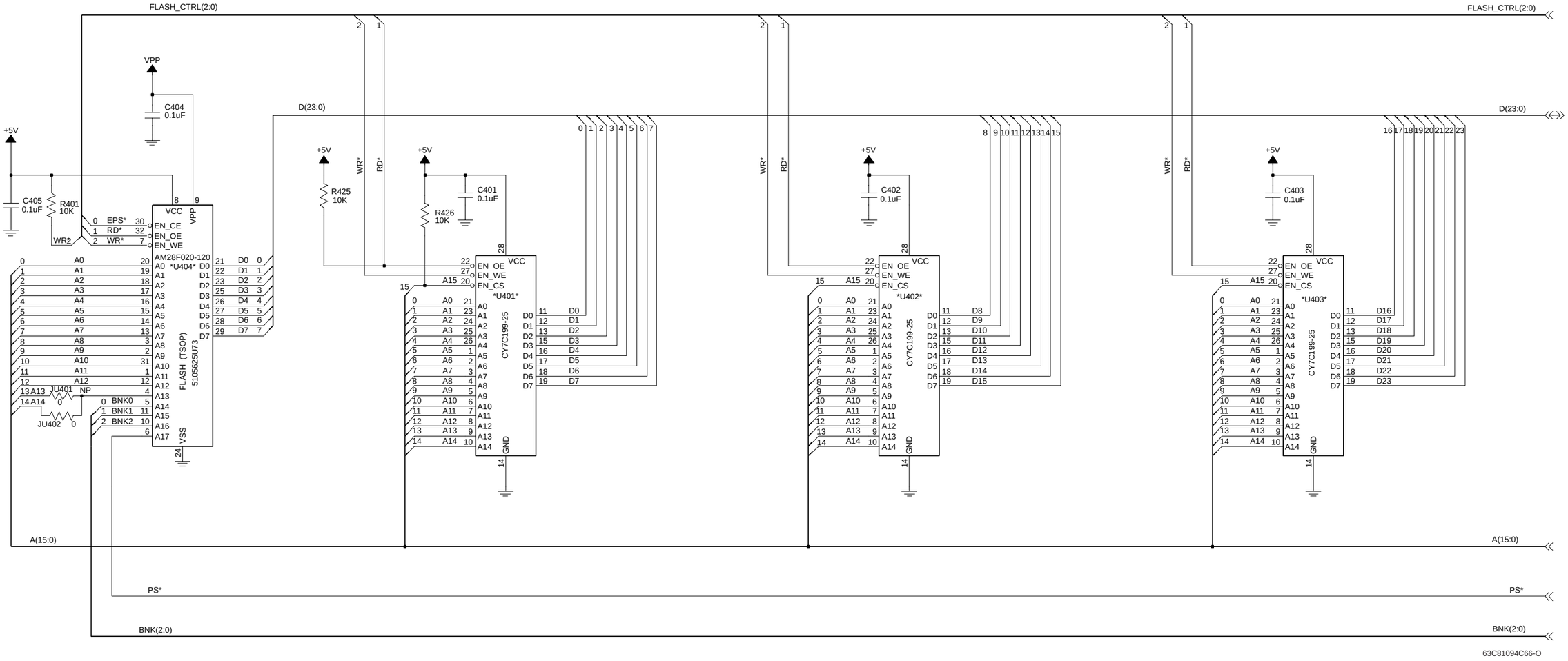
MAEPF-26072-O

NTN8250C/D Vocoder Board Electrical Parts List

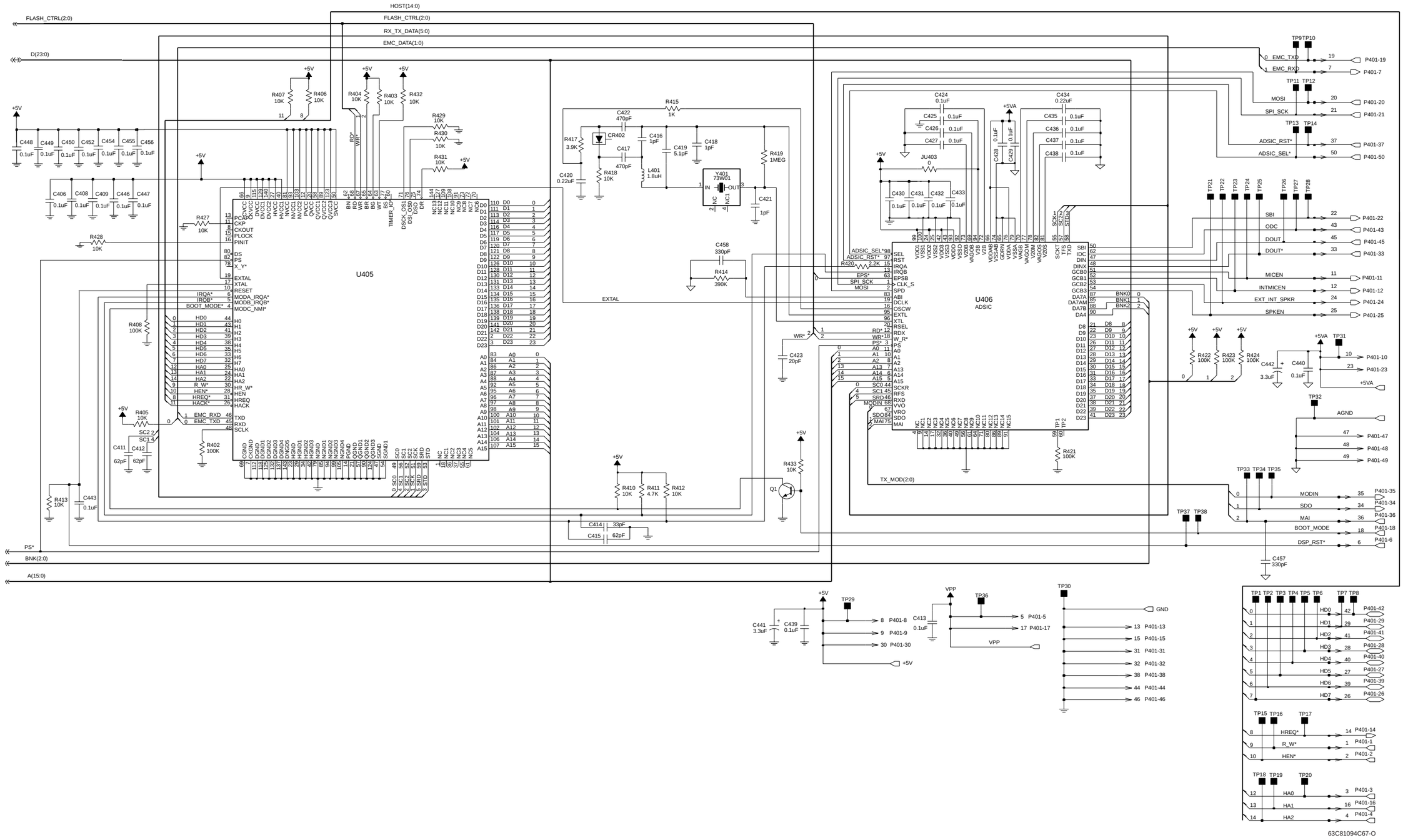
ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: unless otherwise stated
C401 thru 410	2113932K15	0.1µF
C411, 412	2113930F46	62pF
C413	2113932K15	0.1µF
C414	2113930F39	33pF
C415	2113930F46	62pF
C416	2113930F03	1pF
C417	2113931F17	470pF
C418	2113930F03	1pF
C419	2113930F25	8.2 pF
C420	2113743A23	.22µF
C421	2113930F03	1pF
C422	2113931F17	470pF
C423	2113930F34	20pF
C424 thru 433	2113932K15	0.1µF
C434	2113743A23	.22µF
C435 thru 440	2113932K15	0.1µF
C441, 442	2311049A42	3.3 µF
C443	2113932K15	0.1µF
C444, 445	2113932K15	Not Placed
C446	2113931F13	330pF (NTN8250D only)
		DIODE: See Note 1.
CR402	4813825A06	PIN Diode, 35V
		JUMPER:
JU401	0662057B47	Not Placed
JU402	0662057B47	0
JU403	0662057B47	0
		COIL, RF: unless otherwise stated
L401	2462587E71	1800nH Chip Inductor
		RESISTOR; Ω:
R401	0662057A73	10K
R402	0662057A97	100K
R403 thru 407	0662057A73	10K
R408	0662057A97	100K
R409	0662057A93	68K
R410 thru 413	0662057A73	10K
R414	0662057B12	390K
R415	0662057A49	1K
R416	0662057B47	0
R417	0662057A63	3.9K
R418	0662057A73	10K
R419	0662057B22	1M
R420	0662057A57	2.2K
R421 thru 424	0662057A97	100K
R425, 426	0662057A73	10K
		INTEGRATED CIRCUIT MODULE: See Note 1.
U401 thru 403	5105462G87	32K X 8 DSP-SRAM
U404	5105625U73	256K X 8 FLASH ROM
U405	5105457W70	DSP (Digital Signal Processor)
U406	5105457W19	ADSIC (ABACUS/DSP Support IC)
		CRYSTAL: See Note 2
Y401	4805573W01	33 MHz Crystal
		MISCELLANEOUS:
	8405258Z04	PC Board (NTN8250C)
	or 8405258Z05	PC Board (NTN8250D)

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. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. THE NTN8250 Vocoder kits use an 8-layer printed circuit board.



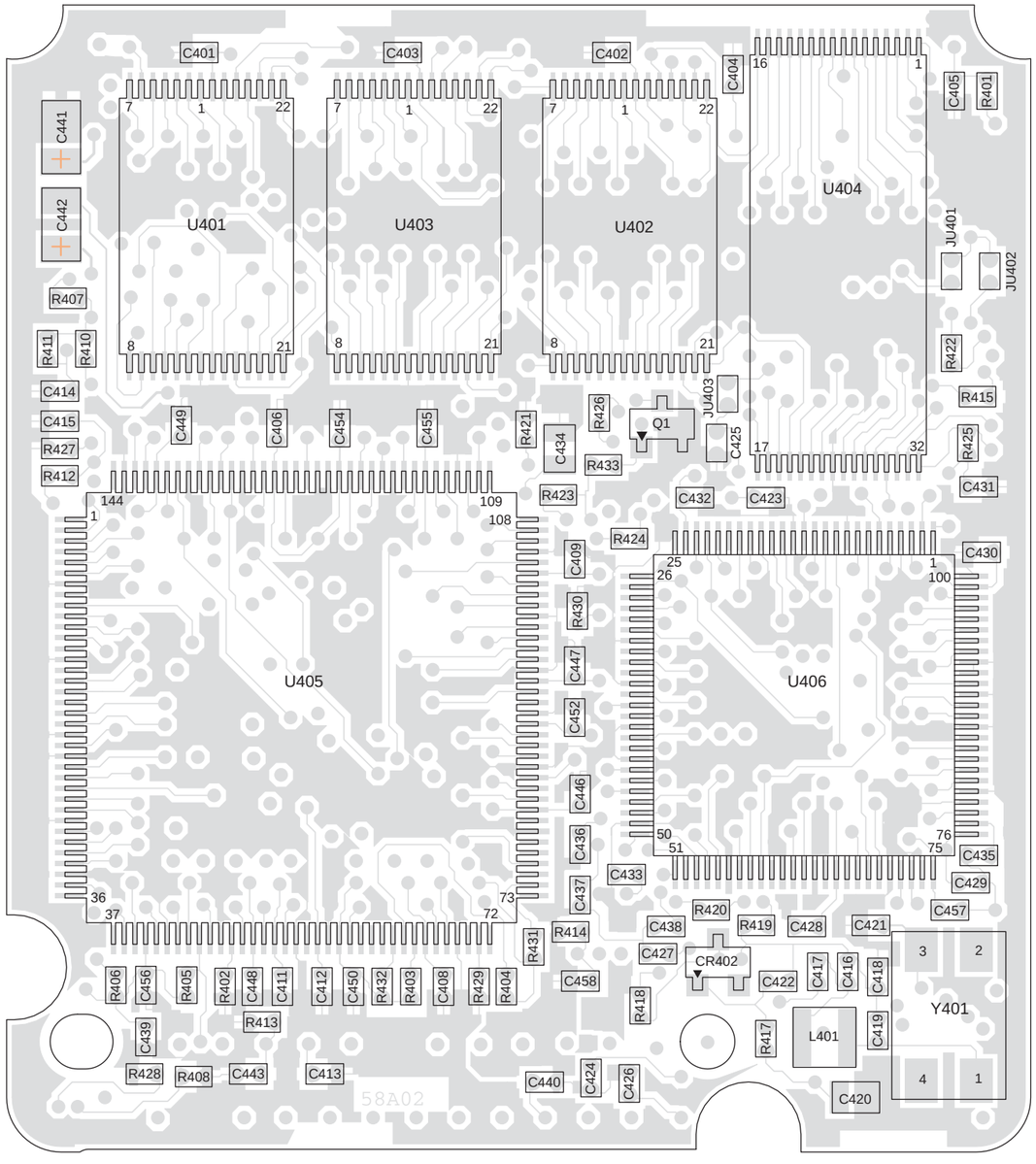


NTN8250F Vocoder Board Schematic Diagram, Sheet 1 of 2



NTN8250F Vocoder Board Schematic Diagram, Sheet 2 of 2

VIEWED FROM SIDE 1



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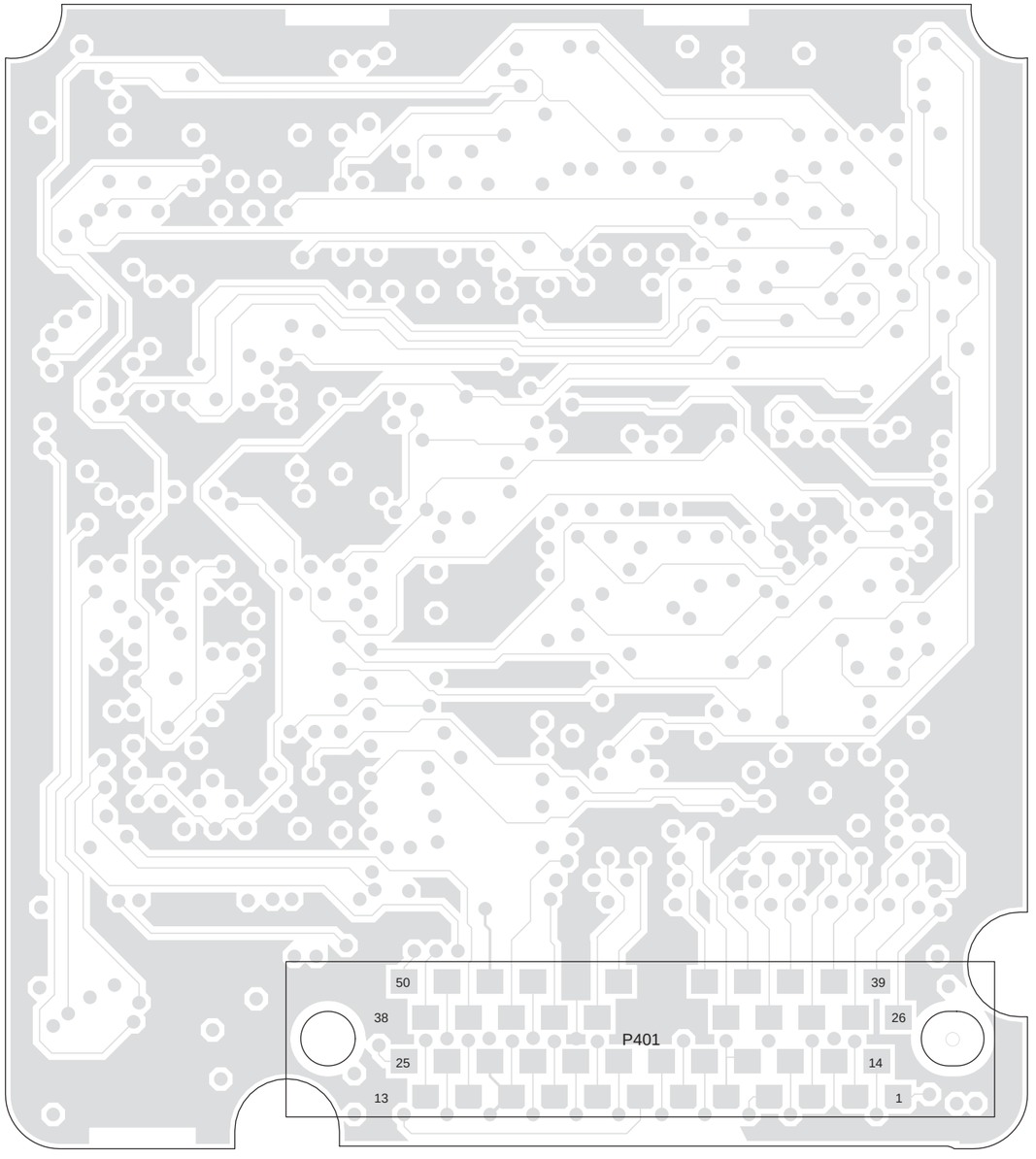
VIEWED FROM SIDE 2



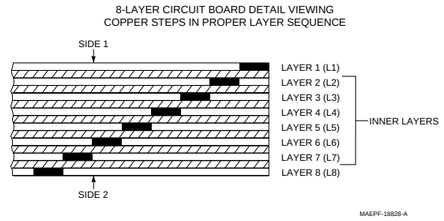
MAEPF-27136-O

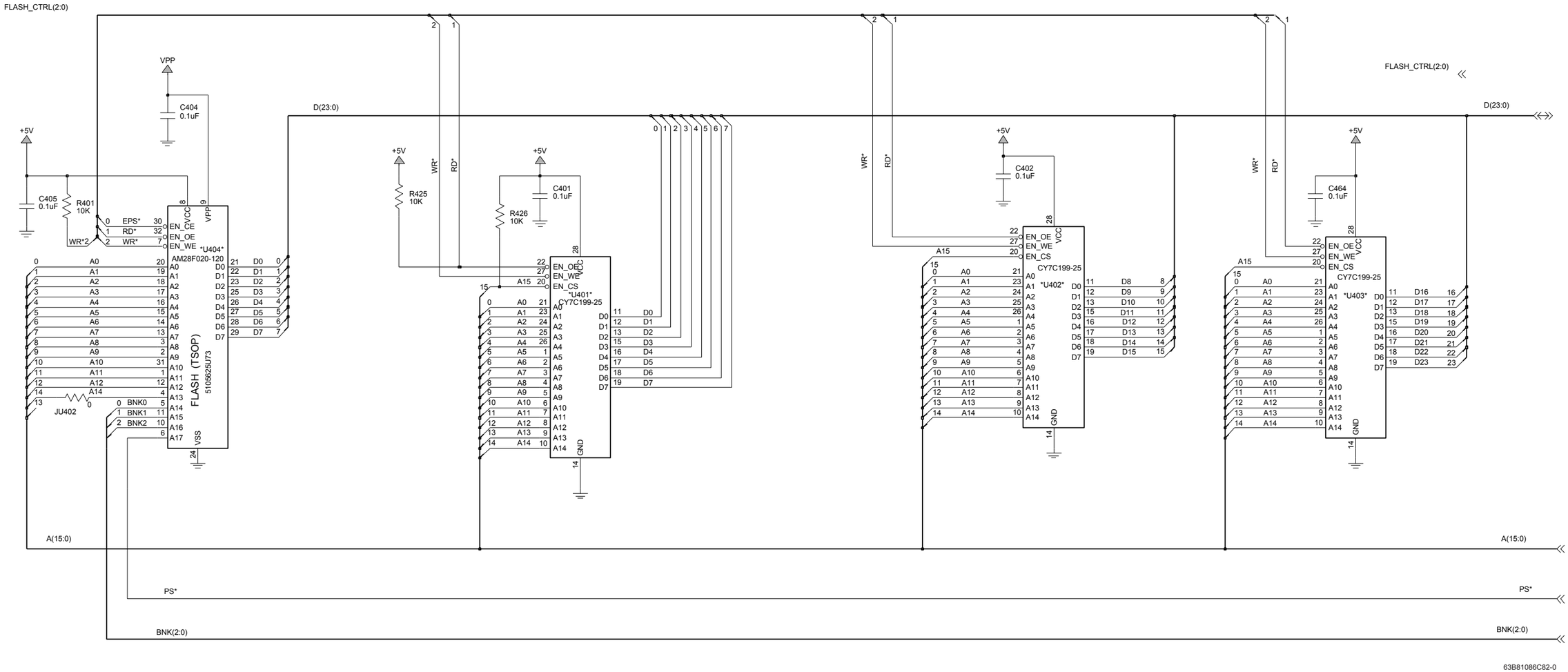
NTN8250F Vocoder Board Component Location Detail

NTN8250F Vocoder Board
Electrical Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 50V unless otherwise stated
C401 thru C406	2113932K15	0.1 uF +80/-20% 16V
C406	2113932K15	0.1 uF +80/-20% 16V
C408, C409	2113932K15	0.1 uF +80/-20% 16V
C411, C412	----------	Not Placed
C413	2113932K15	0.1 uF +80/-20% 16V
C414	2113930F39	33
C415	2113930F46	62
C416	2113930F03	1 pF 50V ±0.1 pF 50V
C417	2113931F17	470
C418	2113930F03	1 pF 50V ±0.1 pF 50V
C419	2113930F20	5.1 pF 50V ±0.25 pF 50V
C420	2113743A23	0.22 uF 10%
C421	2113930F03	1 pF 50V ±0.1 pF 50V
C422	2113931F17	470
C423	2113930F34	20
C424 thru C433	2113932K15	0.1 uF +80/-20% 16V
C434	2113743A23	0.22 uF 10%
C435 thru C440	2113932K15	CAP CER .100 UF +80/-20% 16V
C441, C442	2311049A42	3.3 uF
C443	2113932K15	0.1 uF +80/-20% 16V
C446 thru C450	2113932K15	0.1 uF +80/-20% 16V
C452	2113932K15	0.1 uF +80/-20% 16V
C454 thru C456	2113932K15	0.1 uF +80/-20% 16V
C457, C458	2113931F13	330
		DIODE: See Note 1.
CR402	4813825A06	PIN DIODE, 35V
		JUMPER:
JU401	----------	Not Placed
JU402, JU403	0662057B47	0
		COIL, RF:
L401	2462587E71	1800 nH
		PLUG:
P401	----------	Not Placed
		TRANSISTOR: See Note 1.
Q1	4805128M12	NPN
		RESISTOR, Fixed: Ω **±5%; 1/8W** unless otherwise stated
R401	0662057A73	10k
R402	0662057A97	100k
R403 thru R407	0662057A73	10k
R408	0662057A97	100k
R410	0662057A73	10k
R411	0662057A65	4.7k
R412, R413	0662057A73	10k
R414	0662057B12	390k
R415	0662057A49	1k
R417	0662057A63	3.9k
R418	0662057A73	10k
R419	0662057B22	1 M
R420	0662057A57	2.2k
R421 thru R424	0662057A97	100k
R425 thru R433	0662057A73	10k
		INTEGRATED CIRCUIT MODULE: See Note 1.
U401 thru U403	5185963A18	32k x 8 DSP-SRAM
U404	5185130C54	256k x 8 FLASH ROM
U405	5105457W66	DSP (Digital Signal Processor)
U406	5185963A10	ADSIC (ABACUS/DSP Support IC)
		CRYSTAL: See Note 2.
Y401	4805573W01	33 MHz

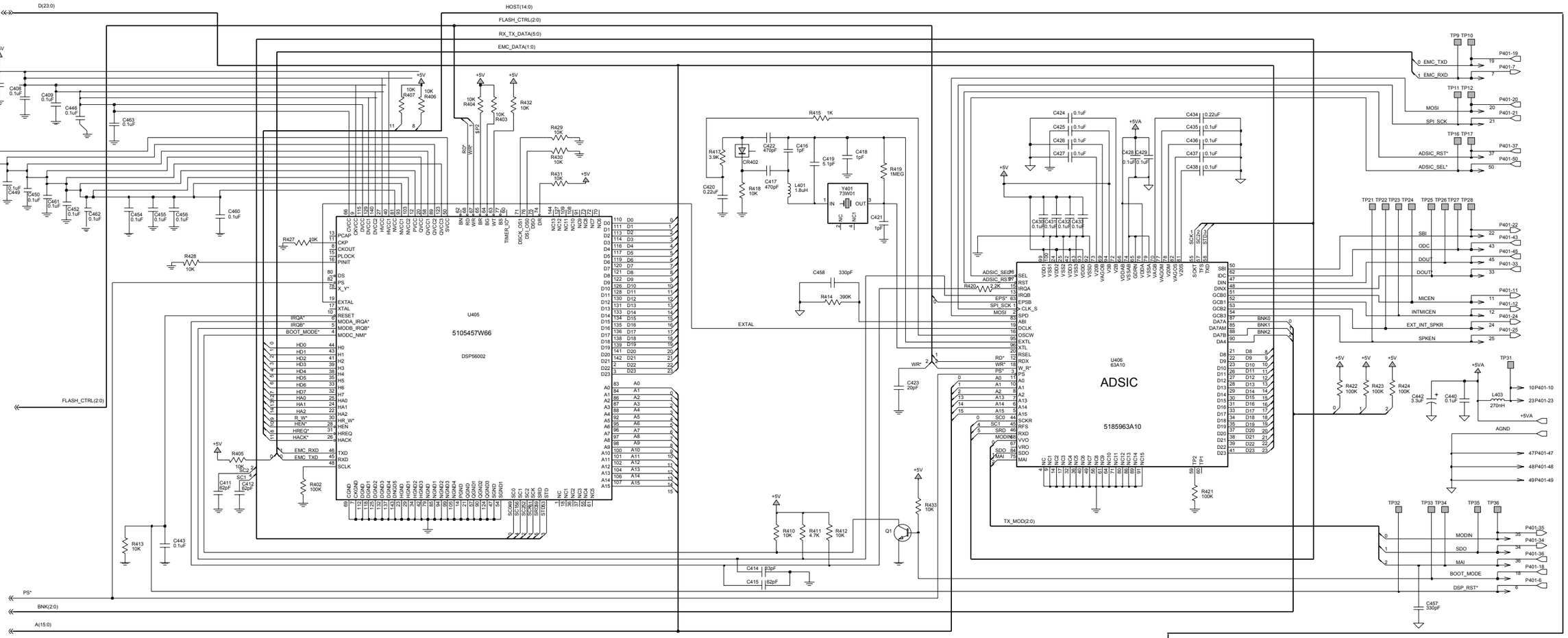
Notes:
1. For optimum performance, order replacement diodes, transistors, and circuit modules by Motorola part number only.
2. When ordering crystals, specify carrier frequency, crystal frequency, crystal type number, and Motorola part number.
3. Part value notations:
   p=10^{-12}
   n=10^{-9}
   µ=10^{-6}
   m=10^{-3}
   k=10^{3}
   M=10^{6}
4. ITEM refers to the component reference designator. SIDE refers to the location of the component on the board; S1=Side 1, S2=Side 2.
5. THE NTN8250 Vocoder kits use an 8-layer printed circuit board.





NOTE: If NTN8250G Vocoder Board is used with NLE4249A-D (UHF-R1) or NLE4250A-E (UHF-R2) RF Boards, the capacitor C513 must be removed from the RF Boards for proper operation.

NTN8250G Vocoder Board Schematic Diagram, Sheet 1 of 2



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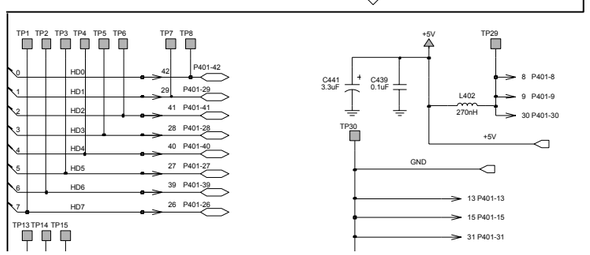
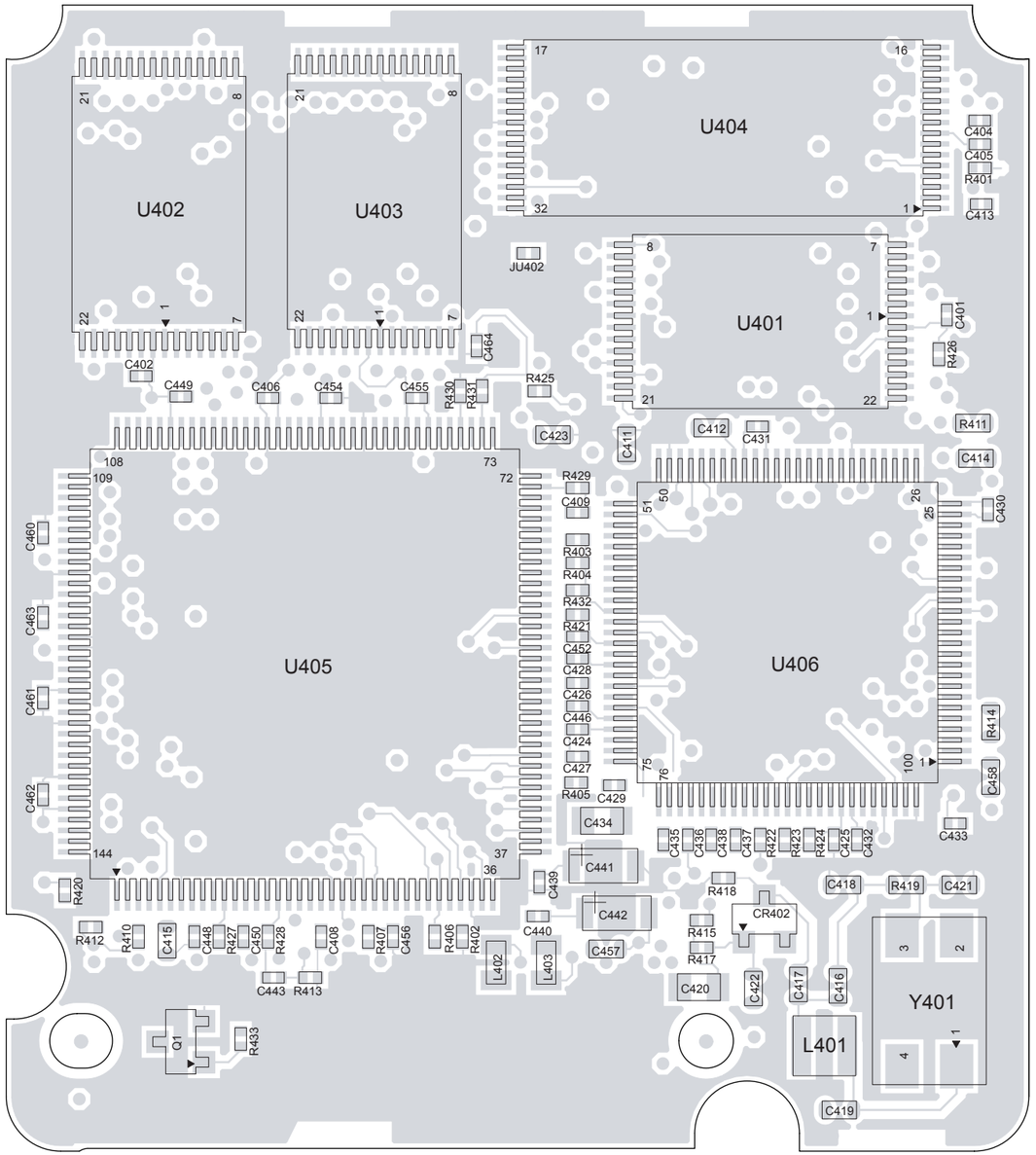


NTN8250G Vocoder Board Schematic Diagram, Sheet 2 of 2

VIEWED FROM SIDE 1



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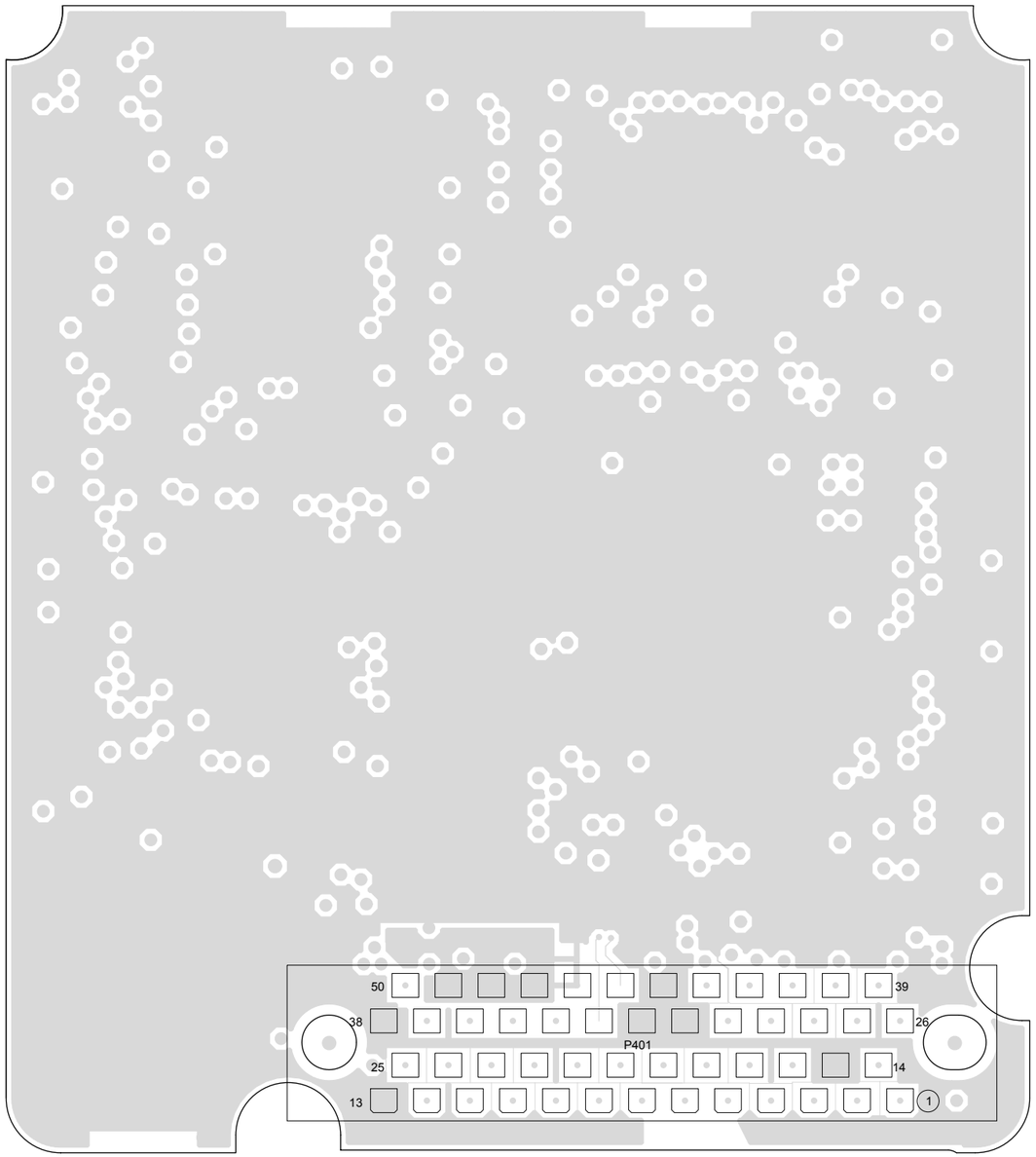
VIEWED FROM SIDE 2



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NTN8250G Vocoder Board Component Location Detail

NTN8250G Vocoder Board Electrical Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 50V unless otherwise stated
C401 thru C406	2113743M24	0.1 uF +80/-20% 16V
C408, C409	2113743M24	0.1 uF +80/-20% 16V
C411, C412	2113930F46	62
C413	2113932K15	0.1 uF +80/-20% 16V
C414	2113930F39	33
C415	2113930F46	62
C416	2113930F03	1 pF 50V ±0.1 pF 50V
C417	2113931F17	470
C418	2113930F03	1 pF 50V ±0.1 pF 50V
C419	2113930F20	5.1 pF 50V ±0.25 pF 50V
C420	2113743A23	0.22 uF 10%
C421	2113930F03	1 pF 50V ±0.1 pF 50V
C422	2113931F17	470
C423	2113930F34	20
C424 thru C433	2113743M24	0.1 uF +80/-20% 16V
C434	2113743A23	0.22 uF 10%
C435 thru C440	2113743M24	CAP CER .100 UF +80/-20% 16V
C441, C442	2311049A42	3.3 uF
C443	2113743M24	0.1 uF +80/-20% 16V
C446 thru C450	2113932K15	0.1 uF +80/-20% 16V
C452	2113932K15	0.1 uF +80/-20% 16V
C454 thru C456	2113932K15	0.1 uF +80/-20% 16V
C457, C458	2113931F13	330
C460 thru C464	2113743M24	0.1 uF +80/-20% 16V
		DIODE: See Note 1.
CR402	4813825A06	PIN DIODE, 35V
		JUMPER:
JU401	----------	Not Placed
JU402	0662057M01	0
		COIL, RF:
L401	2462587E71	1800 nH
L402, L403	2462587Q40	
		PLUG:
P401	----------	Not Placed
		PRINTED CIRCUIT BOARD:
PCB	8485725E01	Printed Circuit Board
		TRANSISTOR: See Note 1.
Q1	4805128M12	NPN
		RESISTOR, Fixed: Ω **±5%; 1/8W** unless otherwise stated
R401	0662057M98	10k
R402	0662057N23	100k
R403 thru R407	0662057M98	10k
R410	0662057M98	10k
R411	0662057A65	4.7k
R412, R413	0662057M98	10k
R414	0662057B12	390k
R415	0662057M74	1k
R417	0662057M88	3.9k
R418	0662057M98	10k
R419	0662057B22	1 M
R420	0662057M82	2.2k
R421 thru R424	0662057N23	100k
R425 thru R433	0662057M98	10k
		INTEGRATED CIRCUIT MODULE: See Note 1.
U401 thru U403	5185963A18	32k x 8 DSP-SRAM
U404	5185130C54	256k x 8 FLASH ROM
U405	5105457W66	DSP (Digital Signal Processor)
U406	5185963A10	ADSIC (ABACUS/DSP Support IC)
		CRYSTAL: See Note 2.
Y401	4805573W01	33 MHz

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.
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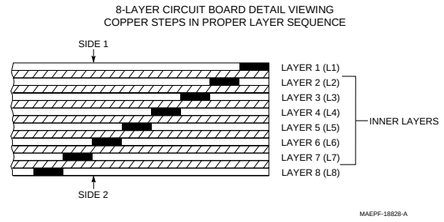


Vocoder/Controller Board Signals

Due to the nature of the schematic-generating program, signal names must be different when they are not directly connected to the same point. The following tables provide a cross-reference to the various pinouts for the same functional signal.

Vocoder Board Address Bus (A) Pinouts

Bus	U401, U402, U403	U404	U405	U406
A0	21	20	C2/83	E9/11
A1	23	19	D3/84	E10/10
A2	24	18	D2/86	E8/8
A3	25	17	E2/87	—
A4	26	16	D4/88	—
A5	1	15	B1/92	—
A6	2	14	E3/95	—
A7	3	13	F1/96	—
A8	4	3	F2/97	—
A9	5	2	F3/98	—
A10	6	31	G1/100	—
A11	7	1	J2/101	—
A12	8	12	K1/102	—
A13	9	4	H3/104	D9/7
A14	10	5	G2/106	B9/6
A15	20	11	H2/107	D10/5

Controller Board Address Bus (HA) Pinouts

Bus	U405	U701	U702	U705	U706	U727
HA0	E9/25	17	D7	10	13	21
HA1	F8/24	16	C7	9	11	20
HA2	F9/22	15	C8	8	10	19
HA3	—	14	D8	7	8	18
HA4	—	13	E6	6	2	17
HA5	—	12	—	5	7	16
HA6	—	11	—	4	6	15
HA7	—	10	—	3	5	14
HA8	—	9	F6	25	27	8
HA9	—	8	F7	24	12	7
HA10	—	7	—	21	24	36
HA11	—	6	—	23	26	6
HA12	—	5	—	2	4	5
HA13	—	4	—	26	28	4
HA14	—	3-In	H8-In H4-Out	1	3	3
HA15	—	78-In	H7-In K3-Out	—	—	2
HA16	—	—	K6	—	—	1
HA17	—	—	G5	—	—	40
HA18	—	—	J6	—	—	13
HA19	—	—	H6	—	—	37

Vocoder Board Data Bus (D) Pinouts

Bus	U401	U402	U403	U404	U405	U406
D0	11	—	—	21	G3/110	—
D1	12	—	—	22	J1/111	—
D2	13	—	—	23	K3/113	—
D3	15	—	—	25	L3/114	—
D4	16	—	—	26	J3/116	—
D5	17	—	—	27	K4/117	—
D6	18	—	—	28	H4/119	—
D7	19	—	—	29	L2/120	—
D8	—	11	—	—	K2/121	H10/21
D9	—	12	—	—	J4/122	H9/22
D10	—	13	—	—	K5/126	H8/23
D11	—	15	—	—	L5/128	J8/26
D12	—	16	—	—	J5/130	L9/27
D13	—	17	—	—	K6/131	K8/28
D14	—	18	—	—	J6/133	L8/29
D15	—	19	—	—	H7/134	J7/30
D16	—	—	11	—	L9/135	K7/31
D17	—	—	12	—	K8/136	L7/33
D18	—	—	13	—	K7/138	J6/34
D19	—	—	15	—	J7/139	K6/35
D20	—	—	16	—	L8/141	J5/37
D21	—	—	17	—	K10/142	L6/38
D22	—	—	18	—	J9/2	L5/39
D23	—	—	19	—	J10/3	K5/41

Controller Board Data Bus (HD) Pinouts

Bus	U405	U701	U702	U705	U706	U727
HD0	C7/44	40	C3	1	14	25
HD1	B8/43	43	B1	12	15	26
HD2	D7/41	44	C2	13	16	27
HD3	A9/39	45	D4	15	18	28
HD4	C9/38	46	C1	16	19	32
HD5	C10/35	47	D2	17	20	33
HD6	D8/33	48	D3	18	21	34
HD7	C8/32	49	D1	19	23	35

U701 (MCU)

U701 Pin Number	Description	To/From
18	PE0	R171
19	PE4 TG1 TOGGLE SWITCH	J101-34
23	PE1 B SENSE/LBAT/PWR DWN	VR122
24	PE5 TG2 CONCENTRIC SWITCH	J101-23
25	PE2 VOL	J101-31
26	PE6	R177
27	PE3 EMERG	J101-41
28	PE7 BAT_STATUS	R176 P201-5
32	MOD B	Q104C
33	MOD A	Q104C
34	ECLK (1.8432MHz)	U206-A4
35	R/W*	U405-D9/30 U206-B3
36	EXTAL 7.3728MHz	Y100-2
37	XTAL	R158
39	4XECLK (7.3726MHz)	U206-A3
50	RESET/RESET*	U727-10 U206-E4
51	XIRQ*	R160
52	IRQ*	U206-E2
53	PG7 CSPROG*	U206-E3
54	PG6 CSGEN*	U708-1
55	PG5 CS101*	U206-G1
56	PG4 ADSIC RST*	U406-A8/97
57	PG3 ADSIC SEL*	U406-B8/98
58	PG2 DSP RST*	U405-G9/10
59	PG1 ROSC/PSC CE*	P201-8
62	PG0 SYN SEL*	P201-9
63	PD0 BOOT DATA IN (RXD)	U704-2 U206-J2
64	PD1 BOOT DATA OUT (TXD)/KEYFAIL	J704-1 J101-2 U717-1
65	PD2 MISO	J601-7
66	PD3 MOSI	J601-17 P201-17 P301-2 U406-C10/2
67	PD4 SPI SCK	J601-9 P201-10 P301-1 U406-C9/1
68	PD5 DA SEL*	P201-7
70	PA7 BL_HOME*	J101-19
71	PA6 ECLK SHIFT	Q102B
72	PA5 BOOTSTRAP*	U206-E5
73	PA4 BL_FREQ	J101-20
74	PA3 SB9600 BUSY	J101-8
75	PA2 HREQ*	U405-B10/31
76	PA1 BOOT MODE	R409
77	PA0 MUX_CNTL	U717-4

U702 (SLIC)

U702 Pin Number	Description	To/From
A2	MEM R/W*	U705-27 U706-6 U727-9
A3	4XECLK	U701-39
A4	ECLK	U701-34
A5	RS232 DATA OUT/BOOT DATA IN	J101-6
A7	PJ6 COL1*	P107-1
B2,G3	RXDIN/RS232 DATA IN	J101-4
B3	R/W*	U405-D9/30 U701-35
B4	PJ0 COL3 MOB IRQ*	P107-3
B6	PJ3 CTSOUT*	J101-1
C4	OE*	U706-1 U705-22 U727-24
C6	PJ5 OPT SEL2	J101-7
C9	POR*	U726-1
D5	PJ1 COL2	P107-2
D6	PJ7 EMC EN*	J601-19
E2	IRQ*	J701-52
E3	AV*/CSPROG*	U701-53
E4	HC11RST*/RESET*	U701-50 U727-10
E5	BOOTSTRAP*	U701-72
E7	BL EN	P107-4 P301-4
E8	GRN LED	J101-22
F2	PH2 RTA2	J101-26
F3	PH0 RTA0	J101-27
F4	PH1 RTA1	J101-24
F5	ROM2CS*	U725-2
F8	ROW5 5V EN*	P107-9
G1	CE*/CS101*	U701-55
G2	SCNSLB	R180
G4	ROW2 SPKREN*	P107-6
G6	CS2B RAM SEL*	U708-2
G7	ROW6 MICEN	P107-10
G8	DISP EN*	P301-3
G9	ROW4 TXPA EN*	P107-8
H1	PH3 RTA3	J101-25
H2	PH5 INT PTT*	J101-19 U206-H2
H3	PH6 EMC REQ	J601-11
H9	RED LED	J101-21
J2	BOOTRX/BOOT DATA IN	U701-63 U704-2
J3	ROW1	P107-5
J4	EE1CS*	U706-27
J7	CS1B HEN*	U405-E8/28
J8	RTSIN*	J101-10
J9	B+ CNTL	U709-2 Q105
K2	PH7 LOCK DET*	P201-3 U302-41 CR502
K5	ROM1CS*	U725-1
K7	CS3B EMC WAKEUP*	J601-25
K8	ROW3 BUSY OUT*	P107-7

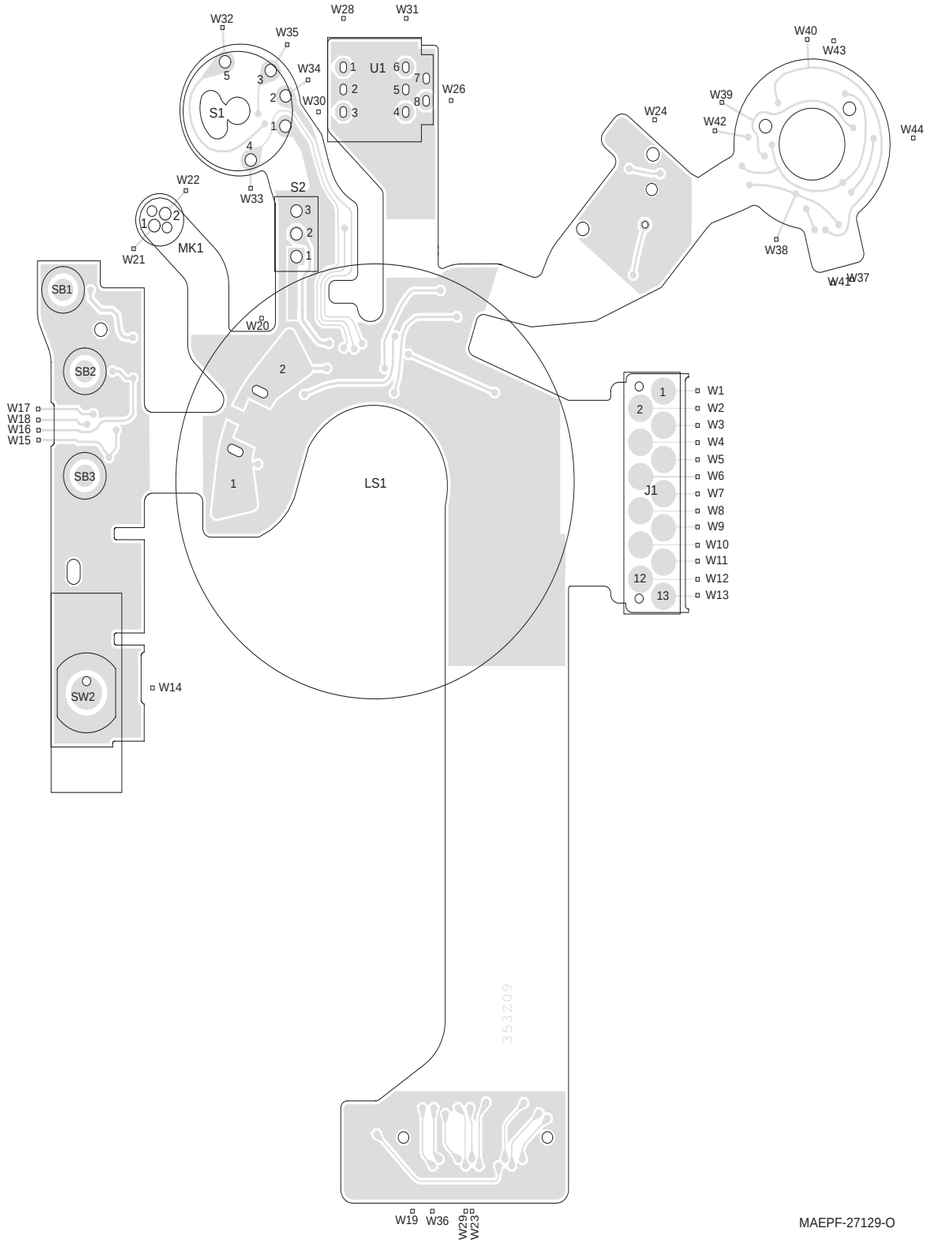
Vocoder U405 (DSP)

U405 Pin Number	Description	To/From
A2/53	TXD/STD	U406-H1/58
A3/68	RD*	U401-22 U402-22 U403-22
A7/46	TXD/EMC RXD	J601-5
B2/52	SC2 TFS 48kHz	U406-H2/57
B5/56	SC1 RFS 20kHz	U406-J4/45
B6/51	SCK SCKT 1.2MHz	U406-G3/55
B7/45	RXD/EMC TXD	J601-3
B9/49	SC0 SCKR 2.4MHz	U406-K4/44
B10/31	HREQ*	U701-75
C1/82	PS*	U404-6 U406-D8/3
C4/67	WR*	U401-27 U402-27 U403-27
C5/59	SRD RXO	U406-L3/46
C6/48	SCLK	R402
D9/30	HR/W*	U701-35 U702-B3
E8/28	HEN*	U702-J7
E10/26	HACK*	R407
G9/10	RESET/DSP RST*	U701-58
H9/5	MODB/IRQB*	U406-F9/13
H10/6	MODA/IRQA*	U406-F10/15
J8/17	XTAL	R408
K9/19	EXTAL (DCLK)	U406-G9/19
4	MODC/NMI*	Q1

Vocoder U406 (ADSIC)

U406 Pin Number	Description	To/From
A4/83	AB1	R414
A8/97	RST*/ADSIC RST*	U701-56
B2/68	MODIN	P201-14
B5/84	SDO	U401-C6
B6/87	DA7A BNK0	U404-5
B8/98	SEL*/ADSIC SEL*	U701-57
C1/75	MAI	U401-F2
C3/88	DA7B BNK1	U404-11
C6/95	EXTL	Y401
C7//96	XTL 33MHz	Y401
C8/90	DA4 BNK2	U404-10
C9/1	SCLK/SPI SCK	U701-67 J601-9 P201-10 P301-1
C10/2	SPD/MOSI	U701-66 J601-17 P201-17 P301-2
D8/3	PS*	U404-6 U405-C1/82
F2/63	SSW/EPS*	U404-30
F3/62	IDC ODC 2.4MHz	P201-11
F8/12	RD*	U405-A3/68 U404-32 U402/3/1-22
F9/13	IRQB/IRQB* 8kHz	U405-H9/5
F10/15	IRQA/IRQA*	U405-H10/6
G2/59	TP1	R421
G3/55	SCKT SCK 1.2MHz	U405-B6/51
G9/19	DCLK	U405-K9/19
G10/18	WR*	U405-C4/67 U404-7 U402/3/1-27
H1/58	TXD STD	U405-A2/53
H2/57	TFS SC2 48kHz	U405-B2/52
H3/48	DIN*/DOUT*	P201-1
J1/54	GCB3 SPKEN	U718-19
J2/53	GCB2 (EXT/INT SPKR)	U718-20
J3/50	SBI	P201-4
J4/45	RFS SC1 20kHz	U405-B5/56
K1/52	GCB1	U712-4 U718-16 Q107 (INT MICEN)
K2/51	GCB0 MICEN	U718-4, Q108
K3/47	DIN/DOUT	P201-2
K4/44	SCKR SCO 2.4MHz	U405-B9/49
K9/16	OSCW	CR402
L3/46	RXD SRD	U405-C5/59

VIEWED FROM SIDE 1



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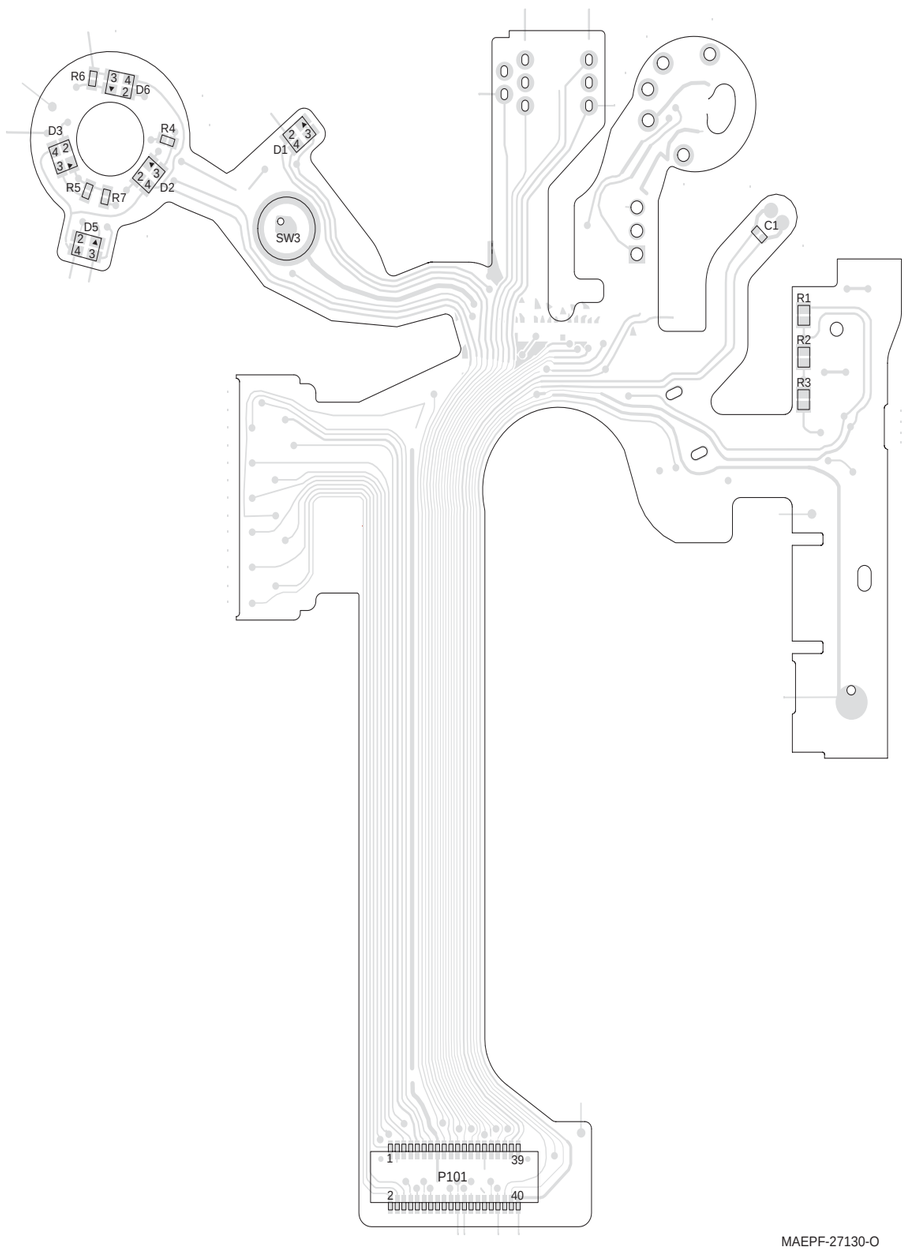

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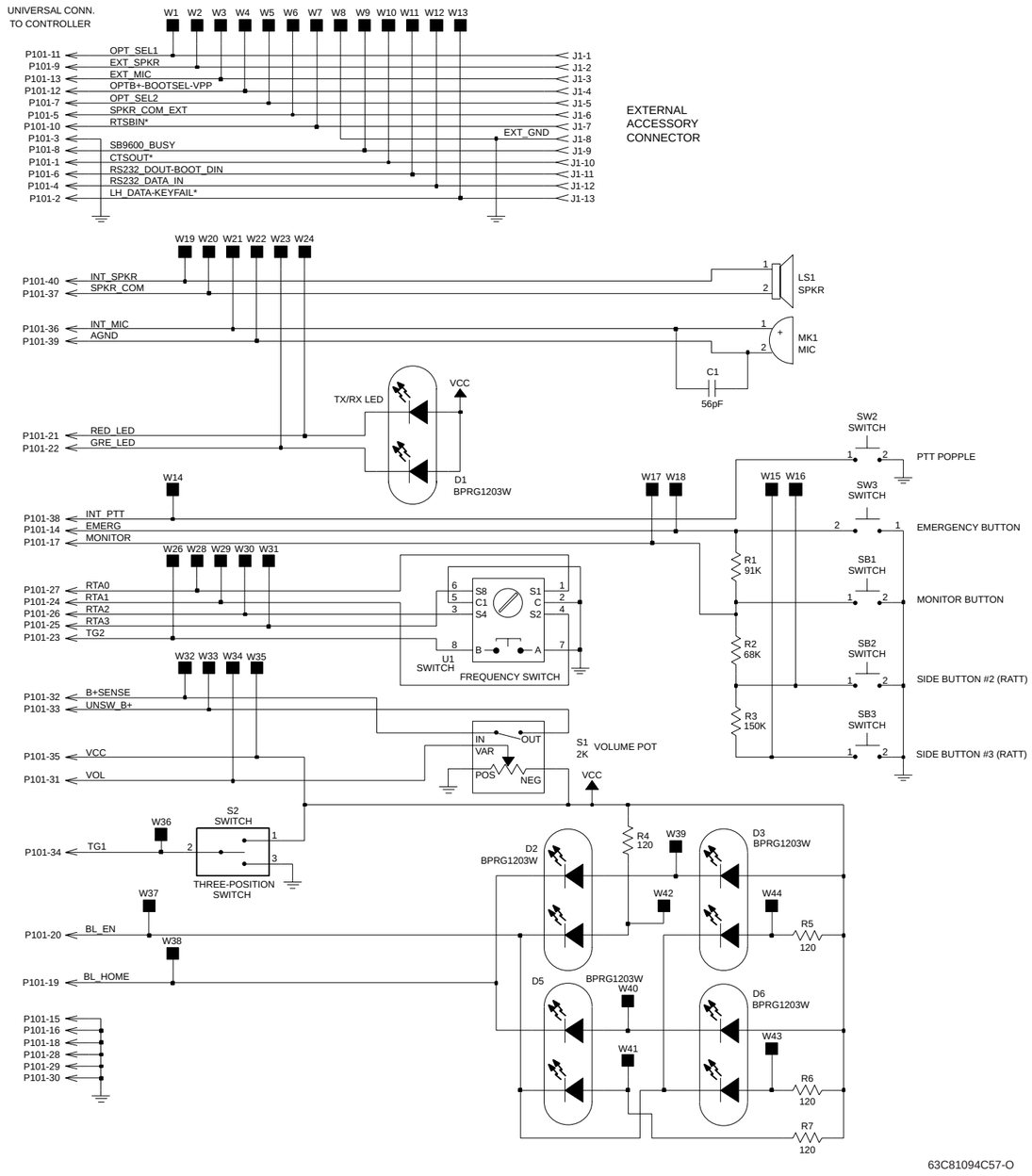
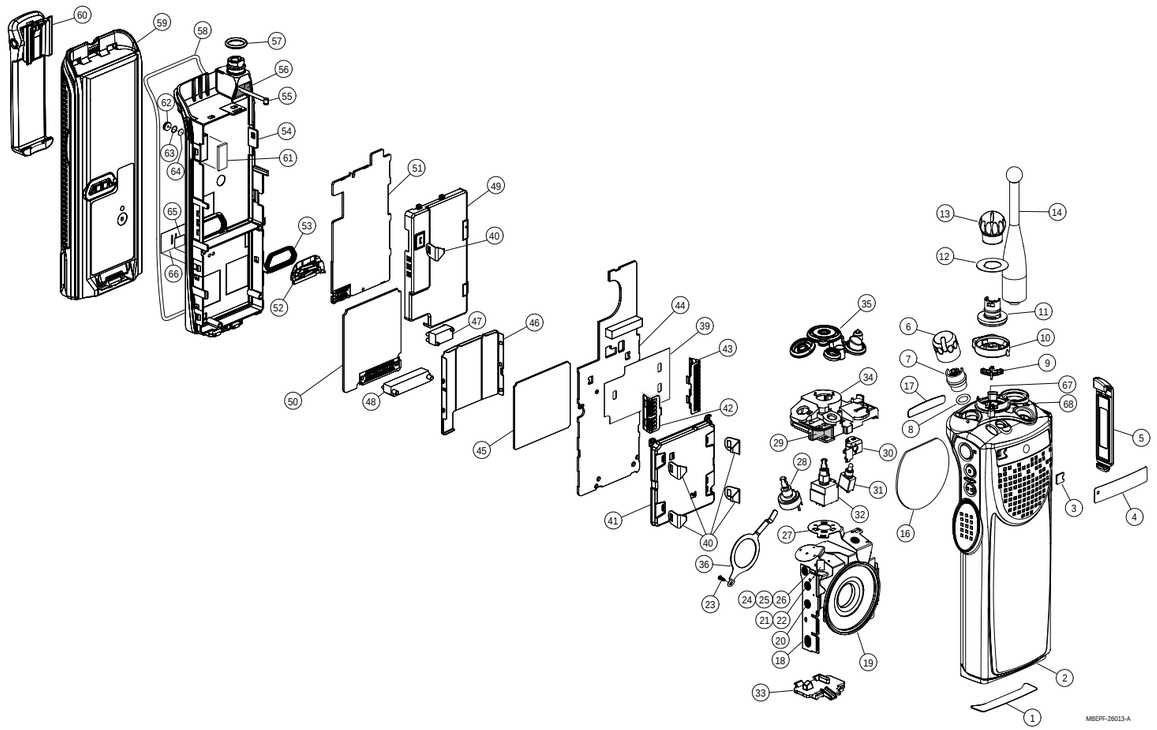
0105956V33 Controller Flex Circuit Detail



0105956V33 Controller Flex Electrical Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR:
C1	2113740F45	56 pF
		DIODE:
D1, D2, D3, D5, D6	4805729G63	LED, Dual
		CONNECTOR:
J1	0905313Z01	
		SPEAKER:
LS1	5005213W02	
		MICROPHONE:
MK1	5005227J07	
		CONNECTOR
P101	2880422L02	
		RESISTOR:
R1	0660076A96	91k
R2	0660076A93	68k
R3	0660076B05	150k
R4, R5, R6, R7	0662057A27	120
		SWITCH:
S1	1805629V01	Potentiometer
S2	4005572W01	3-Pole; 3 Position
		SWITCH:
SB1, SB2, SB3	0905310Z01	Pushbutton
SW2	3905517V01	Pushbutton
SW3	3905329W01	Pushbutton
		MODULE:
U1	4002622J03	

0105956V33 Controller Flex Schematic and Parts List



Model I Exploded View and Parts List

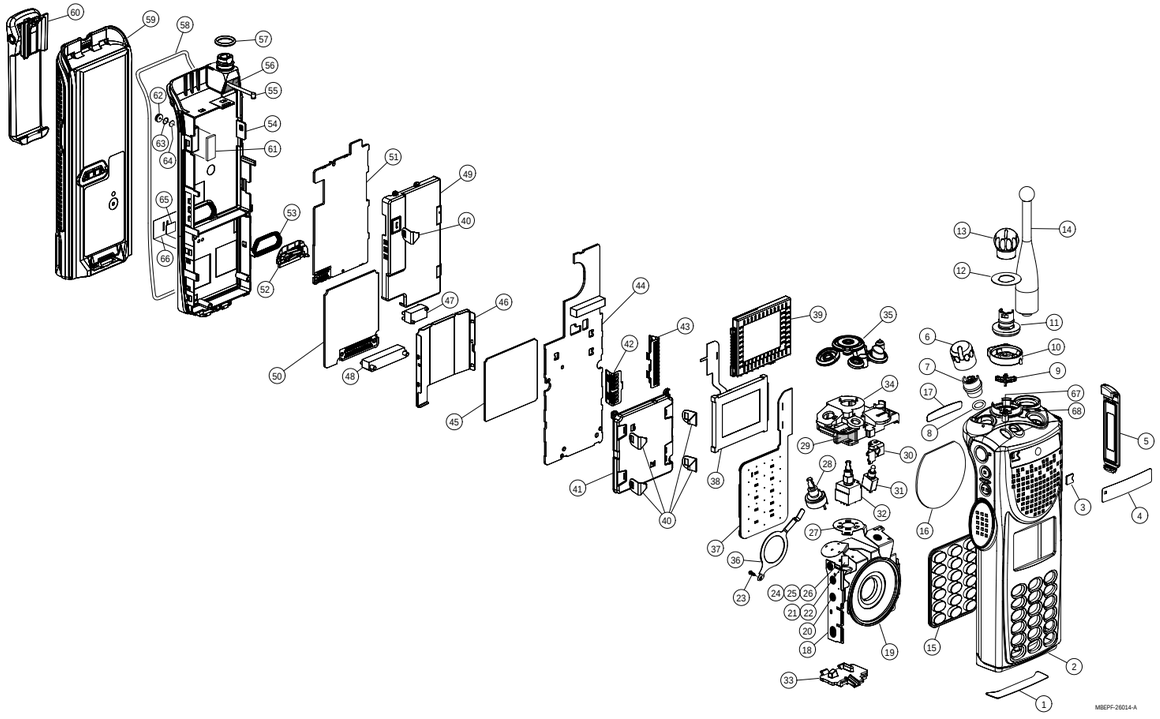
Model I Exploded View Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
1	3305630Z01	LABEL, Motorola Bottom
2	1585505D02 *or* 1585504D05 *or* 1585504D06	ASSEMBLY, Model I Housing (See Note 1) ASSEMBLY, Model I Housing (R Model) (See Note 1) ASSEMBLY, Model I Housing (Yellow R Model) (See Note 1)
3	3505586Z02 *or* 3585626B01	GRILLCLOTH, Microphone Front MESH, Microphone Front (R Models)
4	3385619B01 *or* 3385619B02 *or* 3385619B03	LABEL, Motorola Front LABEL, Motorola Front (R Model) LABEL, Motorola Front (Yellow R Model)
5	1505579Z01	COVER, Accessory Connector
6	3605371Z01	KNOB, Volume
7	4305372Z01	INSERT, Volume Knob Retainer
8	3205379W01	O-RING, Volume Torque
9	6105376Z01	LIGHTPIPE, Indicator
10	4505375Z01	LEVER, Secure
11	4305373Z02	INSERT, Frequency Knob Retainer
12	1305374Z03	ESCUTCHEON, Frequency Dial
13	3605370Z01	KNOB, Frequency
14	NAD6563_ *or* NAD6566_ *or* NAD6567_ *or* NAD6568_ *or* NAE6546_ *or* NAE6547_ *or* NAE6548_ *or* NAE6549_ *or* NAF5037_ *or* NAF5039_ *or* NAF5042_	ANTENNA, VHF Wideband Helical (136-174MHz) ANTENNA, VHF Helical (136-151MHz) ANTENNA, VHF Helical (151-162MHz) ANTENNA, VHF Helical (162-174MHz) ANTENNA, UHF Helical (403-435MHz) ANTENNA, UHF Helical (435-470MHz) ANTENNA, UHF Helical (470-512MHz) ANTENNA, UHF Wideband Whip (403-520MHz) ANTENNA, 800MHz Whip (806-870MHz) ANTENNA, 800MHz Dipole (806-870MHz) ANTENNA, 800MHz Stubby Quarterwave (806-870MHz)
16	3505340Z02	MESH, Speaker
17	3305574Z01 *or* 3305574Z02	LABEL, Motorola Back LABEL, Motorola Back (Yellow R Model)
18	0105956V33	ASSEMBLY, Controls Universal Flex (includes items 19 thru 22, 24 thru 28, and 30 thru 32)
19	5085962A03 *or* 5085962A05	SPEAKER (part of item 18) SPEAKER (part of item 18) (R Models)
20	3905667Z02	POPPLES, PTT and Side Button (part of item 18)
21	- - - - - - - - - -	MICROPHONE, Electret (part of item 18) (Not Field Replaceable)
22	- - - - - - - - - -	CAPACITOR, 56pF (part of item 18) (Not Field Replaceable)
23	0300140332	SCREW, Tapping - 28 x 3/16
24	0660076A93	RESISTOR, 68kΩ (part of item 18)
25	0660076A96	RESISTOR, 91kΩ (part of item 18)
26	0660076B05	RESISTOR, 150kΩ (part of item 18)
27	4805729G63	LED, Green/Red (5 req'd) (part of item 18)
28	1805629V04	POTENTIOMETER, Volume (part of item 18)
29	7505748Z01	PAD, Microphone Boot (non-R models only)
30	1405332Z01 *or* 1486164A01	BOOT, Microphone Boot (part of item 18) BOOT, Microphone Boot (part of item 18)(R Models)
31	4005572W04	SWITCH, Toggle, 3 Pos. A/B/C (part of item 18)
32	4002622J04	SWITCH, Frequency (part of item 18)
33	0705357Z01	BRACKET, Controls Bottom
34	0705352Z02	BRACKET, Controls
35	3205354Z04	SEAL, Controls
36	4205338Z02	RETAINER, Speaker
39	1405874Z01	INSULATOR, Control Front
40	4205631Z01	CLIP, Control Locking
41	2605342Z02	SHIELD, Controller Front
42	0705330Z01	BRACKET, Flex Attach Display
43	0705368Z01	BRACKET, Flex Attach Keypad
44	NCN6128_ *or* NCN6167_	KIT, Controller Board (See Note 2) KIT, Controller Board (See Note 2)
45	NTN8253B *or* NTN8254B *or* NTN8255A *or* NTN8256B *or* NTN8257B *or* NTN8258A *or* NTN8259A *or* NTN8260B *or* NTN8261B *or* NTN8326A *or* NTN8328A *or* NTN8329A *or* NTN8330A *or* NTN8331A *or* NTN8418A *or* PLN7748A *or* PLN7750A	KIT, DES Encryption Board KIT, DES-XL Encryption Board KIT, DES-OFB Encryption Board KIT, DVI-XL Encryption Board KIT, DVP-XL Encryption Board KIT, DES-OFB and DES-XL Encryption Board KIT, DES-OFB and DVP-XL Encryption Board KIT, DES-XL and DVP-XL Encryption Board KIT, DVP-XL and DVI-XL Encryption Board KIT, DES-OFB and DVI-XL Encryption Board KIT, DVP Encryption Board KIT, DVI-XL and DVP Encryption Board KIT, DVP and DES-XL Encryption Board KIT, DVP and DVP-XL Encryption Board KIT, DES-OFB and DES Encryption Board DVI-XL Variant Tag8 Variant Tag6
46	2605344Z01	SHIELD, Vocoder with Insulators
47	2805216Z03	CONNECTOR, Compression, 20-Pin
48	2805214Z03	CONNECTOR, Compression, 50-Pin
49	2605343Z07	SHIELD, RF with Insulator
50	NTN8250_	KIT, Vocoder Board
51	NUF6472_ *or* NLE4249_ *or* NLE4250_ *or* NLD8898_	KIT, 800MHz RF Board KIT, UHF Range 1 RF Board KIT, UHF Range 2 RF Board KIT, VHF RF Board
52	0905585Z02 *or* 0905585Z03	ASSEMBLY, B+ ASSEMBLY, B+ (R Models)
53	3205351Z02	SEAL, B+
54	1505348Z01 *or* 1505348Z10	ASSEMBLY, Casting ASSEMBLY, Casting (R Models, 4-Hole Vent Port)
55	3005664Z01	ASSEMBLY, Coaxial Cable
56	7505487Z01	PAD, Coaxial
57	3205082E96	GASKET, O-Ring Bushing
58	3205349Z03 *or* 3205349Z04	SEAL, Main SEAL, Main (R Models)
59	NTN8294_ *or* NTN8298_ *or* NTN8297_	BATTERY, NiCd BATTERY, NiMH BATTERY, NiCd (Ruggedized)
60	NTN8266_	KIT, Belt Clip
61	7505922Z01	PAD, Thermal
62	0286165A03	NUT, Spanner
63	3205300V01	SEAL, O-Ring
64	3205472M03	SEAL, Port (No longer used.)
65	3285877B01 *or* 3285877B02	SEAL, Port (R Models, 2-Hole Vent Port) SEAL, Port (R Models, 4-Hole Vent Port)
66	3385873B01	LABEL, Seal
67	3385657D01 *or* 3385657D02	LABEL, ABC, Black Housing (optional—need if housing is not pad printed) LABEL, ABC, Yellow Housing (optional—need if housing is not pad printed)
68	3385658D01 *or* 3385658D02	LABEL, Toggle, Black Housing (optional—need if housing is not pad printed) LABEL, Toggle, Yellow Housing (optional—need if housing is not pad printed)

Notes: 1. The 1585504D05 and 1585504D06 ruggedized housing assemblies are ***not*** interchangeable with the 1585505D02 standard housing assembly.

2. The NCN6167_ Controller Board is ***not*** interchangeable with the NCN6128_ Controller Board.

Caution Depending on the ruggedized casting (54) configuration (two or four hole vent port), use the appropriate vent port seal (65) as indicated in this parts list.



Models II and III Exploded View and Parts List

Models II and III Exploded View Parts List

ITEM	MOTOROLA PART NUMBER	DESCRIPTION
1	3305630Z01	LABEL, Motorola Bottom
2	1585506D03	ASSEMBLY, Model III Housing (See Note 1)
	or 1585507D06	ASSEMBLY, Model III Housing (R Model) (See Note 1)
	or 1585507D08	ASSEMBLY, Model III Housing (Yellow R Model) (See Note 1)
	or 1585506D04	ASSEMBLY, Model II Housing (See Note 1)
	or 1585507D07	ASSEMBLY, Model II Housing (R Model) (See Note 1)
	or 1585507D09	ASSEMBLY, Model II Housing (Yellow R Model) (See Note 1)
3	3505586Z02	GRILLCLOTH, Microphone Front
	or 3585626B01	MESH, Microphone Front (R Models)
4	3385619B01	LABEL, Motorola Front
	or 3385619B02	LABEL, Motorola Front (R Models)
	or 3385619B03	LABEL, Motorola Front (Yellow R Models)
5	1505579Z01	COVER, Accessory Connector
6	3605371Z01	KNOB, Volume
7	4305372Z01	INSERT, Volume Knob Retainer
8	3205379W01	O-RING, Volume Torque
9	6105376Z01	LIGHTPIPE, Indicator
10	4505375Z01	LEVER, Secure
11	4305373Z02	INSERT, Frequency Knob Retainer
12	1305374Z03	ESCUTCHEON, Frequency Dial
13	3605370Z01	KNOB, Frequency
14	NAD6563_	ANTENNA, VHF Wideband Helical (136-174MHz)
	or NAD6566_	ANTENNA, VHF Helical (136-151MHz)
	or NAD6567_	ANTENNA, VHF Helical (151-162MHz)
	or NAD6568_	ANTENNA, VHF Helical (162-174MHz)
	or NAE6546_	ANTENNA, UHF Helical (403-435MHz)
	or NAE6547_	ANTENNA, UHF Helical (435-470MHz)
	or NAE6548_	ANTENNA, UHF Helical (470-512MHz)
	or NAE6549_	ANTENNA, UHF Wideband Whip (403-520MHz)
	or NAF5037_	ANTENNA, 800MHz Whip (806-870MHz)
	or NAF5039_	ANTENNA, 800MHz Dipole (806-870MHz)
	or NAF5042_	ANTENNA, 800MHz Stubby Quarterwave (806-870MHz)
15	7505293Z01	KEYPAD, Model III
	or 7505293Z02	KEYPAD, Model III (R Models)
	or 7585696A01	KEYPAD, Model II
	or 7585696A02	KEYPAD, Model II (R Models)
16	3505340Z02	MESH, Speaker
17	3305574Z01	LABEL, Motorola Back
	or 3305574Z02	LABEL, Motorola Back (Yellow R Models)
18	0105956V33	ASSEMBLY, Controls Universal Flex (includes items 19 thru 22, 24 thru 28, and 30 thru 32)
19	5085962A03	SPEAKER (part of item 18)
	or 5085962A05	SPEAKER (part of item 18) (R Models)
20	3905667Z02	POPPLES, PTT and Side Button (part of item 18)
21	- - - - - - - - - -	MICROPHONE, Electret (part of item 18) (Not Field Replaceable)
22	- - - - - - - - - -	CAPACITOR, 56pF (part of item 18) (Not Field Replaceable)
23	0300140332	SCREW, Tapping - 28 x 3/16
24	0660076A93	RESISTOR, 68kΩ (part of item 18)
25	0660076A96	RESISTOR, 91kΩ (part of item 18)
26	0660076B05	RESISTOR, 150kΩ (part of item 18)
27	4805729G63	LED, Green/Red (5 req'd) (part of item 18)
28	1805629V04	POTENTIOMETER, Volume (part of item 18)
29	7505748Z01	PAD, Microphone Boot (non-R models)
30	1405332Z01	BOOT, Microphone Boot (part of item 18)
	or 1486164A01	BOOT, Microphone Boot (part of item 18) (R Models)
31	4005572W04	SWITCH, Toggle, 3 Pos. A/B/C (part of item 18)
32	4002622J04	SWITCH, Frequency (part of item 18)
33	0705357Z01	BRACKET, Controls Bottom
34	0705352Z02	BRACKET, Controls
35	3205354Z04	SEAL, Controls
36	4205338Z02	RETAINER, Speaker
37	NTN8311_	KIT, Keypad Flex Assembly, Model III
	or NTN8493_	KIT, Keypad Flex Assembly, Model II
38	5105385Y19	MODULE, LCD
39	7505336Z01	PAD, Display Locator
40	4205631Z01	CLIP, Control Locking
41	2605342Z01	SHIELD, Controller Front
42	0705330Z01	BRACKET, Flex Attach Display
43	0705368Z01	BRACKET, Flex Attach Keypad
44	NCN6128_	KIT, Controller Board (See Note 2)
	or NCN6167_	KIT, Controller Board (See Note 2)
45	NTN8253B	KIT, DES Encryption Board
	or NTN8254B	KIT, DES-XL Encryption Board
	or NTN8255A	KIT, DES-OFB Encryption Board
	or NTN8256B	KIT, DVI-XL Encryption Board
	or NTN8257B	KIT, DVP-XL Encryption Board
	or NTN8258A	KIT, DES-OFB and DES-XL Encryption Board
	or NTN8259A	KIT, DES-OFB and DVP-XL Encryption Board
	or NTN8260B	KIT, DES-XL and DVP-XL Encryption Board
	or NTN8261B	KIT, DVP-XL and DVI-XL Encryption Board
	or NTN8326A	KIT, DES-OFB and DVI-XL Encryption Board
	or NTN8328A	KIT, DVP Encryption Board
	or NTN8329A	KIT, DVI-XL and DVP Encryption Board
	or NTN8330A	KIT, DVP and DES-XL Encryption Board
	or NTN8331A	KIT, DVP and DVP-XL Encryption Board
	or NTN8418A	KIT, DES-OFB and DES Encryption Board
	or PLN7748A	DVI-XL Variant Tag8
	or PLN7750A	Variant Tag6
46	2605344Z01	SHIELD, Vocoder with Insulators
47	2805216Z03	CONNECTOR, Compression, 20-Pin
48	2805214Z03	CONNECTOR, Compression, 50-Pin
49	2605343Z07	SHIELD, 800MHz with Insulator
50	NTN8250_	KIT, Vocoder Board
51	NUF6472_	KIT, 800MHz RF Board
	or NLE4249_	KIT, UHF Range 1 RF Board
	or NLE4250_	KIT, UHF Range 2 RF Board
	or NLD8898_	KIT, VHF RF Board
52	0905585Z02	ASSEMBLY, B+
	or 0905585Z03	ASSEMBLY, B+ (R Models)
53	3205351Z02	SEAL, B+
54	1505348Z01	ASSEMBLY, Casting
	or 1505348Z10	ASSEMBLY, Casting (R Models, 4-Hole Vent Port)
55	3005664Z01	ASSEMBLY, Coaxial Cable
56	7505487Z01	PAD, Coax
57	3205082E96	GASKET, O-Ring Bushing
58	3205349Z03	SEAL, Main
	or 3205349Z04	SEAL, Main (R Models)
59	NTN8294_	BATTERY, NiCd
	or NTN8298_	BATTERY, NiMH
	or NTN8297_	BATTERY, NiCd (Ruggedized)
60	NTN8266_	KIT, Belt Clip
61	7505922Z01	PAD, Thermal
62	0286165A03	NUT, Spanner
63	3205300V01	SEAL, O-Ring
64	3205472M03	SEAL, Port (No longer used.)
65	3285877B01	SEAL, Port (R Models, 2-Hole Vent Port)
	or 3285877B02	SEAL, Port (R Models, 4-Hole Vent Port)
66	3385873B01	LABEL, Seal
67	3385657D01	LABEL, ABC, Black Housing (optional—need if housing is not pad printed)
	or 3385657D02	LABEL, ABC, Yellow Housing (optional—need if housing is not pad printed)
68	3385658D01	LABEL, Toggle, Black Housing (optional—need if housing is not pad printed)
	or 3385658D02	LABEL, Toggle, Yellow Housing (optional—need if housing is not pad printed)

Notes: 1. The 1585507D07 and 1585507D09 ruggedized housing assemblies are ***not*** interchangeable with the 1585506D04 standard housing assembly. The 1585507D06 and 1585507D08 ruggedized housing assemblies are ***not*** interchangeable with the 1585506D03 standard housing assembly.

2. The NCN6167_ Controller Board is ***not*** interchangeable with the NCN6128_ Controller Board.

Caution Depending on the ruggedized casting (54) configuration (two or four hole vent port), use the appropriate vent port seal (65) as indicated in this parts list.

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Replacement Parts Ordering

Basic Ordering Information

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

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Product Customer Service

Customer Response Center
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1-800-247-2346
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