ASTRO® XTS™ 5000

VHF
UHF Range 1
700 — 800 MHz
Digital Portable Radios

Detailed Service Manual

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ASTRO® XTS™ 5000

VHF/UHF Range 1/700–800 MHz
Digital Portable Radios

Detailed Service Manual

Motorola, Inc.
8000 West Sunrise Boulevard
Fort Lauderdale, Florida 33322

6881094C31-C

Foreword

The information contained in this manual relates to all ASTRO® XTS™ 5000 digital portable radios, unless otherwise specified. This manual provides sufficient information to enable qualified service shop technicians to troubleshoot and repair an ASTRO XTS 5000 digital 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 xii.

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 Customer Care and Services Division (refer to “Appendix A Replacement Parts Ordering”).

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Related Publications

ASTRO XTS 5000 Digital Portable Radio Model I User Guide 6881094C25
ASTRO XTS 5000 Digital Portable Radio Model II User Guide 6881094C26
ASTRO XTS 5000 Digital Portable Radio Model III User Guide 6881094C27
ASTRO XTS 5000 VHF/UHF Range 1/700–800 MHz Digital Portable Radios Basic Service Manual 6881094C28
Factory Mutual Approval XTS 5000 Product Listing Manual Supplement..... 6881094C78

Commercial Warranty

Limited Warranty

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Product Accessories	One (1) Year

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C. should the Product or parts become, or in MOTOROLA's opinion be likely to become, the subject of a claim of infringement of a United States patent, that such purchaser will permit MOTOROLA, at its option and expense, either to procure for such purchaser the right to continue using the Product or parts or to replace or modify the same so that it becomes noninfringing or to grant such purchaser a credit for the Product or parts as depreciated and accept its return. The depreciation will be an equal amount per year over the lifetime of the Product or parts as established by MOTOROLA.

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Laws in the United States and other countries preserve for MOTOROLA certain exclusive rights for copyrighted MOTOROLA software such as the exclusive rights to reproduce in copies and distribute copies of such Motorola software. MOTOROLA software may be used in only the Product in which the software was originally embodied and such software in such Product may not be replaced, copied, distributed, modified in any way, or used to produce any derivative thereof. No other use including, without limitation, alteration, modification, reproduction, distribution, or reverse engineering of such MOTOROLA software or exercise of rights in such MOTOROLA software is permitted. No license is granted by implication, estoppel or otherwise under MOTOROLA patent rights or copyrights.

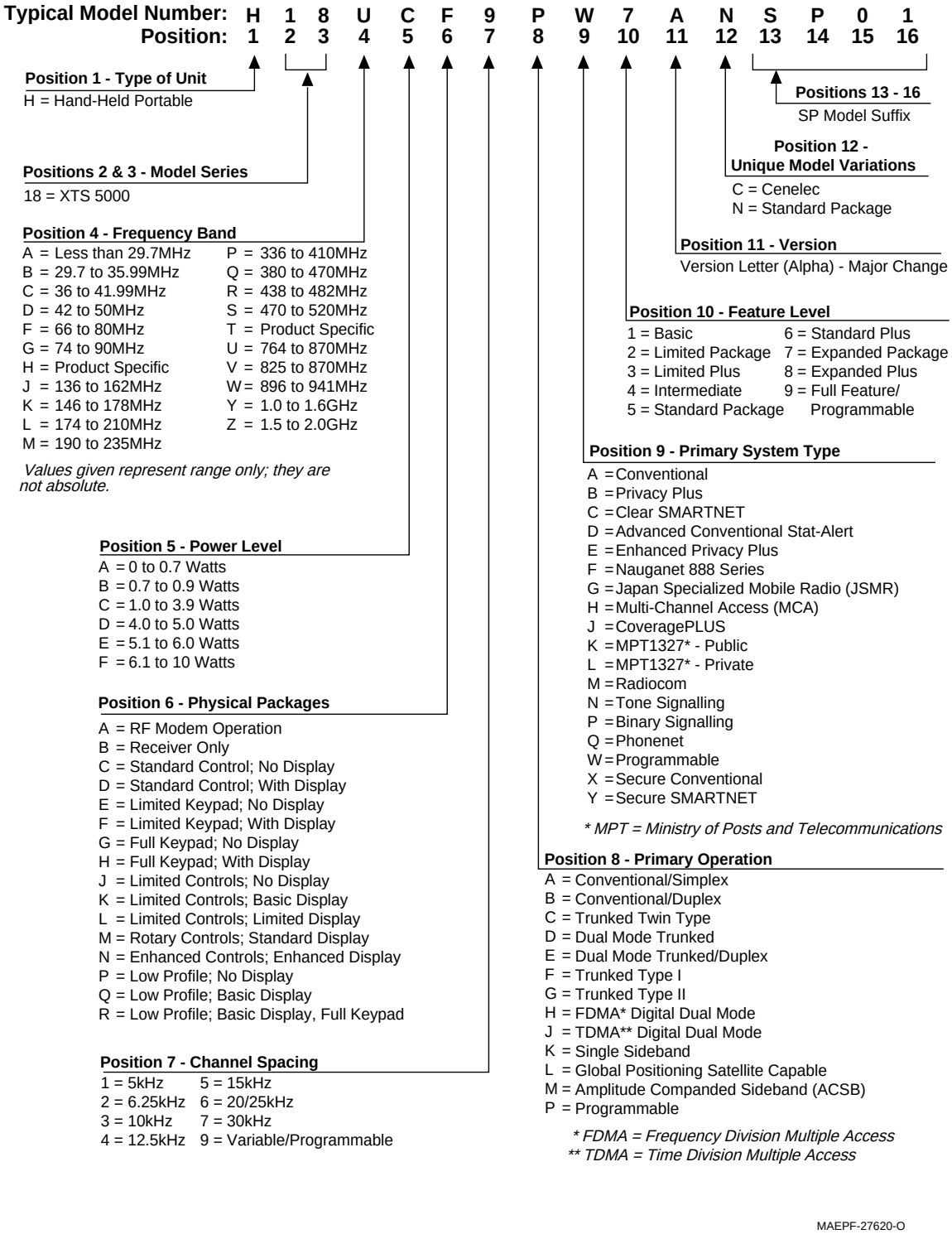
VII. Governing Law

This Warranty is governed by the laws of the State of Illinois, USA.

Notes

Model Numbering, Charts, and Specifications

Portable Radio Model Numbering System



ASTRO XTS 5000 VHF Model Chart

MODEL NUMBER					DESCRIPTION
H18KEC9PW5AN					VHF 1-6 Watts ASTRO XTS 5000 Model I
	H18KEF9PW6AN				VHF 1-6 Watts ASTRO XTS 5000 Model II
		H18KEH9PW7AN			VHF 1-6 Watts ASTRO XTS 5000 Model III
				ITEM NUMBER	DESCRIPTION
X	X	X		NLD8910_	Board, Transceiver (VHF)
X	X	X		NNTN4563_ or, NNTN4717_	Board, VOCON***** Board, VOCON*****
X	X	X		—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X		—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X				NTN9682_	Kit, Front Cover, Model I
	X			NTN9681_	Kit, Front Cover, Model II
		X		NTN9680_	Kit, Front Cover, Model III
X	X	X		—	Antenna, VHF (Refer to the Basic Service Manual accessories appendix)
X	X	X		0985973B02	Assembly, B+ Connector
X	X	X		1505579Z01	Cover, Accessory Connector
X				2685567D01	Assembly, VOCON Shield, Model I
	X			2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X		2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X		2685220D08	Shield, RF (Transceiver) Board
X	X	X		2785219D01	Assembly, Casting
X	X	X		2885866A01	Connector, Compression, 26-Pin
X	X	X		3285900E01	Gasket, Antenna O-Ring
X	X	X		3205349Z03	Seal, Main
X	X	X		3205351Z02	Seal, B+
X	X	X		3285877B02	Seal, Port
X	X	X		3385873B01	Label, Port
	X	X		7285726C02	Module, LCD Display
	X	X		7585189D01	Pad, Display Locator
X	X	X		7585936D02	Pad, RF
X	X	X		7585139E01	Pad, Battery holder
	X			7585104D02	Keypad, Model II
		X		7585104D01	Keypad, Model III

Notes:

X *= Item Included*

***** *= The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON 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 Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.*

ASTRO XTS 5000 R (Ruggedized) VHF Model Chart

MODEL NUMBER								DESCRIPTION
H18KEC9PW5AN w/Q155FE Opt								Ruggedized VHF 1-6 Watts ASTRO XTS 5000 Model I
	H18KEF9PW6AN w/Q155FF Opt							Ruggedized VHF 1-6 Watts ASTRO XTS 5000 Model II
		H18KEH9PW7AN w/Q155FG Opt						Ruggedized VHF 1-6 Watts ASTRO XTS 5000 Model III
			H18KEC9PW5AN w/Q155FS Opt					Ruggedized Yellow VHF 1-6 Watts ASTRO XTS 5000 Model I
				H18KEF9PW6AN w/Q155FT Opt				Ruggedized Yellow VHF 1-6 Watts ASTRO XTS 5000 Model II
					H18KEH9PW7AN w/Q155FU Opt			Ruggedized Yellow VHF 1-6 Watts ASTRO XTS 5000 Model III
							ITEM NUMBER	**DESCRIPTION**
X	X	X	X	X	X		NLD8910_	Board, Transceiver (VHF)
X	X	X	X	X	X		NNTN4563_ or, NNTN4717_	Board, VOCON***** Board, VOCON*****
X	X	X	X	X	X		—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X		—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X							NNTN4059_	Kit, Front Cover, Model I, Ruggedized
	X						NNTN4060_	Kit, Front Cover, Model II, Ruggedized
		X					NNTN4061_	Kit, Front Cover, Model III, Ruggedized
			X				NTN9685_	Kit, Yellow Front Cover, Model I, Ruggedized
				X			NTN9684_	Kit, Yellow Front Cover, Model II, Ruggedized
					X		NTN9683_	Kit, Yellow Front Cover, Model III, Ruggedized
X	X	X	X	X	X		—	Antenna, VHF (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X		0985973B02	Assembly, B+ Connector
X	X	X	X	X	X		1505579Z01	Cover, Accessory Connector
X			X				2685567D01	Assembly, VOCON Shield, Model I
	X			X			2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X			X		2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X	X	X	X		2685220D08	Shield, RF (Transceiver) Board
X	X	X	X	X	X		2785219D04	Assembly, Ruggedized Casting
X	X	X	X	X	X		2885866A01	Connector, Compression, 26-Pin
X	X	X	X	X	X		3285900E01	Gasket, Antenna O-Ring
X	X	X	X	X	X		3205349Z03	Seal, Main
X	X	X	X	X	X		3205351Z02	Seal, B+
X	X	X	X	X	X		3285877B02	Seal, Port
X	X	X	X	X	X		3385873B01	Label, Port
	X	X		X	X		7285726C02	Module, LCD Display
	X	X		X	X		7585189D01	Pad, Display Locator
X	X	X	X	X	X		7585936D02	Pad, RF
X	X	X	X	X	X		7585139E01	Pad, Battery holder
X	X	X	X	X	X		3285688D01	Plug, Vacuum test port
	X			X			7585104D02	Keypad, Model II
		X			X		7585104D01	Keypad, Model III

Notes:

X *= Item Included*

***** *= The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON 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 Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.*

ASTRO XTS 5000 UHF Range 1 Model Chart

MODEL NUMBER								DESCRIPTION
H18QDC9PW5AN								UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model I
	H18QDF9PW6AN							UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model II
		H18QDH9PW7AN						UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model III
			H18QCC9PW5AN					UHF Range 1, Low Power, 20 mW - 2 Watts ASTRO XTS 5000 Model I
				H18QCF9PW6AN				UHF Range 1, Low Power, 20 mW - 2 Watts ASTRO XTS 5000 Model II
					H18QCH9PW7AN			UHF Range 1, Low Power, 20 mW - 2 Watts ASTRO XTS 5000 Model III
							ITEM NUMBER	DESCRIPTION
X	X	X					NLE4272_	Board, Transceiver (UHF)
			X	X	X		NLE4278_	Board, Transceiver (UHF) Low Power
X	X	X	X	X	X		NNTN4819_ or, NNTN4717_	Board, VOCON* Board, VOCON*
X	X	X	X	X	X		—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X		—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X			X				NTN9682_	Kit, Front Cover, Model I
	X			X			NTN9681_	Kit, Front Cover, Model II
		X			X		NTN9680_	Kit, Front Cover, Model III
X	X	X	X	X	X		—	Antenna, UHF (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X		0985973B02	Assembly, B+ Connector
X	X	X	X	X	X		1505579Z01	Cover, Accessory Connector
X			X				2685567D01	Assembly, VOCON Shield, Model I
	X			X			2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X			X		2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X	X	X	X		2685220D08	Shield, RF (Transceiver) Board
X	X	X	X	X	X		2785219D01	Assembly, Casting
X	X	X	X	X	X		2885866A01	Connector, Compression, 26-Pin
X	X	X	X	X	X		3285900E01	Gasket, Antenna O-Ring
X	X	X	X	X	X		3205349Z03	Seal, Main
X	X	X	X	X	X		3205351Z02	Seal, B+
X	X	X	X	X	X		3285877B02	Seal, Port
X	X	X	X	X	X		3385873B01	Label, Port
	X	X		X	X		7285726C03	Module, LCD Display
	X	X		X	X		7585189D01	Pad, Display Locator
X	X	X	X	X	X		7585936D04	Pad, RF
X	X	X	X	X	X		7585139E01	Pad, Battery holder
	X			X			7585104D02	Keypad, Model II
		X			X		7585104D01	Keypad, Model III

Notes:

X *= Item Included*

***** *= The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON 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 Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.*

ASTRO XTS 5000 R (Ruggedized) UHF Range 1 Model Chart

MODEL NUMBER											DESCRIPTION
H18QDC9PW5AN w/Q155FE Opt											Ruggedized UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model I
	H18QDF9PW6AN w/Q155FF Opt										Ruggedized UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model II
		H18QDH9PW7AN w/Q155FG Opt									Ruggedized UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model III
			H18QDC9PW5AN w/Q155FS Opt								Ruggedized Yellow UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model I
				H18QDF9PW6AN w/Q155FT Opt							Ruggedized Yellow UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model II
					H18QDH9PW7AN w/Q155FU Opt						Ruggedized Yellow UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model III
						H18QCC9PW5AN wQ155HW Opt					Ruggedized UHF R1, Low Pwr, 20 mW-2 Watts ASTRO XTS 5000 Model I
							H18QCF9PW6AN wQ155HX Opt				Ruggedized UHF R1, Low Pwr, 20 mW-2 Watts ASTRO XTS 5000 Model II
								H18QCH9PW7AN wQ155HY Opt			Ruggedized UHF R1, Low Pwr, 20 mW-2 Watts ASTRO XTS 5000 Model III
										ITEM NUMBER	DESCRIPTION
X	X	X	X	X	X	X	X	X		NLE4272_	Board, Transceiver (UHF)
X	X	X	X	X	X	X	X	X		NLE4278_	Board, Transceiver (UHF) Low Power
X	X	X	X	X	X	X	X	X		NNTN4819_ or, NNTN4717_	Board, VOCON* Board, VOCON**
X	X	X	X	X	X	X	X	X		—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	X	X	X		—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X						X				NNTN4059_	Kit, Front Cover, Model I, Ruggedized
	X						X			NNTN4060_	Kit, Front Cover, Model II, Ruggedized
		X						X		NNTN4061_	Kit, Front Cover, Model III, Ruggedized
			X							NTN9685_	Kit, Yellow Front Cover, Model I, Ruggedized
				X						NTN9684_	Kit, Yellow Front Cover, Model II, Ruggedized
					X					NTN9683_	Kit, Yellow Front Cover, Model III, Ruggedized
X	X	X	X	X	X	X	X	X		—	Antenna, UHF (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	X	X	X		0985973B02	Assembly, B+ Connector
X	X	X	X	X	X	X	X	X		1505579Z01	Cover, Accessory Connector
X			X			X				2685567D01	Assembly, VOCON Shield, Model I
	X			X			X			2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X			X			X		2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X	X	X	X	X	X	X		2685220D08	Shield, RF (Transceiver) Board
X	X	X	X	X	X	X	X	X		2785219D04	Assembly, Ruggedized Casting
X	X	X	X	X	X	X	X	X		2885866A01	Connector, Compression, 26-Pin
X	X	X	X	X	X	X	X	X		3285900E01	Gasket, Antenna O-Ring
X	X	X	X	X	X	X	X	X		3205349Z03	Seal, Main
X	X	X	X	X	X	X	X	X		3205351Z02	Seal, B+
X	X	X	X	X	X	X	X	X		3285877B02	Seal, Port
X	X	X	X	X	X	X	X	X		3385873B01	Label, Port
	X	X		X	X		X	X		7285726C03	Module, LCD Display
	X	X		X	X		X	X		7585189D01	Pad, Display Locator
X	X	X	X	X	X	X	X	X		7585936D04	Pad, RF
X	X	X	X	X	X	X	X	X		7585139E01	Pad, Battery holder
X	X	X	X	X	X	X	X	X		3285688D01	Plug, Vacuum test port
	X			X			X			7585104D02	Keypad, Model II
		X			X			X		7585104D01	Keypad, Model III

Notes:

X *= Item Included*

***** *= The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON 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 Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.*

ASTRO XTS 5000 700–800 MHz Model Chart

MODEL NUMBER					DESCRIPTION
H18UCC9PW5AN					700/800 MHz 1-3 Watts ASTRO XTS 5000 Model I
	H18UCF9PW6AN				700/800 MHz 1-3 Watts ASTRO XTS 5000 Model II
		H18UCH9PW7AN			700/800 MHz 1-3 Watts ASTRO XTS 5000 Model III
				ITEM NUMBER	**DESCRIPTION**
X	X	X		NUF3577_	Board, Transceiver (700/800 MHz)
X	X	X		NTN9564_ or, NNTN4717_	Board, VOCON***** Board, VOCON*****
X	X	X		—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X		—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X				NTN9682_	Kit, Front Cover, Model I
	X			NTN9681_	Kit, Front Cover, Model II
		X		NTN9680_	Kit, Front Cover, Model III
X	X	X		—	Antenna, 700/800 MHz (Refer to the Basic Service Manual accessories appendix)
X	X	X		0985973B02	Assembly, B+ Connector
X	X	X		1505579Z01	Cover, Accessory Connector
X				2685567D01	Assembly, VOCON Shield, Model I
	X			2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X		2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X		2685220D08	Shield, RF (Transceiver) Board
X	X	X		2785219D01	Assembly, Casting
X	X	X		2885866A01	Connector, Compression, 26-Pin
X	X	X		3285900E01	Gasket, Antenna O-Ring
X	X	X		3205349Z03	Seal, Main
X	X	X		3205351Z02	Seal, B+
X	X	X		3285877B02	Seal, Port
X	X	X		3385873B01	Label, Port
	X	X		7285726C01 or, 7285726C02	Module, LCD Display (for use only with the NTN9564_VOCON board) Module, LCD Display (for use only with the NNTN4717_VOCON board)
	X	X		7585189D01	Pad, Display Locator
X	X	X		7585936D04	Pad, RF
X	X	X		7585139E01	Pad, Battery holder
	X			7585104D02	Keypad, Model II
		X		7585104D01	Keypad, Model III

Notes:

X *= Item Included*

***** *= The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON 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 Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.*

ASTRO XTS 5000 R (Ruggedized) 700–800 MHz Model Chart

MODEL NUMBER								DESCRIPTION
H18UCC9PW5AN w/Q155FP Opt								Ruggedized 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model I
	H18UCF9PW6AN w/Q155FQ Opt							Ruggedized 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model II
		H18UCH9PW7AN w/Q155FR Opt						Ruggedized 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model III
			H18UCC9PW5AN w/Q155GB Opt					Ruggedized Yellow 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model I
				H18UCF9PW6AN w/Q155GC Opt				Ruggedized Yellow 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model II
					H18UCH9PW7AN w/Q155GD Opt			Ruggedized Yellow 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model III
							ITEM NUMBER	**DESCRIPTION**
X	X	X	X	X	X		NUF3577_	Board, Transceiver (700/800 MHz)
X	X	X	X	X	X		NTN9564_ or, NNTN4717_	Board, VOCON* Board, VOCON*
X	X	X	X	X	X		—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X		—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X							NNTN4059_	Kit, Front Cover, Model I, Ruggedized
	X						NNTN4060_	Kit, Front Cover, Model II, Ruggedized
		X					NNTN4061_	Kit, Front Cover, Model III, Ruggedized
			X				NTN9685_	Kit, Yellow Front Cover, Model I, Ruggedized
				X			NTN9684_	Kit, Yellow Front Cover, Model II, Ruggedized
					X		NTN9683_	Kit, Yellow Front Cover, Model III, Ruggedized
X	X	X	X	X	X		—	Antenna, 700/800 MHz (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X		0985973B02	Assembly, B+ Connector
X	X	X	X	X	X		1505579Z01	Cover, Accessory Connector
X			X				2685567D01	Assembly, VOCON Shield, Model I
	X			X			2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X			X		2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X	X	X	X		2685220D08	Shield, RF (Transceiver) Board
X	X	X	X	X	X		2785219D04	Assembly, Ruggedized Casting
X	X	X	X	X	X		2885866A01	Connector, Compression, 26-Pin
X	X	X	X	X	X		3285900E01	Gasket, Antenna O-Ring
X	X	X	X	X	X		3205349Z03	Seal, Main
X	X	X	X	X	X		3205351Z02	Seal, B+
X	X	X	X	X	X		3285877B02	Seal, Port
X	X	X	X	X	X		3385873B01	Label, Port
	X	X		X	X		7285726C01 or, 7285726C02	Module, LCD Display (for use only with the NTN9564_VOCON board) Module, LCD Display (for use only with the NNTN4717_VOCON board)
	X	X		X	X		7585189D01	Pad, Display Locator
X	X	X	X	X	X		7585936D04	Pad, RF
X	X	X	X	X	X		7585139E01	Pad, Battery holder
X	X	X	X	X	X		3285688D01	Plug, Vacuum test port
	X			X			7585104D02	Keypad, Model II
		X			X		7585104D01	Keypad, Model III

Notes:

X *= Item Included*

***** *= The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON 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 Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.*

Specifications for VHF Radios

All specifications are per Telecommunications Industries Association TIA-603 unless otherwise noted.

GENERAL	RECEIVER	TRANSMITTER
FCC Designation: AZ489FT3804 **Temperature Range:** **Operating:** –30°C to +60°C **Storage:** –40°C to +85°C **Power Supply:** Nickel-Cadmium Battery (NiCd) *or* Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion) **Battery Voltage:** **Nominal:** 7.5 Vdc **Range:** 6 to 9 Vdc **Transmit Current Drain (Typical)**: 2100 mA **Receive Current Drain (Rated Audio):** 240 mA **Standby Current Drain:** 80 mA **Recommended Battery:** **Smart NiMH:** NNTN4435_ *or* **Ultra-HIgh-Capacity NiCd:** NTN8294_ *or* **Extended-Capacity NiMH:** NTN8293_ *or* **Li-Ion:** NTN8610_ *or* **Ultra–High-Capacity NiCd FM:** NTN8295_* *or* **Ultra–High-Capacity NiMH FM:** NTN8299_* **Optional FM (Factory Mutual) Battery:** * FM Intrinsically Safe: Class I, II, III, Division 1, Groups C, D,E, F, and G. FM Non-incendive: Class 1, Division 2, Groups A, B, C, and D. **Dimensions (H x W x D):** Note: 2.44" = width at PTT; 2.34" = width at bottom; 1.83" = depth at speaker; 0.97" = depth at keypad **Without Battery (Radio Only):** 6.58" x 2.44" x 1.83"/6.58" x 2.34" x 0.97" (167.13 mm x 61.90 mm x 46.42 mm/ 167.13 mm x 59.49 mm x 24.56 mm) **With Battery:** 6.58" x 2.44" x 1.83"/6.58" x 2.34" x 1.65" (167.13 mm x 61.90 mm x 46.42 mm/ 167.13 mm x 59.49 mm x 41.97 mm) **Weight: (w/ Antenna):** **Less Battery:** 14.10 oz (383 gm) **With Ultra-High Cap. NiCd:** 25.19 oz (693 gm) **With Li-Ion:** 20.41 oz (583 gm) **With Ultra-High Cap. NiMH:** 23.45 oz (644 gm) **With Extended- Cap. NiMH:** 24.04 oz (682 gm)	**Frequency Range:** 136-174 MHz **Bandwidth:** 38 MHz **Usable Sensitivity (typical)** **(12 dB SINAD):** 0.20 µV **Intermodulation (typical):** –75 dB **Selectivity (typical):** **(25/30 kHz Channel):** –75 dB **(12.5 kHz Channel):** –63 dB **Spurious Rejection (typical):** –75 dB **Frequency Stability** **(–30+60°C; 25°C reference):** ±0.0002% **Rated Audio:** 500 mW **FM Hum and Noise (typical):** 25 kHz –55 dB 12.5 kHz –49 dB **Distortion (typical):** 1.5% **Channel Spacing:** 12.5/25 kHz	**Frequency Range:** 136-174 MHz **RF Power:** 136-174 **MHz:** 1-6 Watts **Frequency Stability (typical)** **(–30 to +60°C; 25°C ref.):** ±0.0002% **Emission (typical conducted):** –75 dBc **FM Hum and Noise (typical)** **(Companion Receiver):** 25 kHz –48 dB 12.5 kHz –42 dB **Distortion (typical):** 1.0% (typical) **Modulation Limiting:** 25 kHz chnls ±5.0 kHz 12.5 kHz chnls ±2.5 kHz **ACPR (typical):** 25 kHz –73 dBc 12.5 kHz –63 dBc **Emissions Designators:** 20K0F1E, 16K0F3E, 11K0F3E, 8K10F1D, and 8K10F1E

Specifications subject to change without notice.

Specifications for UHF Range 1 Radios

All specifications are per Telecommunications Industries Association TIA-603 unless otherwise noted.

GENERAL	RECEIVER	TRANSMITTER
FCC Designation: AZ489FT4855 **Temperature Range:** **Operating:** –30°C to +60°C **Storage:** –40°C to +85°C **Power Supply:** Nickel-Cadmium Battery (NiCd) *or* Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion) **Battery Voltage:** **Nominal:** 7.5 Vdc **Range:** 6 to 9 Vdc **Transmit Current Drain (Typical)**: 2100 mA **Receive Current Drain (Rated Audio):** 240 mA **Standby Current Drain:** 80 mA **Recommended Battery:** **Smart NiMH:** NNTN4435 *or* **Ultra-HIgh-Capacity NiCd:** NTN8294 *or* **Extended-Capacity NiMH:** NTN8293 *or* **Li-Ion:** NTN8610 *or* **Ultra–High-Capacity NiCd FM:** NTN8295* *or* **Ultra–High-Capacity NiMH FM:** NTN8299* **Optional FM (Factory Mutual) Battery:** * FM Intrinsically Safe. **Dimensions (H x W x D):** Note: 2.44" = width at PTT; 2.34" = width at bottom; 1.83" = depth at speaker; 0.97" = depth at keypad **Without Battery (Radio Only):** 6.58" x 2.44" x 1.83"/6.58" x 2.34" x 0.97" (167.13 mm x 61.90 mm x 46.42 mm/ 167.13 mm x 59.49 mm x 24.56 mm) **With Battery:** 6.58" x 2.44" x 1.83"/6.58" x 2.34" x 1.65" (167.13 mm x 61.90 mm x 46.42 mm/ 167.13 mm x 59.49 mm x 41.97 mm) **Weight: (w/ Antenna):** **Less Battery:** 14.10 oz (383 gm) **With Ultra-High Cap. NiCd:** 25.19 oz (693 gm) **With Li-Ion:** 20.41 oz (583 gm) **With Ultra-High Cap. NiMH:** 23.45 oz (644 gm) **With Extended- Cap. NiMH:** 24.04 oz (682 gm)	**Frequency Range:** 380-470 MHz **Bandwidth:** 90 MHz **Usable Sensitivity (typical)** **(12 dB SINAD):** 0.25 µV **Intermodulation (typical):** –75 dB **Selectivity (typical):** **(25/30 kHz Channel):** –78 dB **(12.5 kHz Channel):** –60 dB **Spurious Rejection (typical):** –80 dB **Frequency Stability** **(–30+60°C; 25°C reference):** ±0.0002% **Rated Audio:** 500 mW **FM Hum and Noise (typical):** 25 kHz –54 dB 12.5 kHz –45 dB **Distortion (typical):** 1.0% **Channel Spacing:** 12.5/25 kHz	**Frequency Range:** 380-470 MHz **RF Power:** **380-470 MHz:** 1-5 Watts **Frequency Stability (typical)** **(–30 to +60°C; 25°C ref.):** ±0.0002% **Emission (typical conducted):** –70 dBc **FM Hum and Noise (typical)** **(Companion Receiver):** 25 kHz –45 dB 12.5 kHz –40 dB **Distortion (typical):** 1.5% (typical) **Modulation Limiting:** 25 kHz chnls ±5.0 kHz 12.5 kHz chnls ±2.5 kHz **ACPR (typical):** 25 kHz –77 dBc 12.5 kHz –62 dBc **Emissions Designators:** 20K0F1E, 16K0F3E, 11K0F3E, 8K10F1D, and 8K10F1E

Specifications subject to change without notice.

Specifications for 700–800 MHz Radios

All specifications are per Telecommunications Industries Association TIA-603 unless otherwise noted.

GENERAL	RECEIVER	TRANSMITTER
FCC Designation: AZ489FT5806 **Temperature Range:** **Operating:** –30°C to +60°C **Storage:** –40°C to +85°C **Power Supply:** Nickel-Cadmium Battery (NiCd) *or* Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion) **Battery Voltage:** **Nominal:** 7.5 Vdc **Range:** 6 to 9 Vdc **Transmit Current Drain (Typical)**: 1400 mA **Receive Current Drain (Rated Audio):** 240 mA **Standby Current Drain:** 80 mA **Recommended Battery:** **Ultra-HIgh-Capacity Smart NiCd:** HNN9031_ *or* **Ultra-HIgh-Capacity NiCd:** NTN8294_ *or* **Extended-Capacity NiMH:** NTN8293_ *or* **Li-Ion:** NTN8610_ *or* **Ultra–High-Capacity NiCd FM:** NTN8295_* *or* **Ultra–High-Capacity NiMH FM:** NTN8299_* **Optional FM (Factory Mutual) Battery:** * FM Intrinsically Safe: Class I, II, III, Division 1, Groups C, D,E, F, and G. FM Non-incendive: Class 1, Division 2, Groups A, B, C, and D. **Dimensions (H x W x D):** Note: 2.44" = width at PTT; 2.34" = width at bottom; 1.83" = depth at speaker; 0.97" = depth at keypad **Without Battery (Radio Only):** 6.58" x 2.44" x 1.83"/6.58" x 2.34" x 0.97" (167.13 mm x 61.90 mm x 46.42 mm/ 167.13 mm x 59.49 mm x 24.56 mm) **With Battery:** 6.58" x 2.44" x 1.83"/6.58" x 2.34" x 1.65" (167.13 mm x 61.90 mm x 46.42 mm/ 167.13 mm x 59.49 mm x 41.97 mm) **Weight: (w/ Antenna):** **Less Battery:** 14.10 oz (383 gm) **With Ultra-High Cap. NiCd:** 25.19 oz (693 gm) **With Li-Ion:** 20.41 oz (583 gm) **With Ultra-High Cap. NiMH:** 23.45 oz (644 gm) **With Extended- Cap. NiMH:** 24.04 oz (682 gm)	**Frequency Range:** **700 MHz:** 764 to 767; 773 to 776 MHz **800 MHz:** 851 to 870 MHz **Bandwidth:** 106 MHz **Usable Sensitivity (typical)** **(12 dB SINAD):** 0.20 µV **Intermodulation (typical):** –75 dB **Selectivity (typical):** **(25/30 kHz Channel):** –72 dB **(12.5 kHz Channel):** –63 dB **Spurious Rejection (typical):** –75 dB **Frequency Stability** **(–30+60°C; 25°C reference):** ±0.00015% **Rated Audio:** 500 mW **FM Hum and Noise (typical):** 25 kHz –48 dB 12.5 kHz –40 dB **Distortion (typical):** 1.5% **Channel Spacing:** 12.5/25 kHz	**Frequency Range:** **700 MHz:** 764 to 767; 773 to 776; 794 to 797; 803 to 806 MHz **800 MHz:** 806 to 824; 851 to 870 MHz **RF Power:** **764-806 MHz:** 2.5 Watts **806-870 MHz:** 3 Watts **Frequency Stability (typical)** **(–30 to +60°C; 25°C ref.):** ±0.00015% **Emission (typical conducted):** –75 dBc **FM Hum and Noise (typical)** **(Companion Receiver):** 25 kHz –45 dB 12.5 kHz –40 dB **Distortion (typical):** 1.5% (typical) **Modulation Limiting:** 25 kHz chnls ±5.0 kHz 12.5 kHz chnls ±2.5 kHz **Emissions Designators:** 20K0F1E, 16K0F3E, 11K0F3E, 8K10F1D, and 8K10F1E

Specifications subject to change without notice.

Chapter 1 Introduction

1.1 General

This manual includes all the information needed to maintain peak product performance and maximum working time for the ASTRO XTS 5000 radio. This detailed level of service (component level) is typical of the service performed by some service centers, self-maintained customers, and distributors.

Use this manual in conjunction with the *ASTRO XTS 5000 VHF/UHF Range 1/700–800 MHz Digital Portable Radios Basic Service Manual* (Motorola part number 6881094C28), which can help in troubleshooting a problem to a particular printed circuit (PC) board.

Conduct the basic performance checks outlined in the basic service manual first to verify the need to analyze the radio and to help pinpoint the functional problem area. In addition, you will become familiar with the radio test mode of operation, which is a helpful tool. If any basic receive or transmit parameters fail to be met, the radio should be aligned according to the radio alignment procedure.

Included in other areas of this manual are functional block diagrams, detailed theory of operation, troubleshooting charts and waveforms, schematics, and parts lists. You should become familiar with these sections to aid in determining circuit problems. Also included are component location diagrams to aid in locating individual circuit components and some IC diagrams, which identify some convenient probe points.

“Chapter 3, Theory of Operation,” on page 3-1, contains detailed descriptions of the operations of many circuits. Once you locate the problem area, review the troubleshooting flowchart for that circuit to fix the problem.

1.2 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 that is essential to emphasize.

CAUTION indicates a potentially hazardous situation which, if not avoided, might result in equipment damage.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or injury.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or injury.

Chapter 2 Radio Power

This chapter provides a detailed circuit description of the power distribution of an ASTRO XTS 5000 radio.

2.1 General

In the ASTRO XTS 5000 radio, power (B+) is distributed to two boards: the transceiver (RF) board and the VOCON board (see Figure 2-1 on page 2-2 for UHF Range 1 (R1) and 700–800 MHz, and Figure 2-2 on page 2-2 for VHF). 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 7.5 Vdc directly to the transceiver. The following battery types and capacities are available:

Table 2-1. Conventional Batteries

Part Number	Description
NTN8294	1525 NiCd, Ultra-High Capacity
NTN8295	1525 NiCd High-Capacity Factory Mutual (FM) Intrinsically Safe
NTN8297	1525 NiCd High-Capacity Factory Mutual (FM) Intrinsically Safe, Rugged
NTN8299	1750 NiMH Ultra-Capacity FM
NTN8610	1650 Lithium Ion
NTN8923	1800 NiMH Ultra-Capacity
NTN9177	Battery Holder, Clamshell, Black
NTN9183	Battery Holder, Clamshell, Orange
RNN4006	3000 NiMH
RNN4007	3000 NiMH FM

Table 2-2. Smart Batteries

Part Number	Description
HNN9031	1525 NiCd Smart
HNN9032	1525 NiCd Smart FM
NNTN4435_R	1800 mAh, NiMH Smart
NNTN4436	1750 NiMH Smart FM (VHF use only)

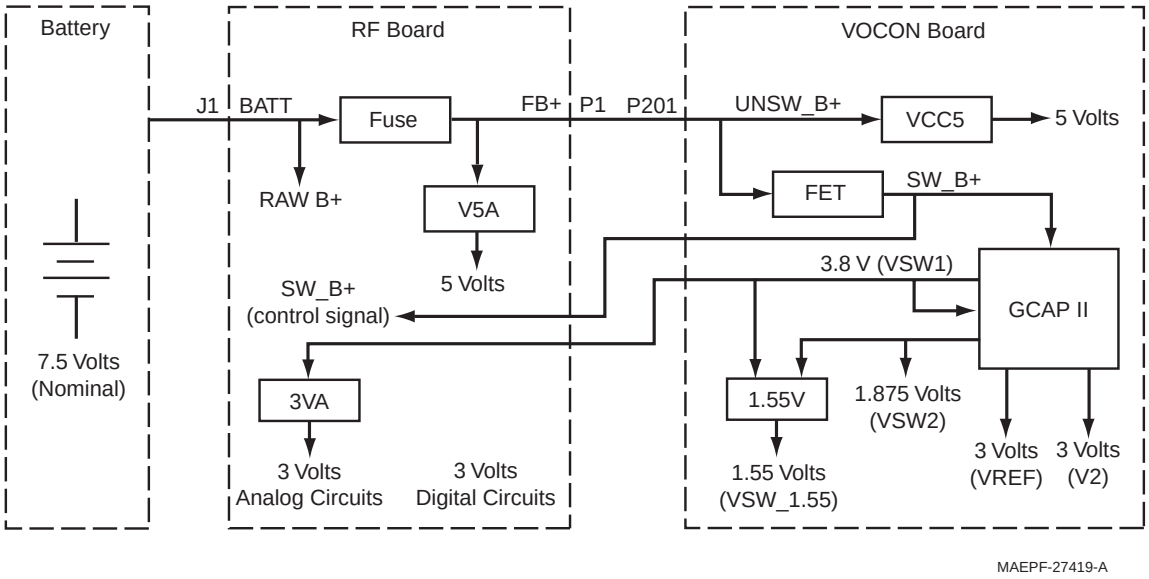


Figure 2-1. DC Power Distribution—UHF Range 1 and 700–800 MHz Radios

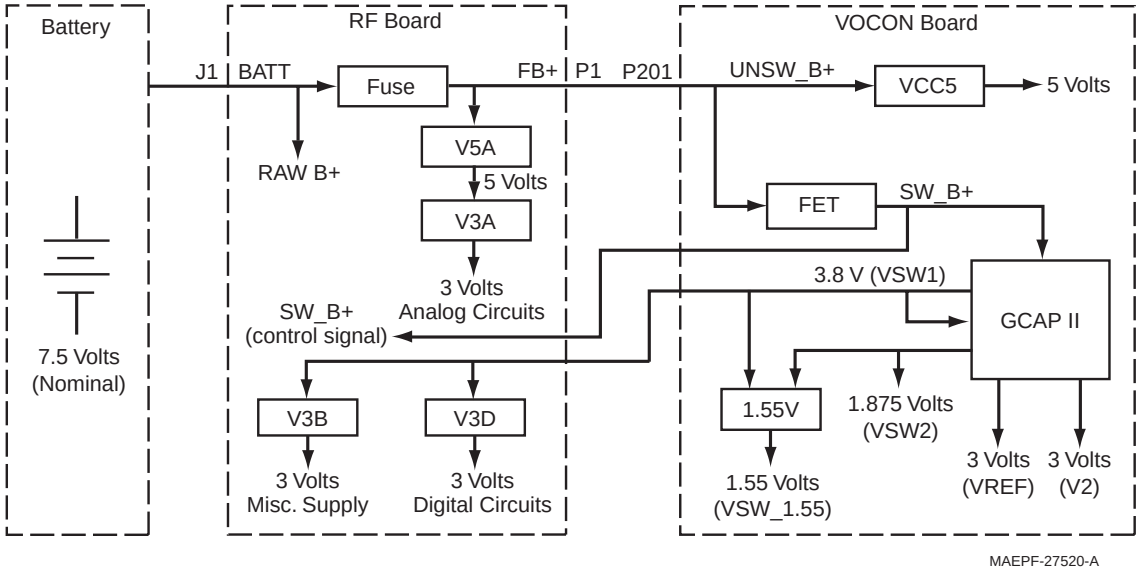


Figure 2-2. DC Power Distribution—VHF Radios

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.

2.2 DC Power Routing—Transceiver Board

NOTE: Refer to Table 8-1, "List of Transceiver Schematics and Board Overlays," on page 8-1 for a listing of schematics showing the transceiver board DC power routing components.

Connector J1, the B-plus assembly, connects the battery to the transceiver board. Capacitors C1, C2, and C3 provide protection against momentary breaks at the B-plus connector due to contact bounce when the radio is dropped.

UHF R1 and 700–800 MHz: Components C5, E4, C7, and E1 form a power-line filter for signal RAWB+, which supplies battery voltage to the transmitter PA.

VHF: Component E1 forms a power-line filter for signal RAWB+, which supplies battery voltage to the transmitter PA.

Transistor Q1, controlled by signal SWB+ (SB+ for VHF) from the VOCON board, turns on XB+, which supplies to the 5-V linear regulator and TX_ALC block.

Fuse F901 and filter C11, L1, C10 (C14, L1, C13 for VHF) supply fused B-plus to the VOCON board. In turn, the VOCON board supplies VSW1, regulated 3.8 Vdc, from the Global Control Audio and Power (GCAP) switching regulator to the XCVR. Switch Q99 (Q503 for VHF), controlled by SWB+, turns on V38 to the XCVR 3-V linear regulators. The XCVR regulated power supplies are summarized in Table 2-3.

Table 2-3. Transceiver Voltage Regulators

Ref. Desig.	IC Name	Output Signal Name	Description
U1	LP2989	V5A	Regulated 5.0 Vdc
U2	LP3985	V3D	Regulated 3.0 Vdc digital
U3	LP3985	V3A	UHF R1 and 700–800 MHz: Regulated 3.0 Vdc analog for the RX FE VHF: Regulated 3.0 Vdc analog for synthesizer
U5	LP3985	V3B	VHF only: Regulated 3.0 Vdc miscellaneous supply

2.3 DC Power Routing—VOCON Board

NOTE: Refer to Table 8-2, "List of VOCON Schematics and Board Overlays," on page 8-1 for a listing of schematics showing the VOCON board DC power routing components.

Raw B+, or unswitched B+, (UNSW_B+) is routed to connector P1 on the transceiver board, and then on to P201 on the VOCON board. Here the UNSW B+ is forwarded to the radio's control top On/Off/volume knob through connector J101 and a flex circuit, as well as to regulator U505 (VCC5).

The On/Off/volume knob controls B+SENSE to Q502, which in turn controls Q501. Transistor Q501 is a solid-state power switch that provides SW B+ to the VOCON board, the audio PA, the GCAP II IC (via GCAP_B+), and back to the transceiver board.

In the case of a secure radio model, SW B+ and UNSW B+ are also supplied to the encryption module through connector J701.

Transistor Q501 is also under the control of the microcontroller unit (MCU) via Vref from U501. This allows the MCU to follow an orderly power-down sequence when it senses that B+SENSE is off. This sense is provided through MECH_SW_BAR (inverted B+SENSE, see Q508).

The digital circuits in the VOCON board are powered from regulators located in the GCAP II IC (U501), an external 5 Vdc regulator (VCC5, U505), and an external 1.55 Vdc regulator (VSW_1.55V, on NNTN4717 VOCON kit only). The GCAP II IC provides three supplies: VSW1, VSW2, and V2. These regulators are software programmable. Table 2-4 lists the supply voltages and the circuits that use these voltages.

Table 2-4. VOCON Board DC Power Distribution

Supply Name	Output Voltage	Supply Type	Unprogrammed Output Voltage	Circuits Supplied
UNSW_B+	9 to 6 Vdc 7.5 Vdc nominal	Battery	N/A	VCC5 input Mechanical switch Power switch (FET) Secure module Real-time clock battery
SW_B+	9 to 6 Vdc 7.5 Vdc nominal	Battery	N/A	VSW1 input (GCAP) Audio power amplifier Side connector SW_B+ to transceiver board GCAP IC Secure module USB circuitry
VCC5	5Vdc	Linear Regulator	N/A	Smart battery circuitry Int. / ext. microphone bias Audio preamplifier Flipper IC Keypad / Display LEDs
VSW1	3.8 Vdc	Switching regulator software progammable	3.2 Vdc	3-V regulators (RF) VSW2 input V2 input
VSW2	1.8 Vdc	Switching regulator software progammable	2.2 Vdc	Patriot core FLASH IC SRAM Display (only on NTN9564 VOCON board)
V2	3 Vdc* 2.9 Vdc**	Linear regulator software progammable	2.775 Vdc	Patriot I/O ring Flipper IC EEPOT Display 16.8 MHz buffer
VSW_1_55V	1.55 Vdc	Linear regulator	N/A	Patriot core (only on NNTN4717 VOCON board)

* = NTN9564,NNTN4563 & NNTN4819 VOCON kits

** = NNTN4717 VOCON kit

Chapter 4 Troubleshooting Procedures

The purpose of this chapter is to aid in troubleshooting problems with the ASTRO XTS 5000 radio. It is intended to be detailed enough to localize the malfunctioning circuit and isolate the defective component. It also contains a listing of service tools recommended for PC board repair at the component level.

Caution

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

4.1 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.

4.2 Recommended Service Tools

Table 4-1 lists recommended service tools that can be used for PC board repairs at the component level. For listings of additonal service tools, service aids, and test equipment that are recommended for all levels of service, refer to the XTS 5000 basic service manual (see " Related Publications" on page xii).

Table 4-1. Recommended Service Tools

Motorola Part Number	Description	Application
R1453	Digital-readout solder station	Digitally controlled soldering iron
RLN4062	Hot-air workstation, 120V	Tool for hot-air soldering/desoldering of surface-mounted integrated circuits
0180386A78	Illuminated magnifying glass with lens attachment	Illumination and magnification of components
0180302E51	Master lens system	
0180386A82	Anti-static grounding kit	Used during all radio assembly and disassembly procedures
6684253C72	Straight prober	
6680384A98	Brush	
1010041A86	Solder (RMA type), 63/67, 0.5 mm diameter, 1 lb. spool	
0180303E45	SMD tool kit (included with R1319A)	
R1319	ChipMaster (110V)	Surface-mount removal and assembly of surface-mounted integrated circuits and/or rework station shields. Includes 5 nozzles.
R1321	ChipMaster (220V)	
R1364	Digital heated tweezer system	Chip component removal
R1427	Board preheater	Reduces heatsink on multi-level boards
6680309B53	Rework equipment catalog	Contains application notes, procedures, and technical references used to rework equipment
ChipMaster Options:		
6680370B54	0.710" x 0.710"	Heat-focus heads for R1319 workstation
6680370B57	0.245" x 0.245"	
6680370B58	0.340" x 0.340"	
6680371B15	0.460" x 0.560"	

Table 4-1. Recommended Service Tools (Continued)

Motorola Part Number	Description	Application
ChipMaster Nozzles:		
6680333E28	PA nozzle	Soldering and unsoldering ICs
6680332E83	PLCC-28* nozzle	
6680332E93	PLCC-32 nozzle	
6680332E82	PLCC-44* nozzle	
6680332E94	PLCC-52 nozzle	
6680332E95	PLCC-68* nozzle	
6680332E96	PLCC-84 nozzle	
6680332E89	QFP-80 nozzle	
6680332E90	QFP-100* nozzle	
6680332E91	QFP-132* nozzle	
6680334E67	QFP-160 nozzle	
6680332E86	SOIC-14/SOL-16J nozzle	
6680333E46	SOL-18 nozzle	
6680332E84	SOIC-20 nozzle	
6680332E87	SOL-20J nozzle	
6680333E45	SOL-24 nozzle	
6680332E88	SOL-28J nozzle	
6680333E54	TSOP-32 nozzle	
6680333E55	TSOP-64 nozzle	

* Included with ChipMaster packages

4.3 Voltage Measurement and Signal Tracing

It is always a good idea to check the battery voltage under load. This can be done by checking the OPT_B+_VPP pin at the side connector (pin 4). The battery voltage should remain at or above 7.0 Vdc. If the battery voltage is less than 7.0 Vdc, then it should be recharged or replaced as necessary prior to analyzing the radio.

In most instances, the problem circuit may be identified using a multimeter, an RF millivoltmeter, oscilloscope (preferably with 100 MHz bandwidth or more), and a spectrum analyzer.

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

4.4 Standard Bias Table

Table 4-2 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 4-2. Standard Operating Bias

Signal Name	Nominal Value	Tolerance	VOCON Board Source
13 MHz	13 MHz	±1000 ppm	C303 (NTN9564) C339 (NNTN4563, NNTN4819 & NNTN4717)
FLIP_32K	32.768 kHz	±400 ppm	U302, pin2 (under shield SH102 on NNTN4563, NNTN4819 & NNTN4717)
SINE32K	32.768 kHz	±400 ppm	C313 (NTN9564) C306 (NNTN4563, NNTN4819 & NNTN4717)
CKIH	16.8 MHz		R452 (under shield SH101 on NNTN4563, NNTN4819 & NNTN4717 or test fixture pin 7 on the board-to-board connector)
16_8MHz	16.8 MHz		C452 (under shield SH101 on NNTN4563, NNTN4819 & NNTN4717)
POR	3.0 Vdc	±5%	POR test point
RESET_OUT	3.0 Vdc	±5%	RESET_OUT test point (NTN9564) D401, pin 3 (NNTN4563, NNTN4819 & NNTN4717)
VSW1	3.85 Vdc	±5%	R502
VSW2	1.85 Vdc	±5%	R501
FILT_B+	7.5 Vdc	6.0-9.0 Vdc	C523
V2	3.0 Vdc* 2.9 Vdc**	±5%	R560
GCAP_B+	7.5 Vdc	6.0-9.0 Vdc	R581
UNSW_B+	7.5 Vdc	6.0-9.0 Vdc	B104
SW_B+	7.5 Vdc	6.0-9.0 Vdc	R587
VCC5	5.0 Vdc	±5%	R503
VSW_1_55 V	1.55 Vdc	±5%	R407 (NNTN4717 VOCON kit only)

* = NTN9564, NNTN4563, & NNTN4819 VOCON kits
** = NNTN4717 VOCON kit

4.5 Power-Up Self-Check Errors

Each time the radio is turned on, the MCU and DSP perform a series of internal diagnostics. These diagnostics consist of checking such programmable devices as the FLASH ROMs, the EEPROM, and SRAM devices.

Problems detected during the power-up self-check routines are presented as error codes on the radio's display. For non-display radios, the problem is presented at power up by a single, low-frequency tone. Table 4-3 lists possible error codes, a description of each error code, and a recommended corrective action.

Table 4-3. Power-Up Self-Check Error Codes

Error Code	Description	Corrective Action
01/02	FLASH ROM codeplug Checksum Non-Fatal Error	Reprogram the codeplug
01/12	Security Partition Checksum Non-Fatal Error	Send radio to depot
01/20	ABACUS Tune Failure Non-Fatal Error	Turn radio off, then on
01/22	Tuning Codeplug Checksum Non-Fatal Error	Send radio to depot
01/81	Host ROM Checksum Fatal Error	Send radio to depot
01/82	FLASH ROM Codeplug Checksum Fatal Error	Reprogram the codeplug
01/88	External RAM Fatal Error — Note: Not a checksum error	Send radio to depot
01/90	General Hardware Failure Fatal Error	Turn radio off, then on
01/92	Security Partition Checksum Fatal Error	Send radio to depot
01/93	FLASHport Authentication Code Failure	Send radio to depot
01/98	Internal RAM Fail Fatal Error	Send radio to depot
01/A2	Tuning Codeplug Checksum Fatal Error	Send radio to depot
02/81	DSP ROM Checksum Fatal Error	Send radio to depot
02/88	DSP RAM Fatal Error — Note: Not a checksum error	Turn radio off, then on
02/90	General DSP Hardware Failure (DSP startup message not received correctly)	Turn radio off, then on
09/10	Secure Hardware Failure	Turn radio off, then on
09/90	Secure Hardware Fatal Error	Turn radio off, then on

4.6 Power-Up Self-Check Diagnostics and Repair (Not for Field Use)

Table 4-4 lists additional action items that can be used for the diagnosis and resolution of the error codes listed in Table 4-3 on page 4-5.

Table 4-4. Power-Up Self-Check Diagnostic Actions

Error Code	Diagnostic Actions
01/02	This non-fatal error will likely recover if the radio's power is cycled. In the event that this does not resolve the issue, the radio should be reflashed. As a last resort, the FLASH ROM U402 should be replaced.
01/12	The radio should be sent to the depot for reflashing of the security codeplug.
01/20	Cycling radio power should resolve this issue.
01/22	The radio should be sent to the depot for reflash of the tuning codeplug followed by retuning of the radio.
01/81	The radio should be sent to the depot for reflashing of the host code.
01/82	The radio should be sent to the depot for reflashing of the radio codeplug.
01/88	Reflashing of the radio should first be performed. If this fails to resolve the issue, then replacement of the SRAM U403 is necessary.
01/90	Cycle power to radio. Continued failure indicates a likely IC failure (GCAP, PCIC, FLIPPER, ABACUS). In this event, radio should be sent to the depot for isolation and repair of the problem IC.
01/92	The radio should be sent to the depot for reprogramming of the security codeplug.
01/93	The radio should be sent to the depot for reflashing of the host code.
01/98	Send radio to the depot for replacement of the SRAM U403.
01/A2	The radio should be sent to the depot for reflashing of the tuning codeplug followed by re-tuning of the radio.
02/81	The radio should be sent to the depot for examination and/or replacement of either the FLASH U402, or the PATRIOT MCU/DSP U401.
02/88	Cycle power to the radio. If this does not fix the problem, then the radio should be sent to the depot for reflashing of the DSP code. Continued failure requires examination and/or replacement of the SRAM U403.
02/90	Cycle power to the radio. If this fails to fix the problem, then the radio should be sent to the depot for reflashing of the DSP code. Continued failure may require replacement of U401, the PATRIOT MCU/DSP.
09/10	Cycle power to the radio. If this fails then follow instructions in the secure hardware failure troubleshooting flowchart.
09/90	Cycle power to the radio. If this fails then follow instructions in the secure hardware failure troubleshooting flowchart.

Chapter 5 Troubleshooting Charts

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 of operation sections prior to troubleshooting a radio.

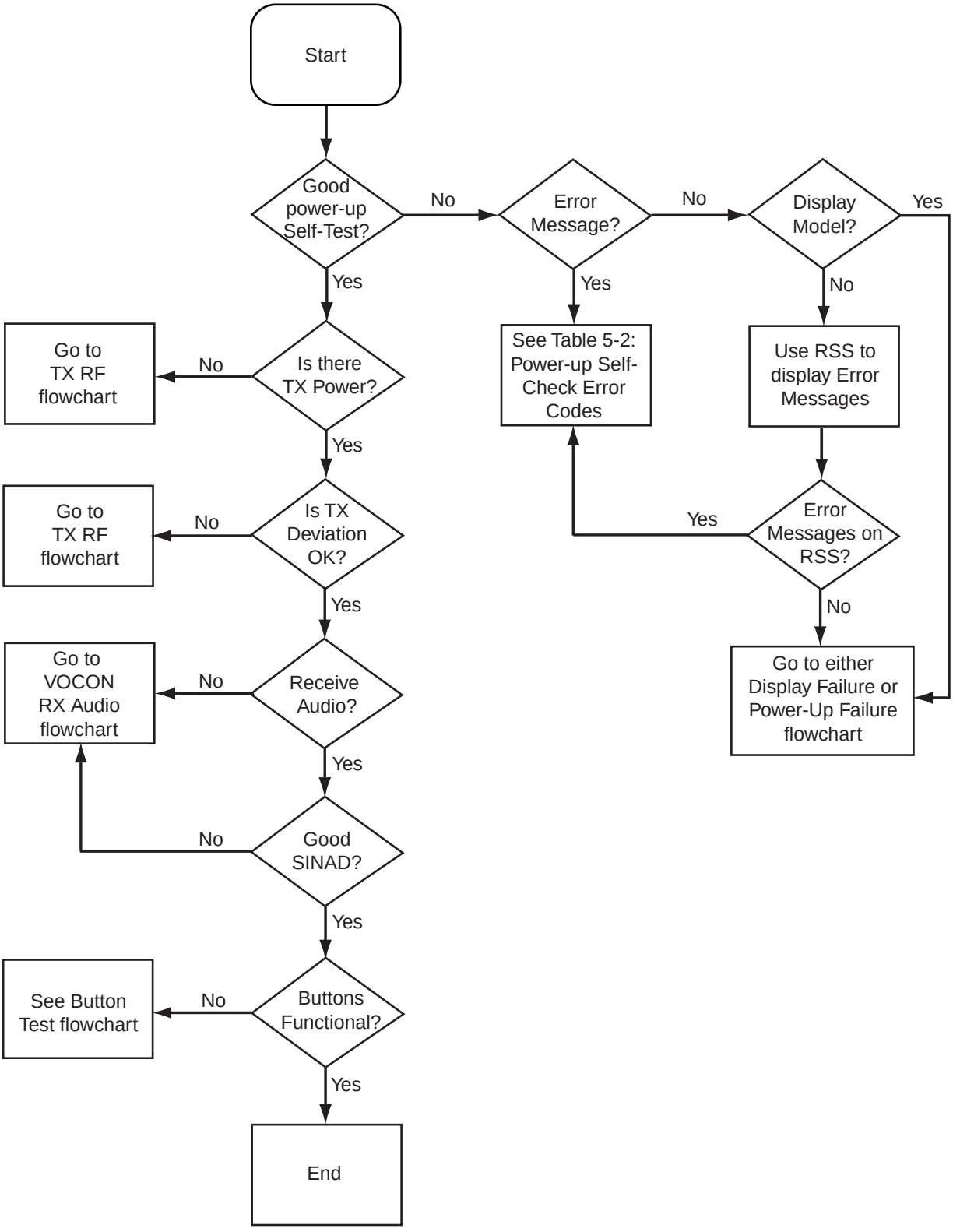
5.1 List of Troubleshooting Charts

Most troubleshooting charts (see Table 5-1) 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, continuity from the source IC should be checked before replacing the source IC.

Table 5-1. Troubleshooting Charts List

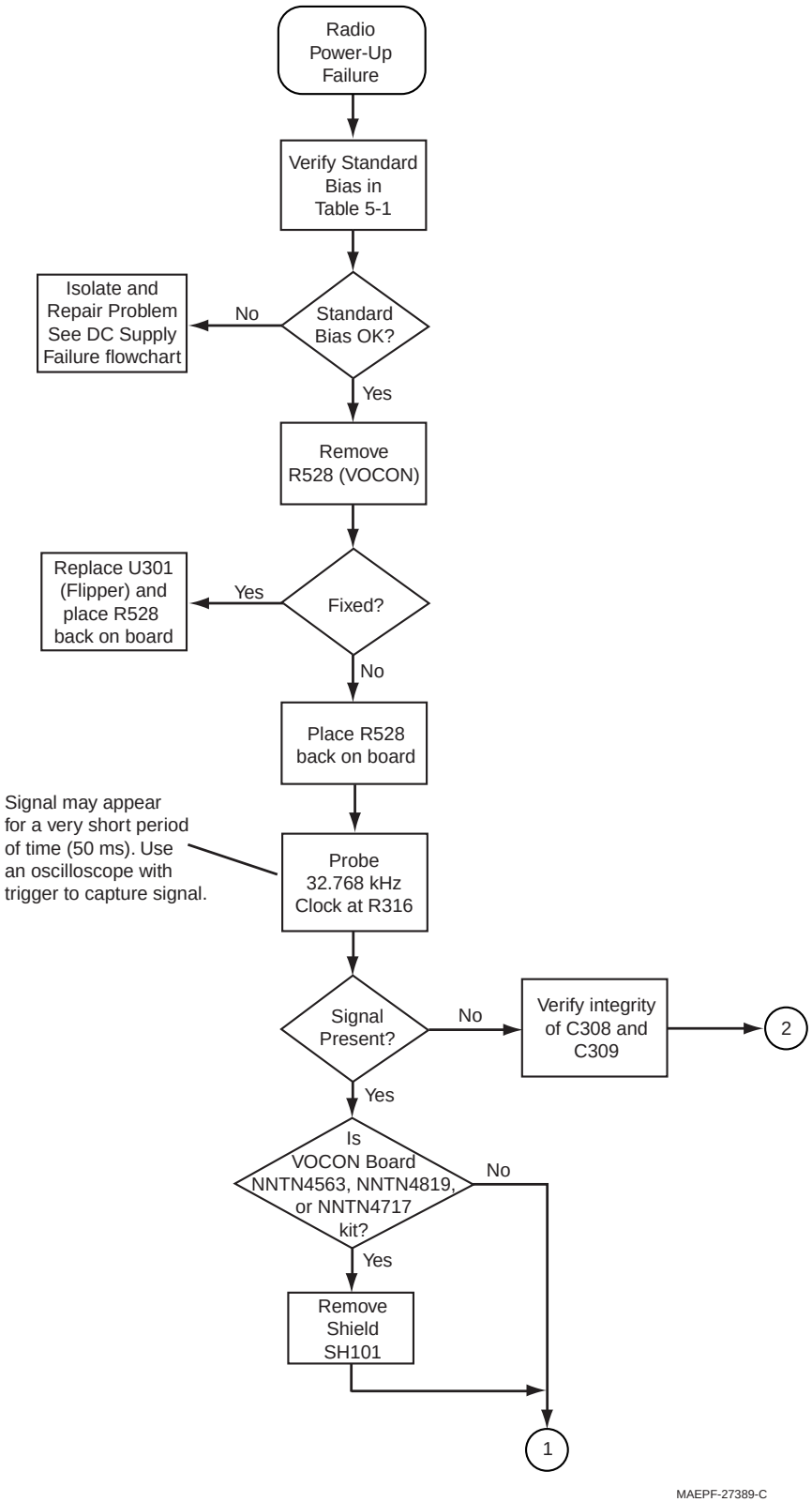
Chart Title	Page Number
Main Troubleshooting Flowchart	5-2
Power-Up Failure	5-3
DC Supply Failure	5-5
Display Failure (NNTN4563, NNTN4819, & NNTN4717 VOCON Kits)	5-8
Display Failure (NTN9564)	5-11
Volume Set Error	5-14
Channel/Zone Select Error	5-15
Button Test	5-16
Top/Side Button Test	5-17
VCO TX/RX Unlock	5-18
VOCON TX Audio	5-19
VOCON RX Audio	5-21
RX RF	5-23
TX RF (VHF)	5-28
TX RF (UHF R1/700-800 MHz)	5-31
Keyload Failure	5-34
Secure Hardware Failure	5-35

5.2 Main Troubleshooting Flowchart

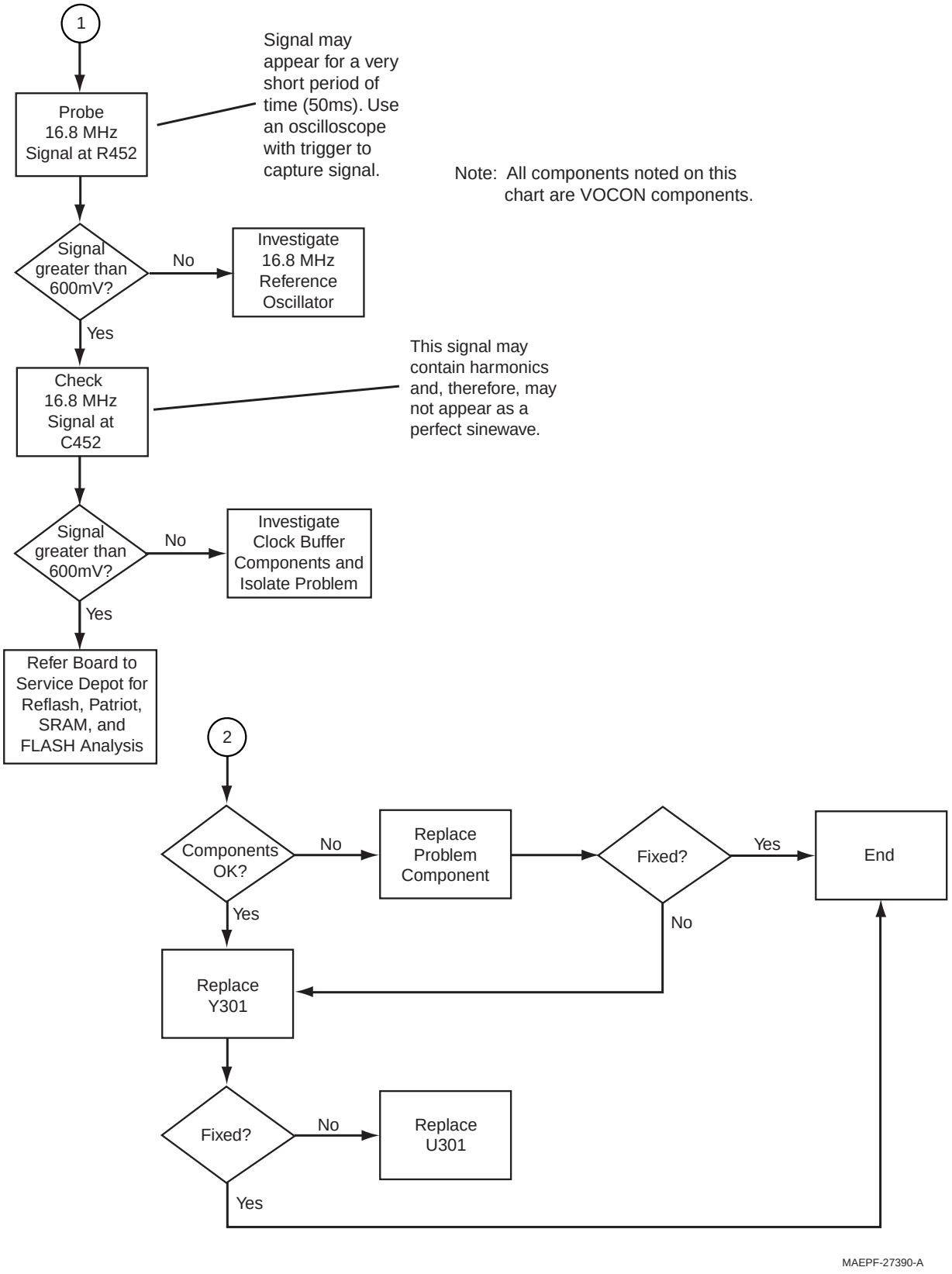


MAEPF-27403-A

5.3 Power-Up Failure—Page 1

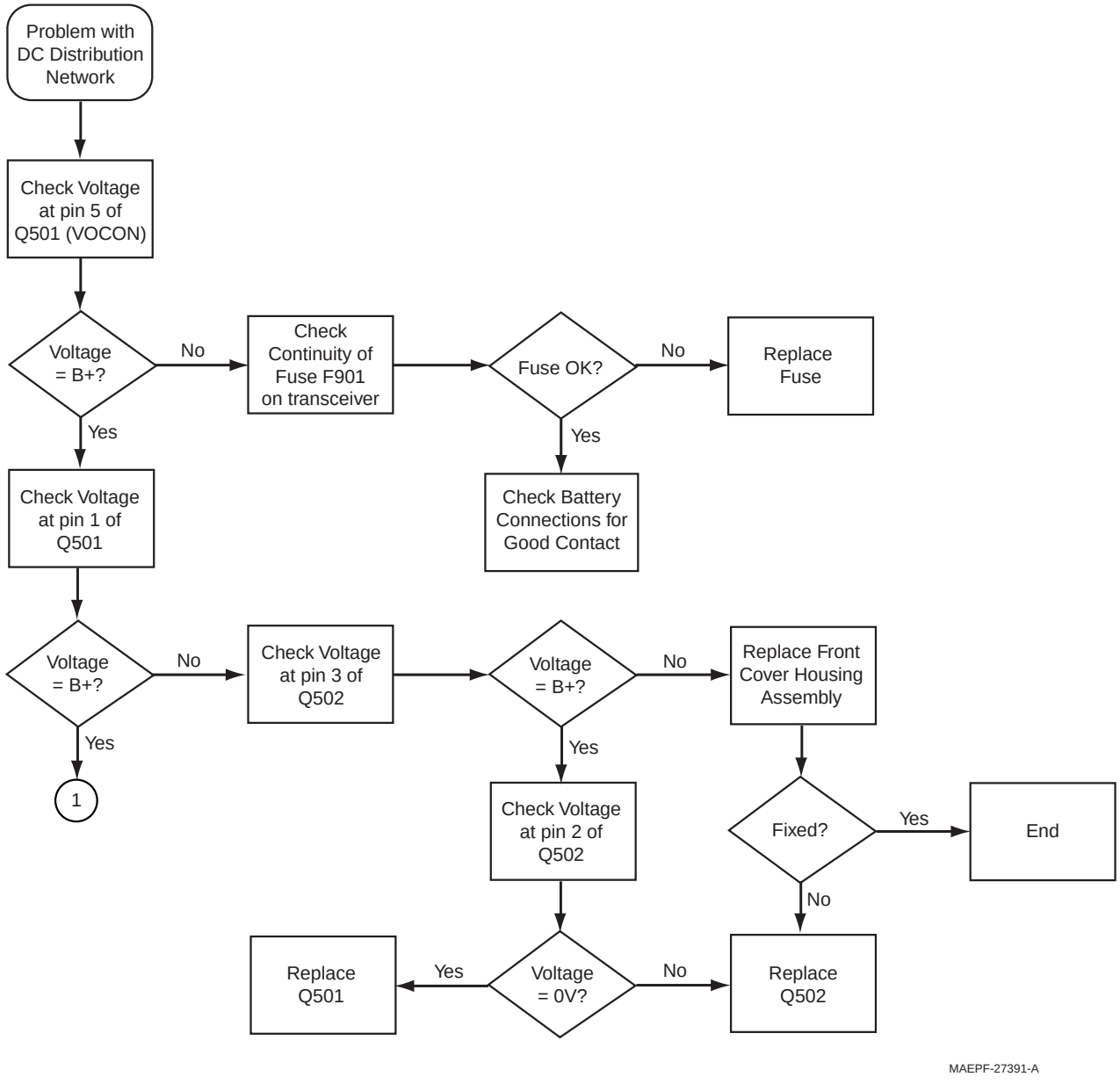


Power-Up Failure—Page 2

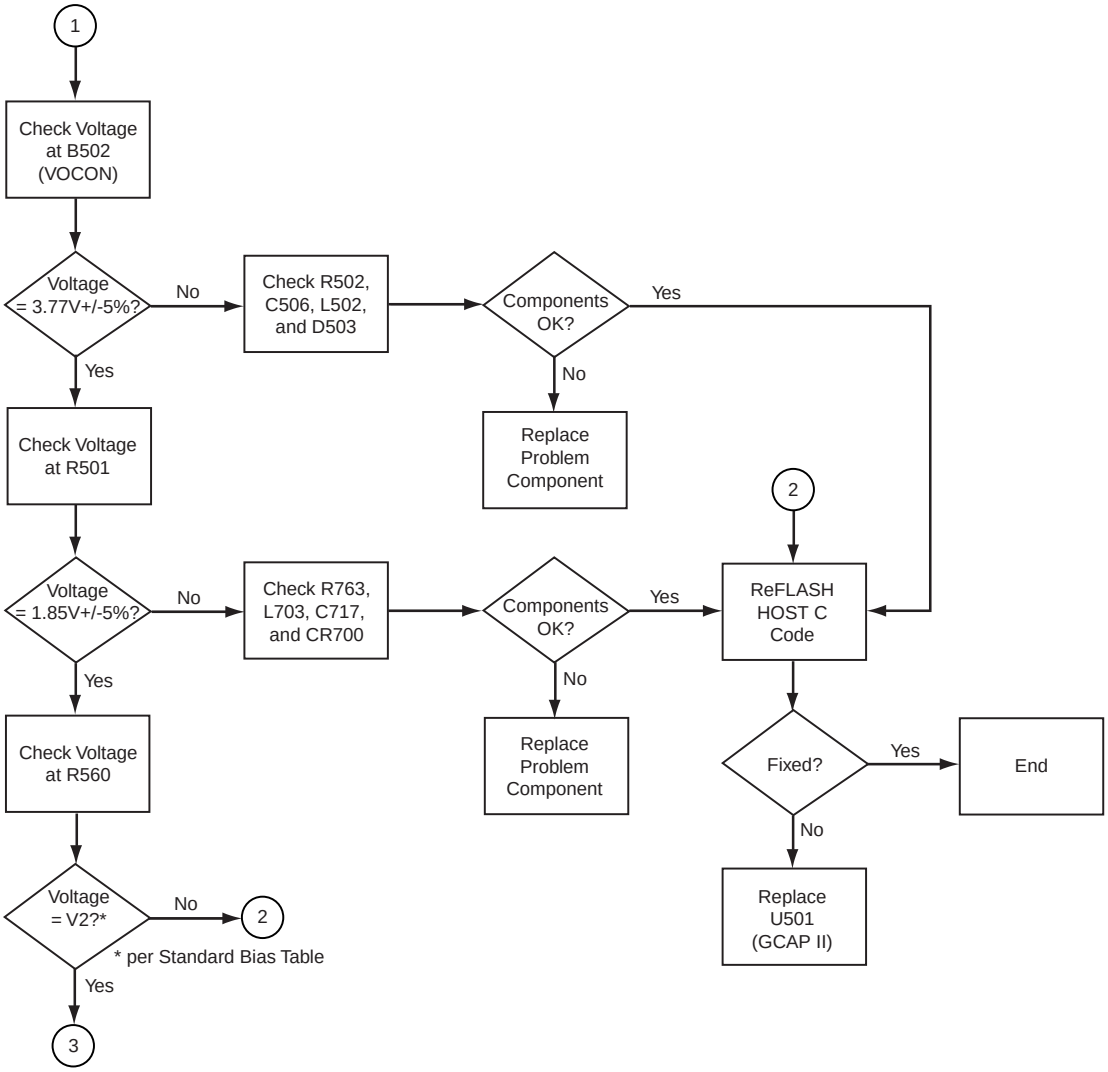


5.4 DC Supply Failure—Page 1

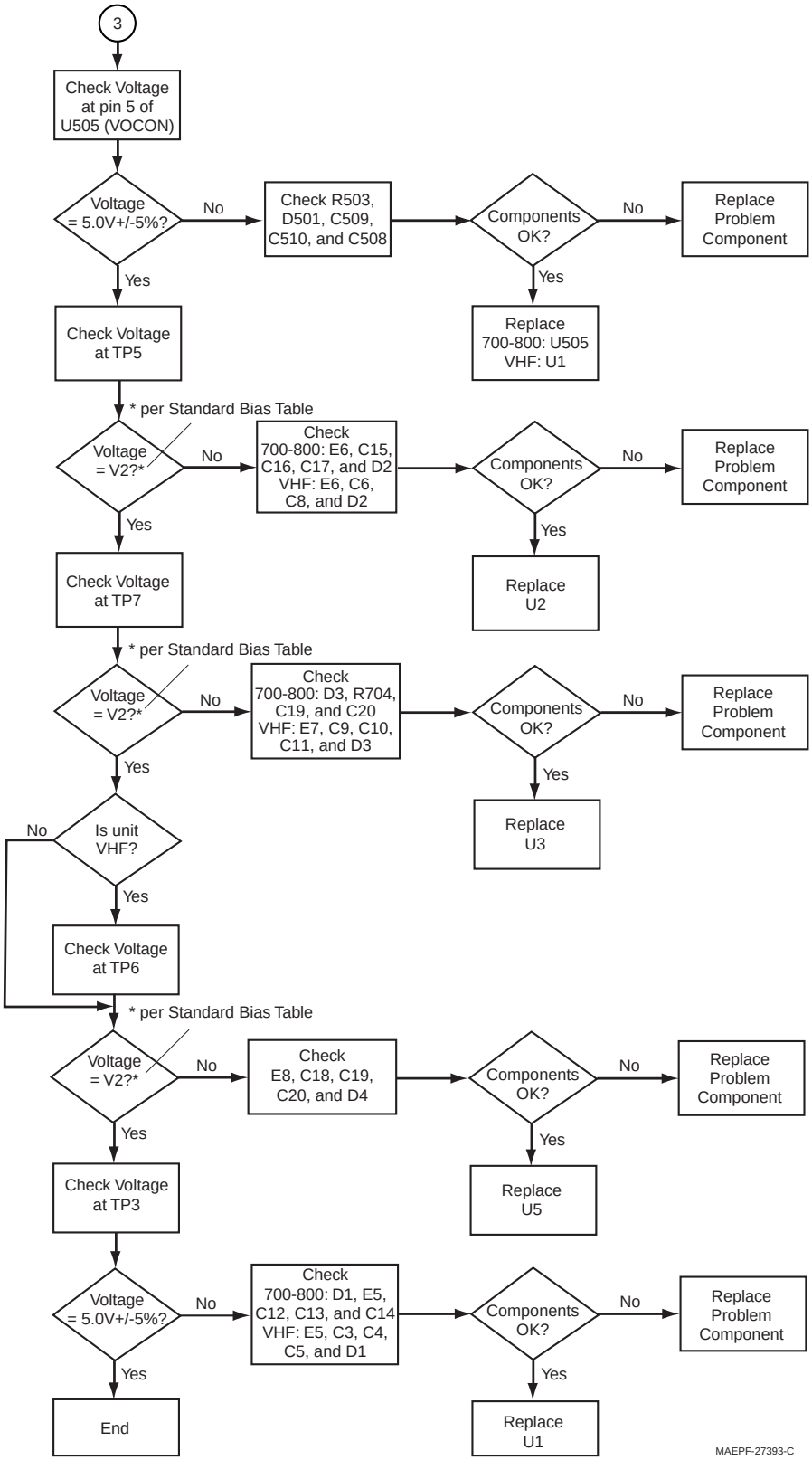
NOTE: Since the failure of a critical voltage supply might cause the radio to automatically power down, supply voltages should first be probed with a multimeter. If all the board voltages are absent, then the voltage test point should be retested using a rising-edge-triggered oscilloscope. If the voltage is still absent, then another voltage should be tested using the oscilloscope. If that voltage is present, then the original voltage supply in question is defective and requires investigation of associated circuitry.



DC Supply Failure—Page 2

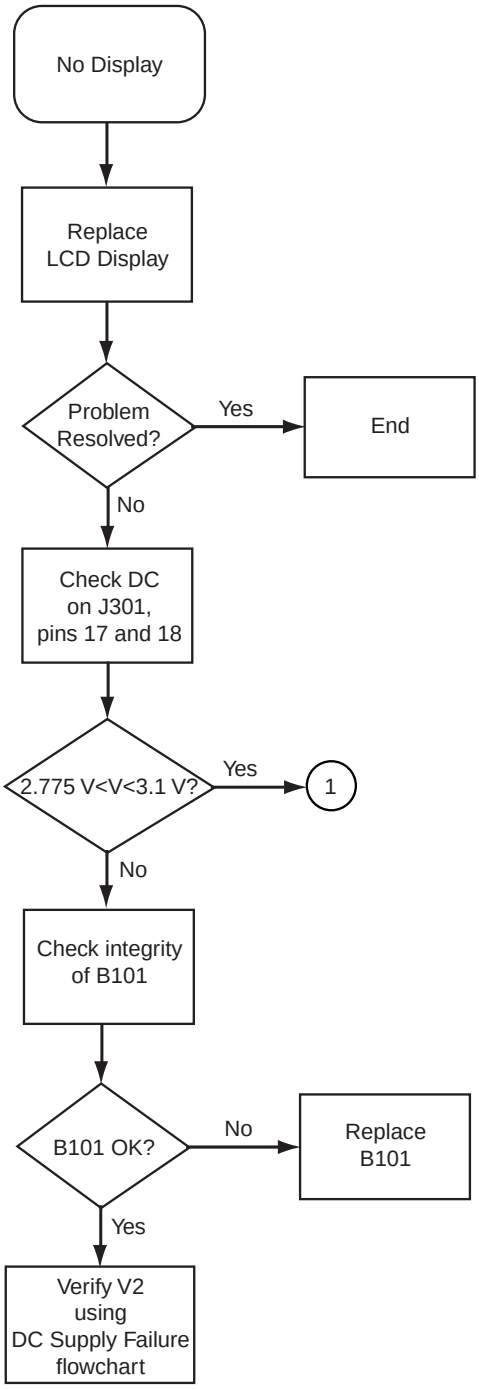


DC Supply Failure—Page 3



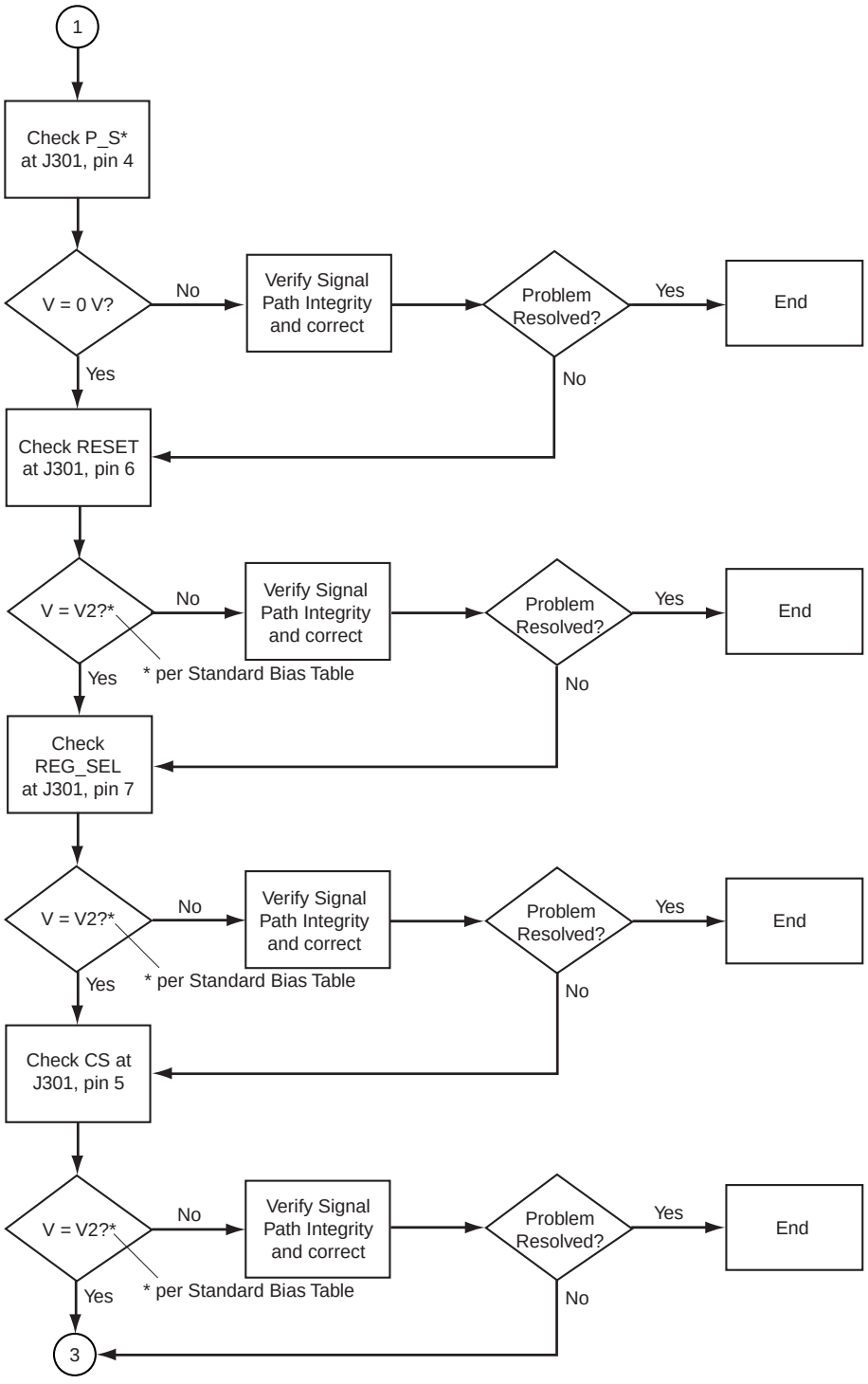
5.5 Display Failure (NNTN4563, NNTN4819, & NNTN4717 VOCON Kits) Page 1

NOTE: The NNTN4563 VOCON board is compatible only with the 7285726C02 display module, and the NNTN4819 VOCON board is compatible only with the 7285726C03 display module.



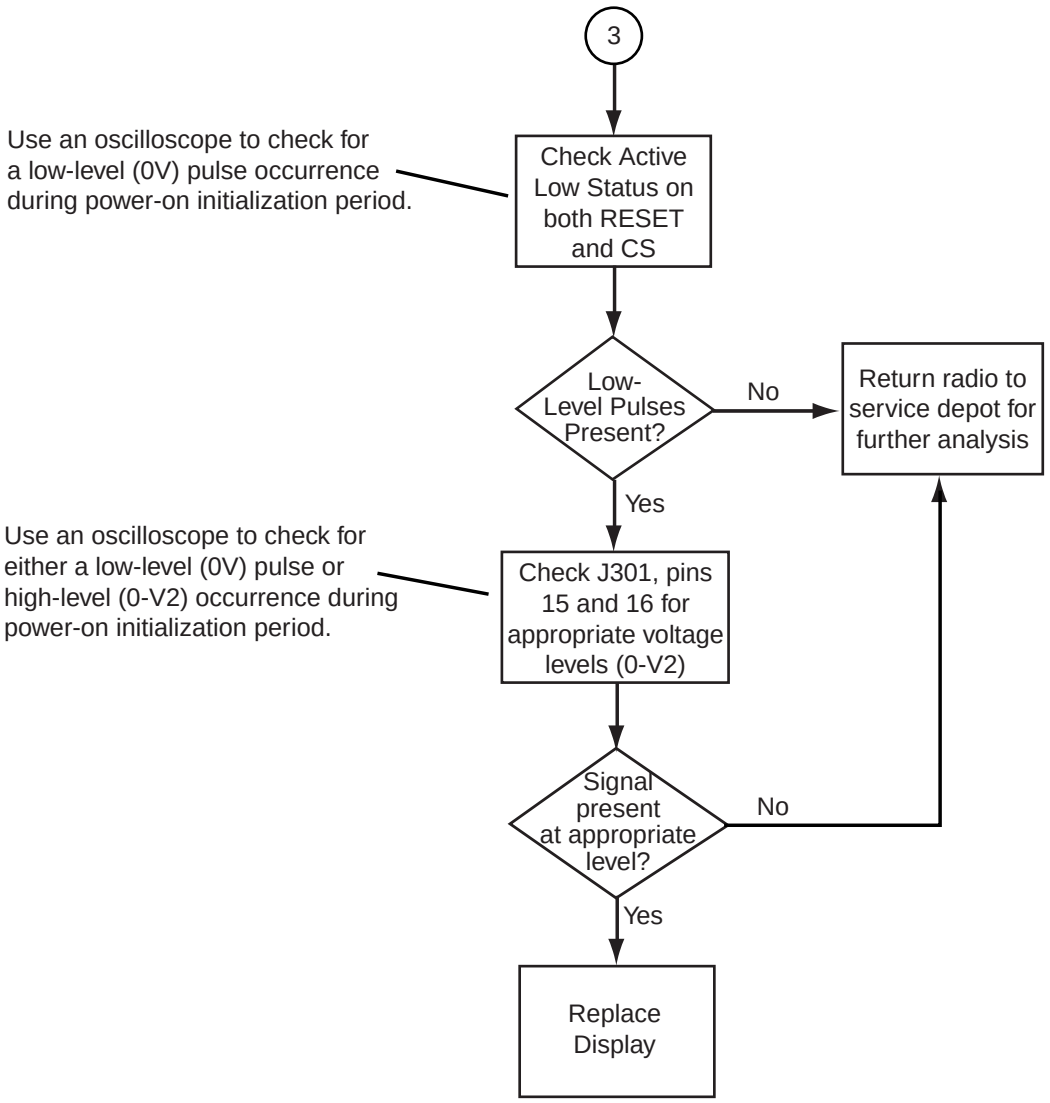
MAEPF-27505-B

Display Failure (NNTN4563, NNTN4819, & NNTN4717 VOCON Kits) Page 2



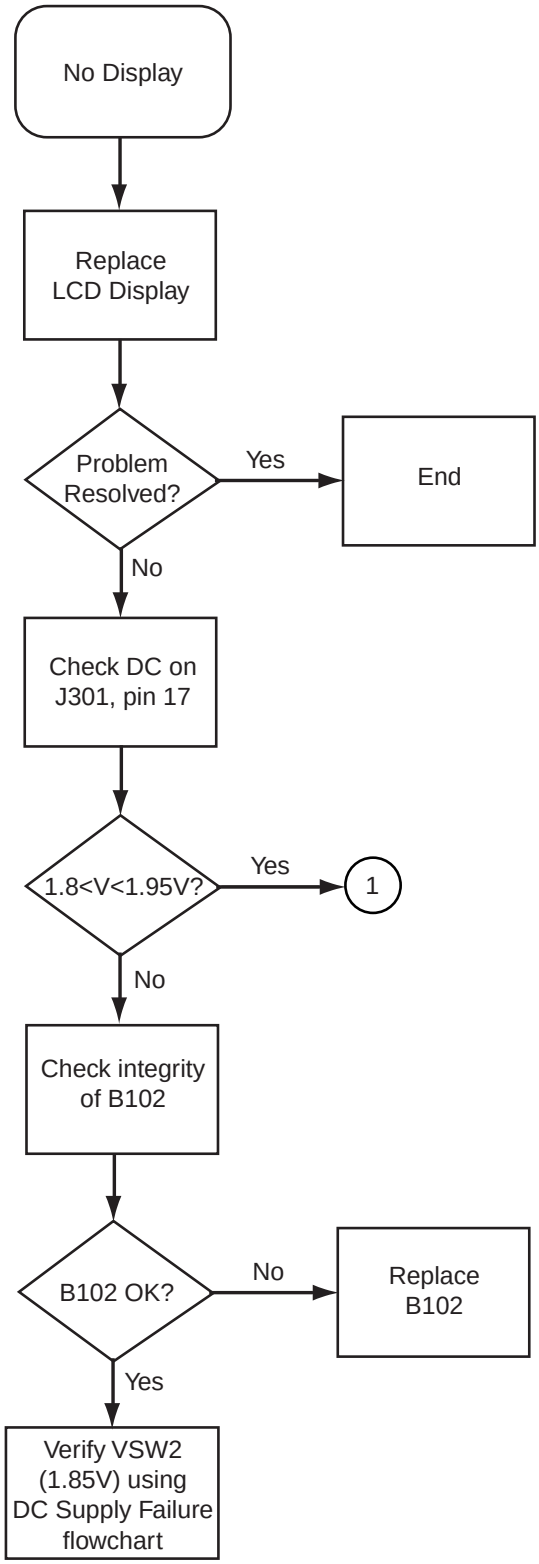
MAEPF-27506-A

Display Failure (NNTN4563, NNTN4819, & NNTN4717 VOCON Kits) Page 3



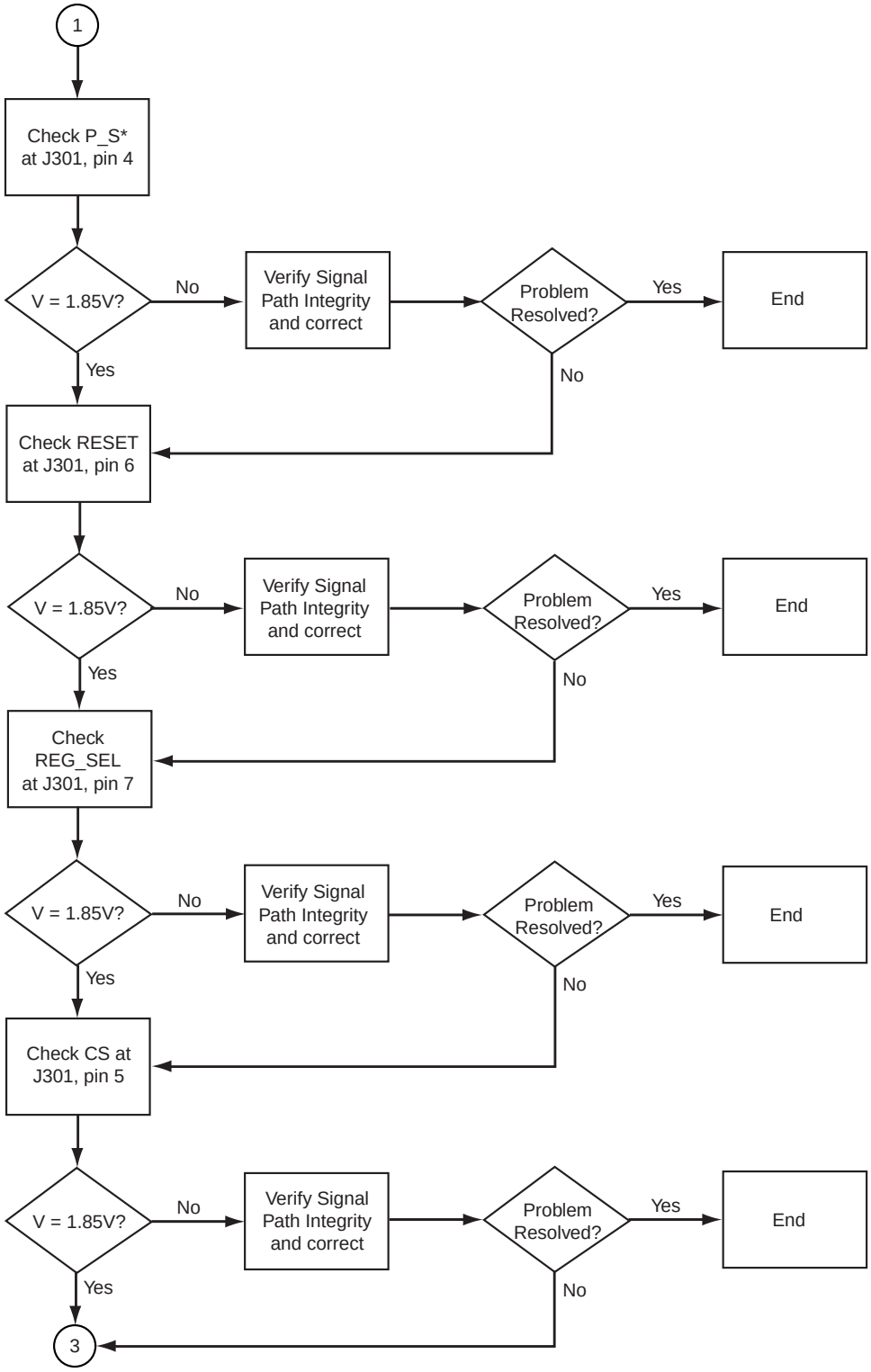
5.6 Display Failure (NTN9564)—Page 1

NOTE: The NTN9564 VOCON board is compatible only with the 7285726C01 display module.



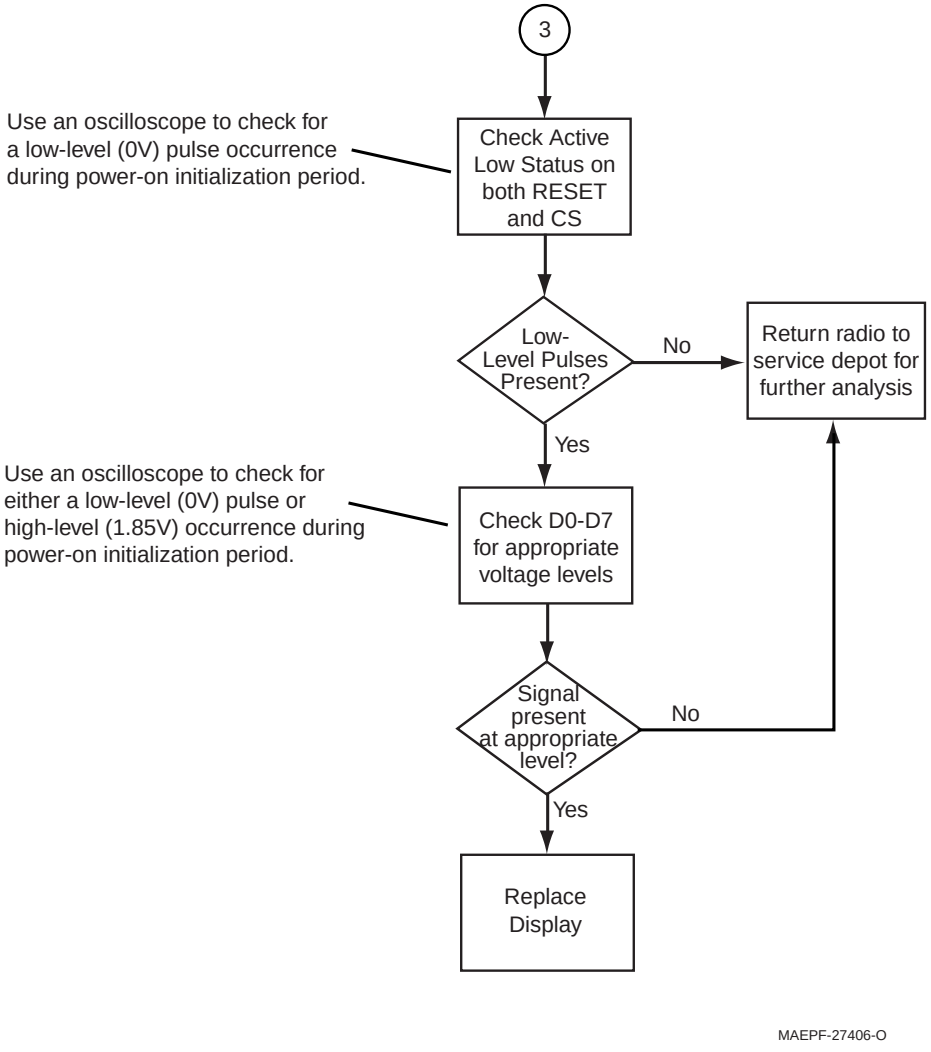
MAEPF-27404-O

Display Failure (NTN9564)—Page 2

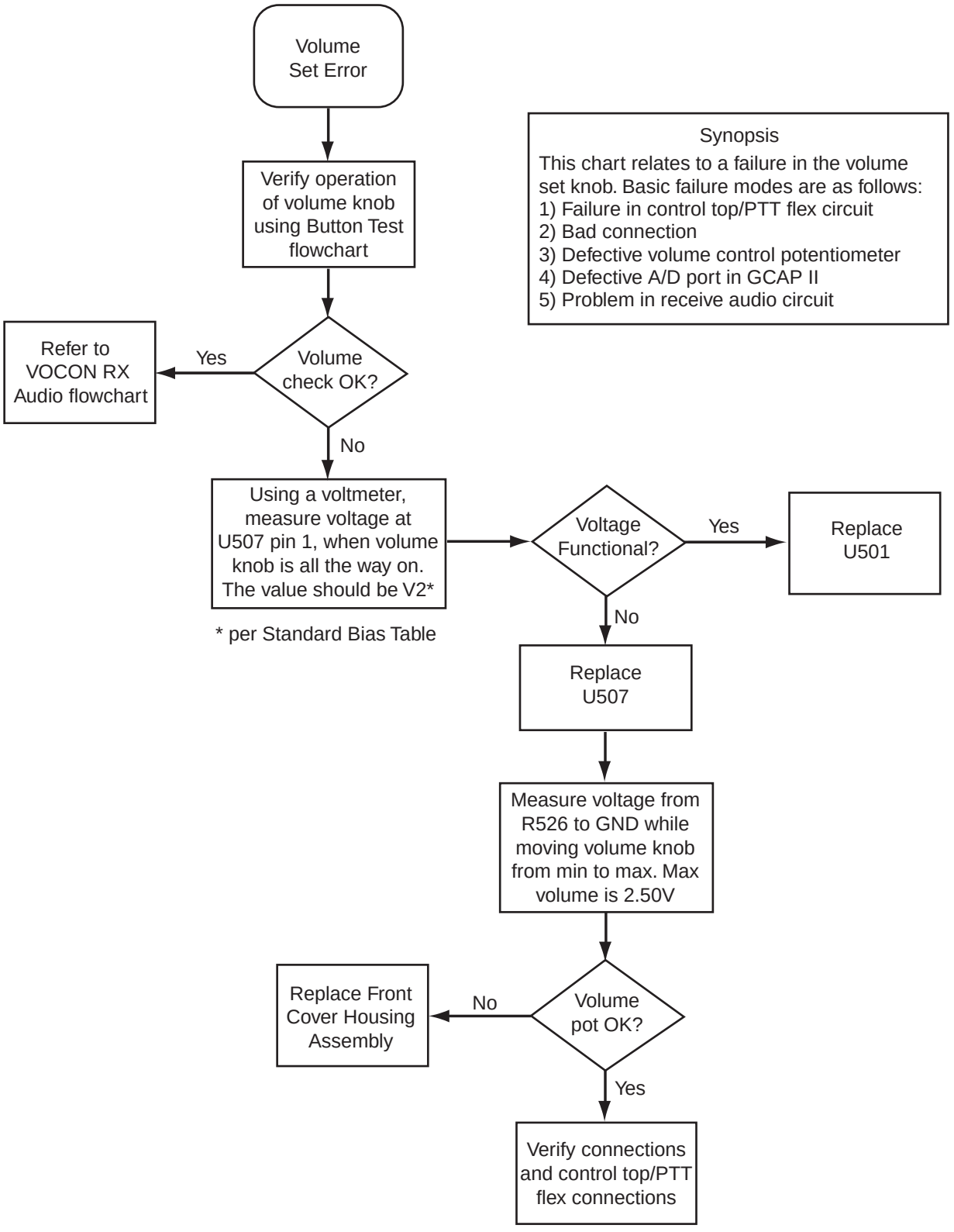


MAEPF-27405-O

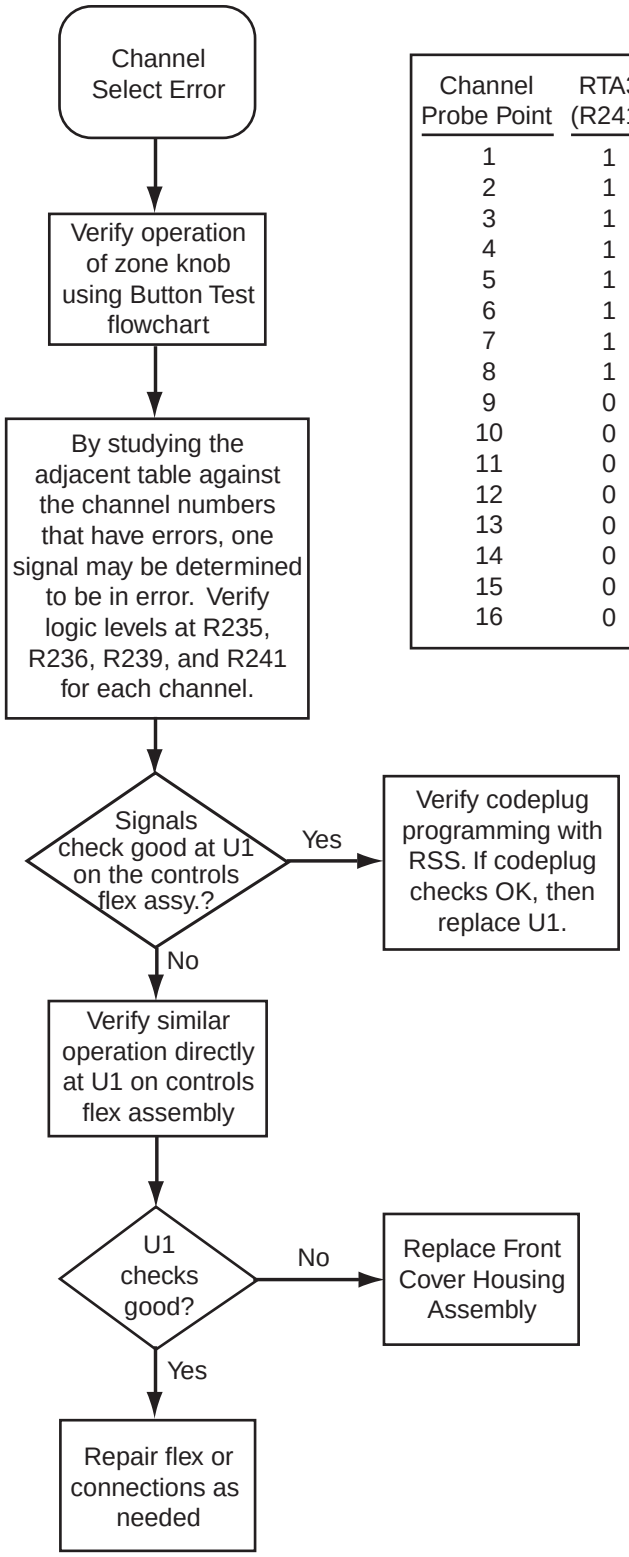
Display Failure (NTN9564)—Page 3



5.7 Volume Set Error



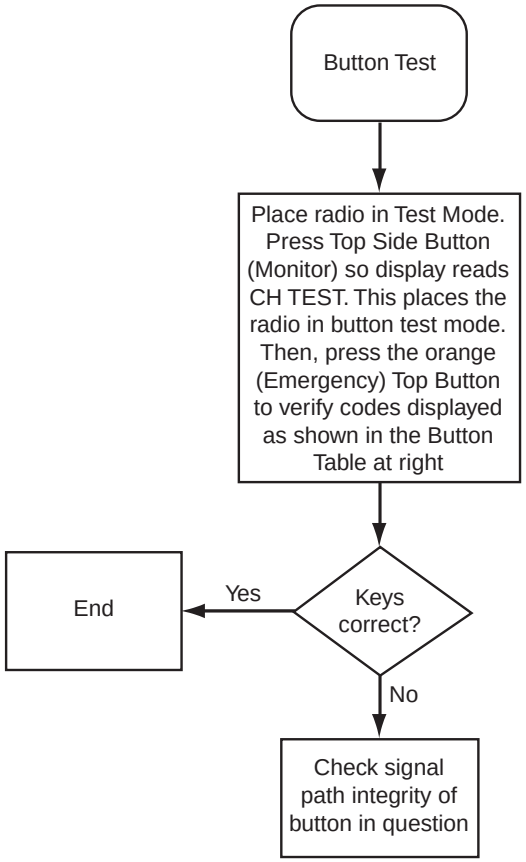
5.8 Channel/Zone Select Error



Channel Probe Point	RTA3 (R241)	RTA2 (R239)	RTA1 (R236)	RTA0 (R235)
1	1	1	1	1
2	1	1	1	0
3	1	1	0	1
4	1	1	0	0
5	1	0	1	1
6	1	0	1	0
7	1	0	0	1
8	1	0	0	0
9	0	1	1	1
10	0	1	1	0
11	0	1	0	1
12	0	1	0	0
13	0	0	1	1
14	0	0	1	0
15	0	0	0	1
16	0	0	0	0

MAEPF-27402-O

5.9 Button Test



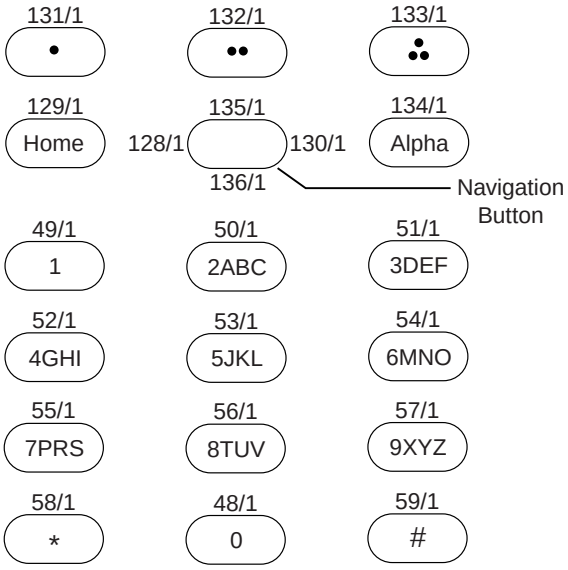
Synopsis

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 GCAP II

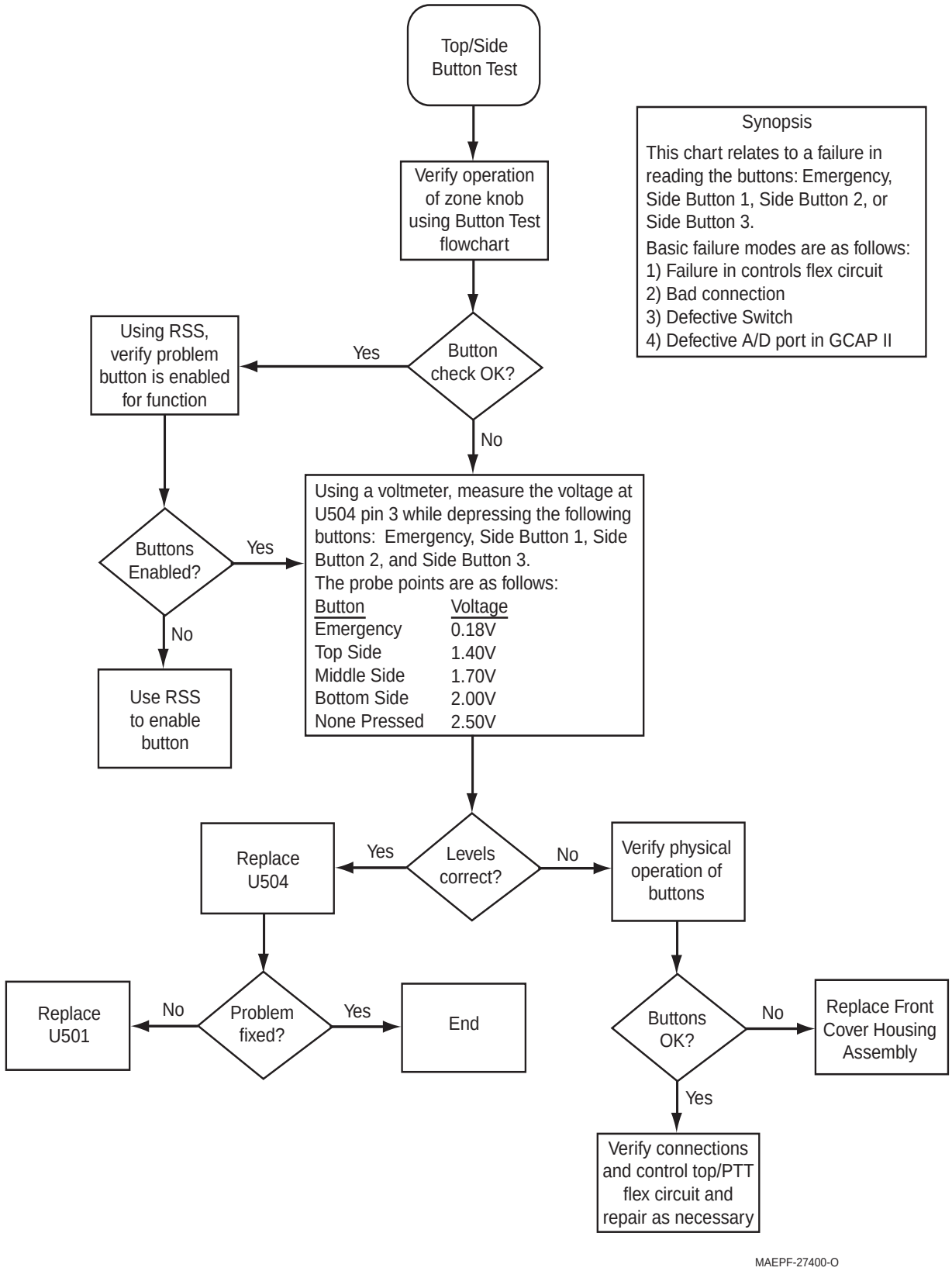
Button Table

Button	Code
PTT	1/ 0-1
Top Button (Emergency)	3/ 0-1
Side Button 1 (Monitor)	96/ 0-1
Side Button 2	97/ 0-1
Side Button 3	98/ 0-1
Channel Select (Frequency)	4/ 0-15
Volume Control Knob	0/ 0-244
Zone Select	65/ 0-2

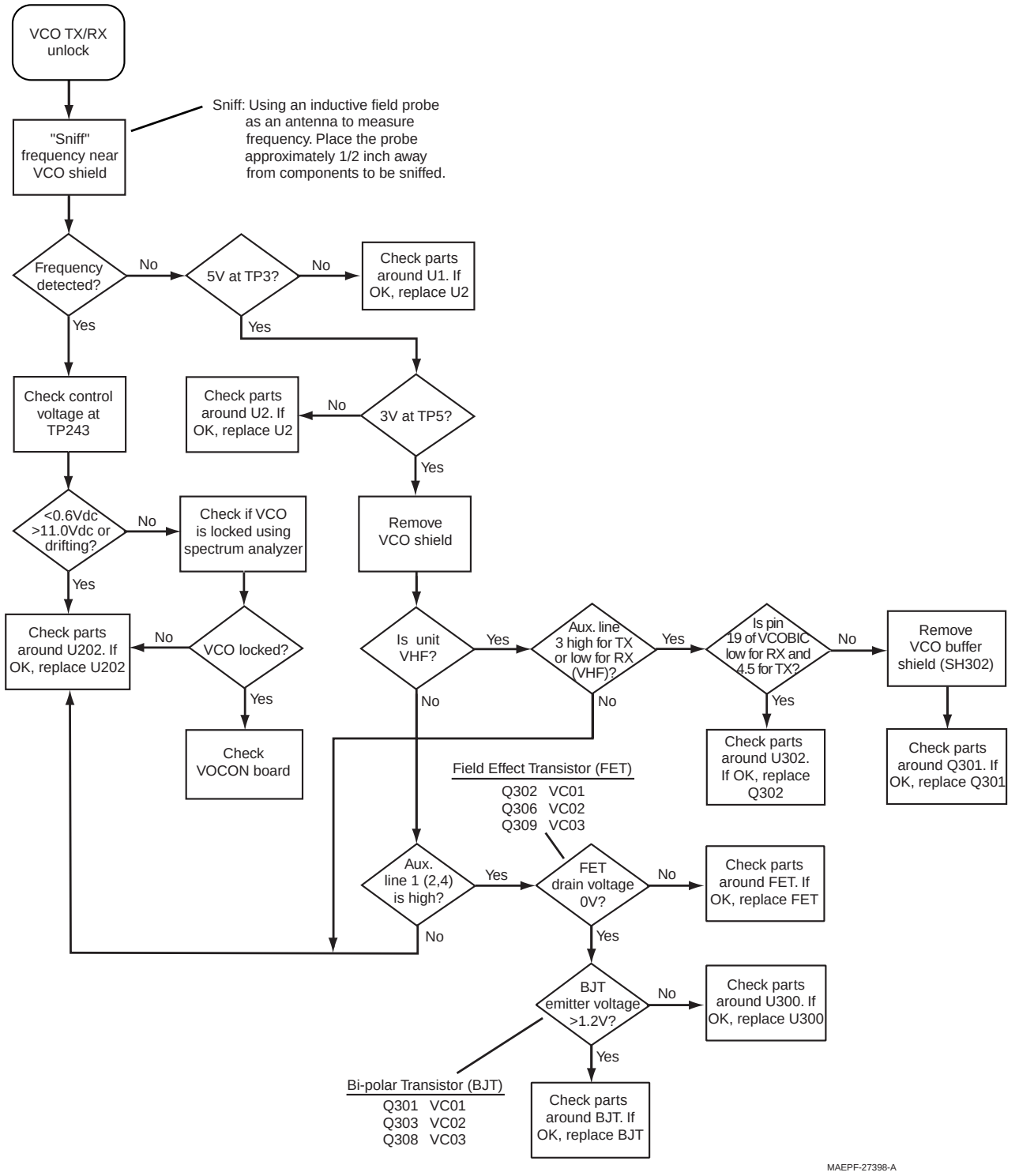


MAEPF-27399-O

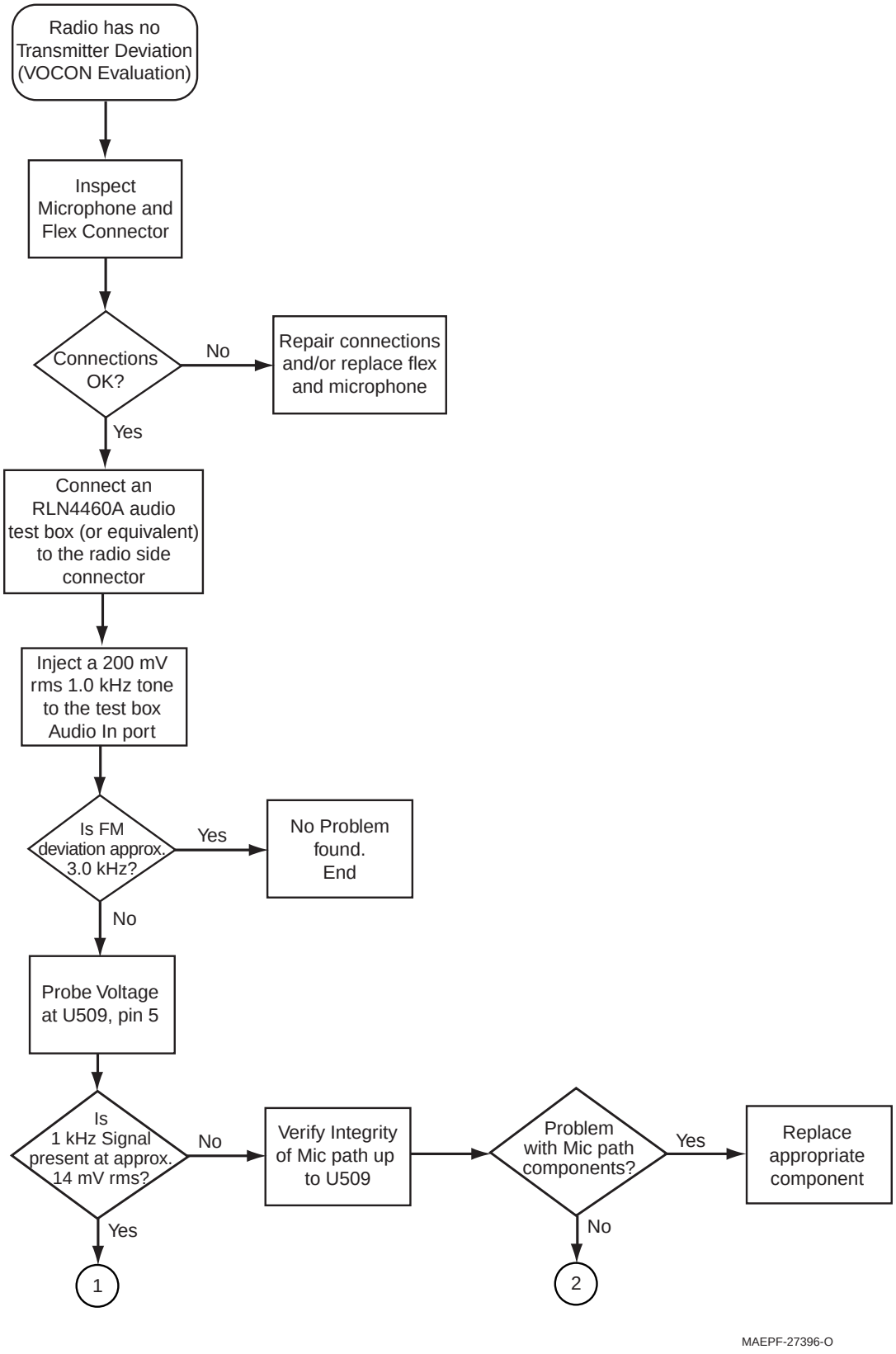
5.10 Top/Side Button Test



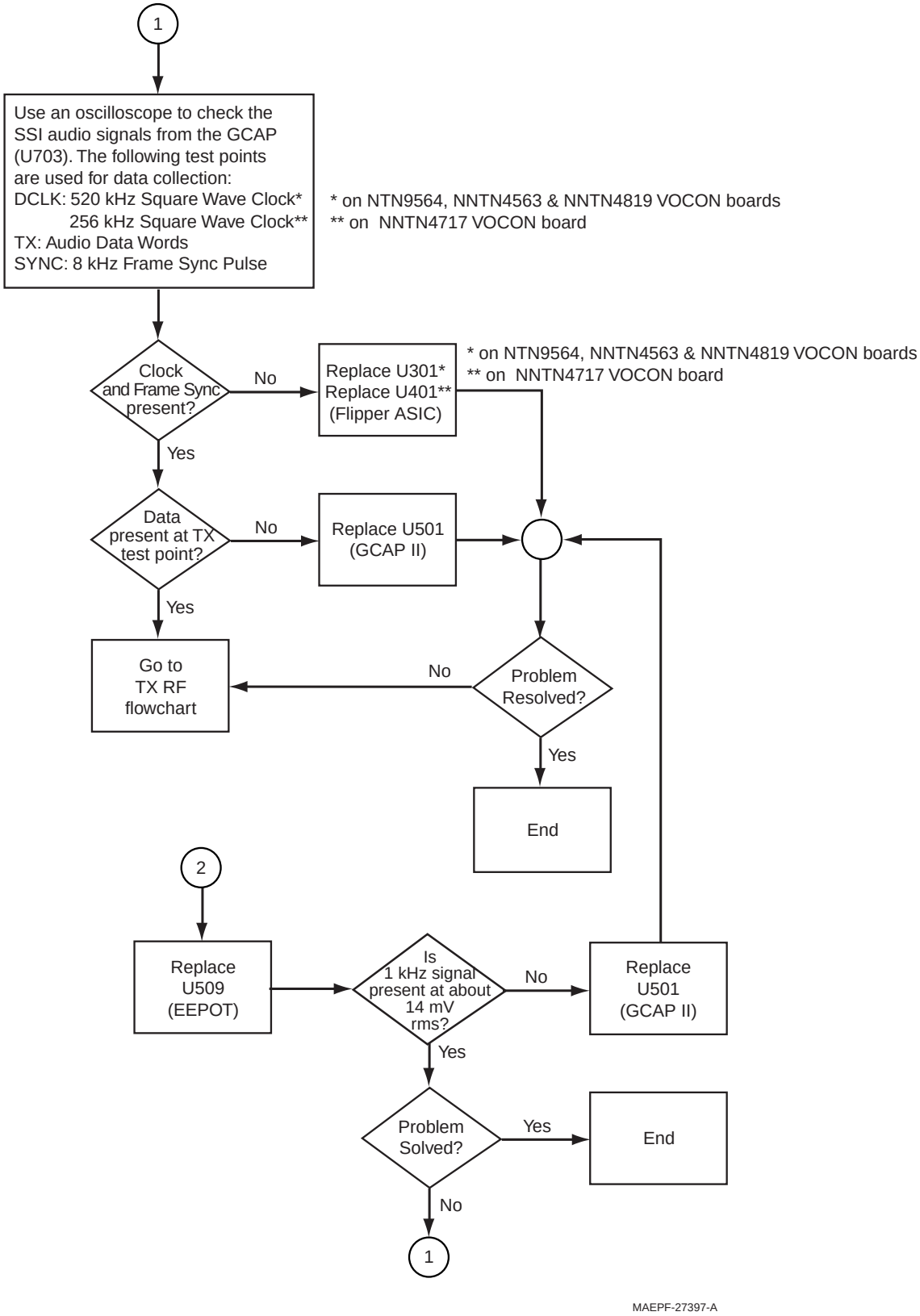
5.11 VCO TX/RX Unlock



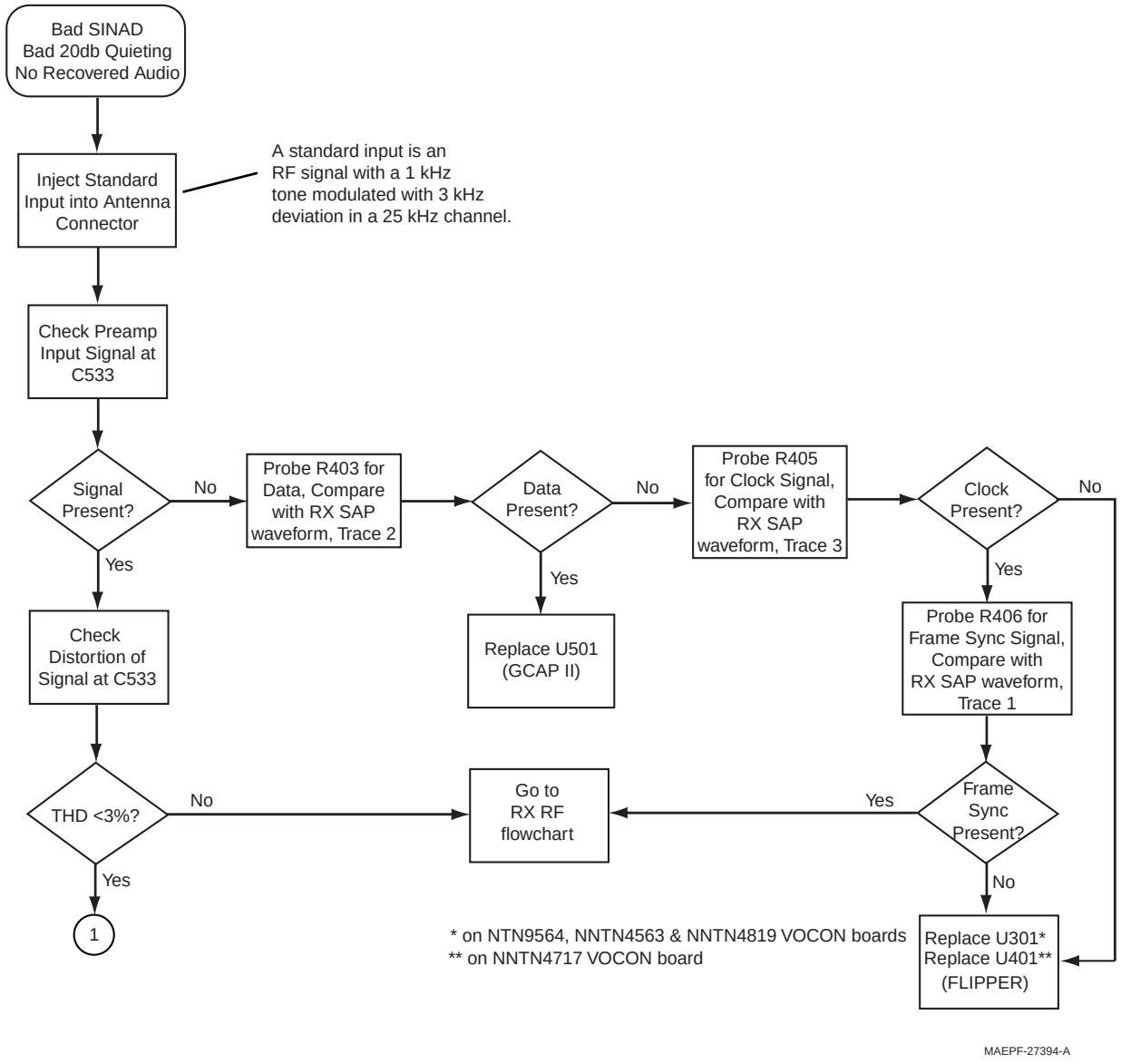
5.12 VOCON TX Audio—Page 1



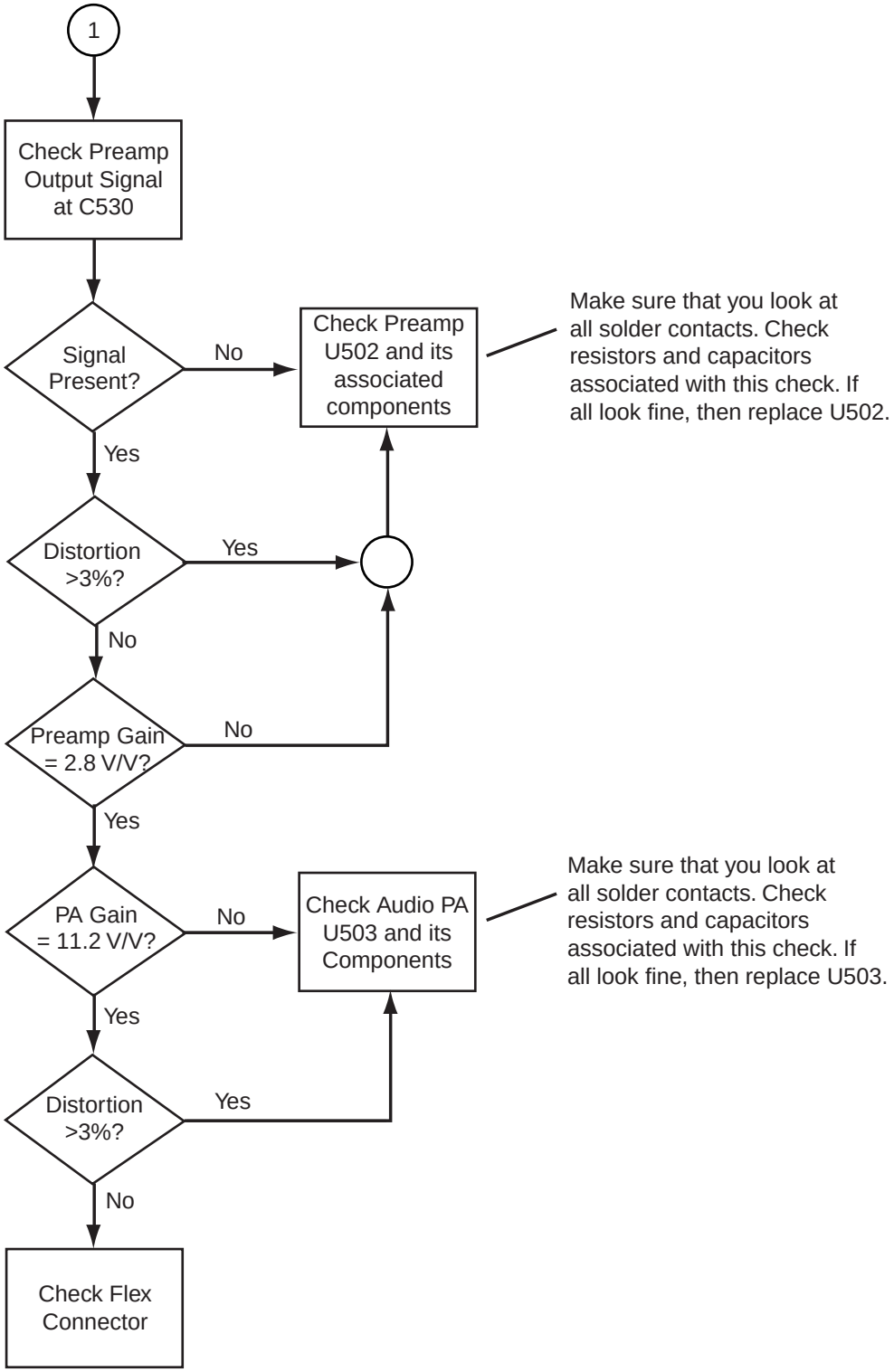
VOCON TX Audio—Page 2



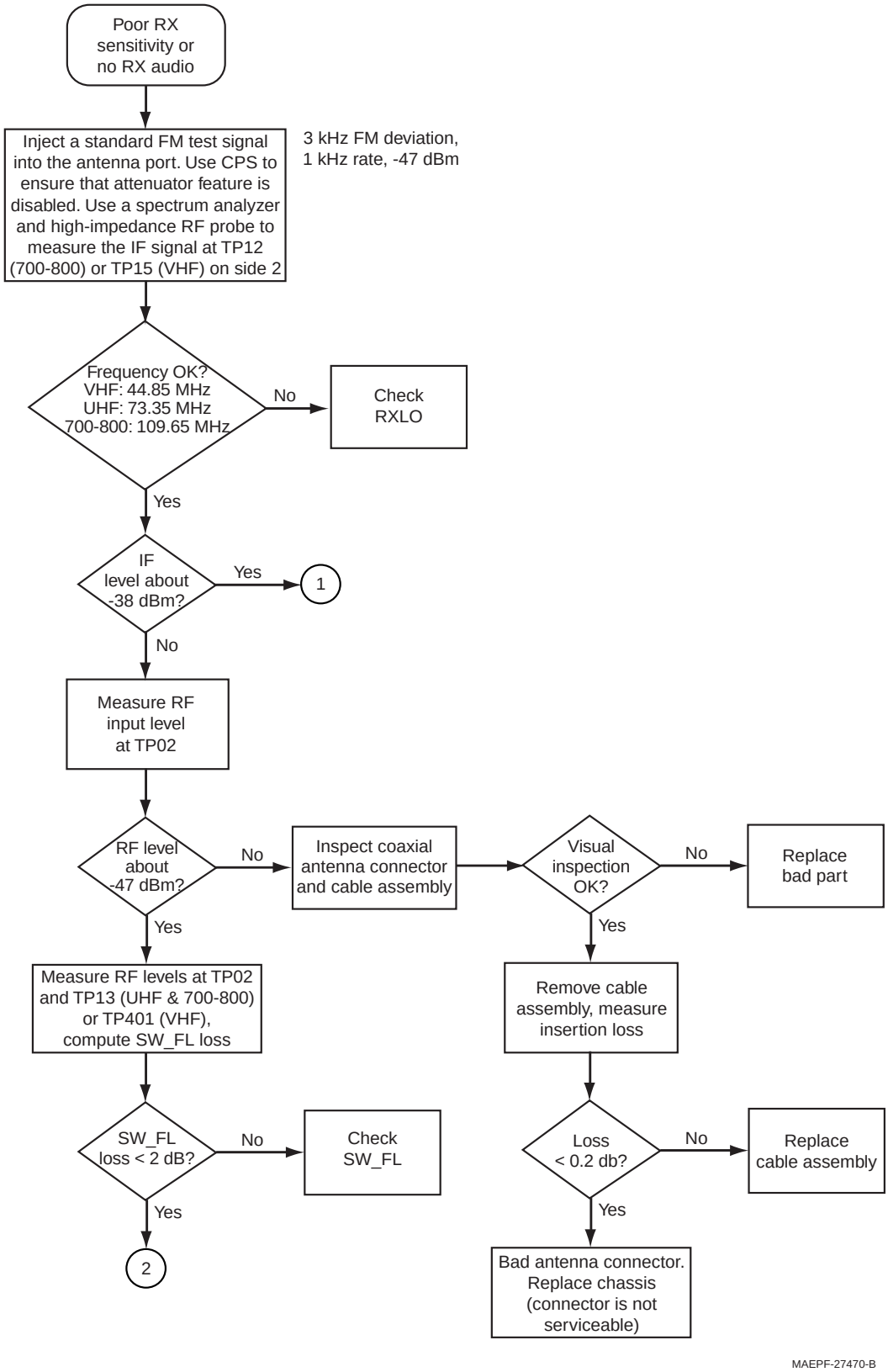
5.13 VOCON RX Audio—Page 1



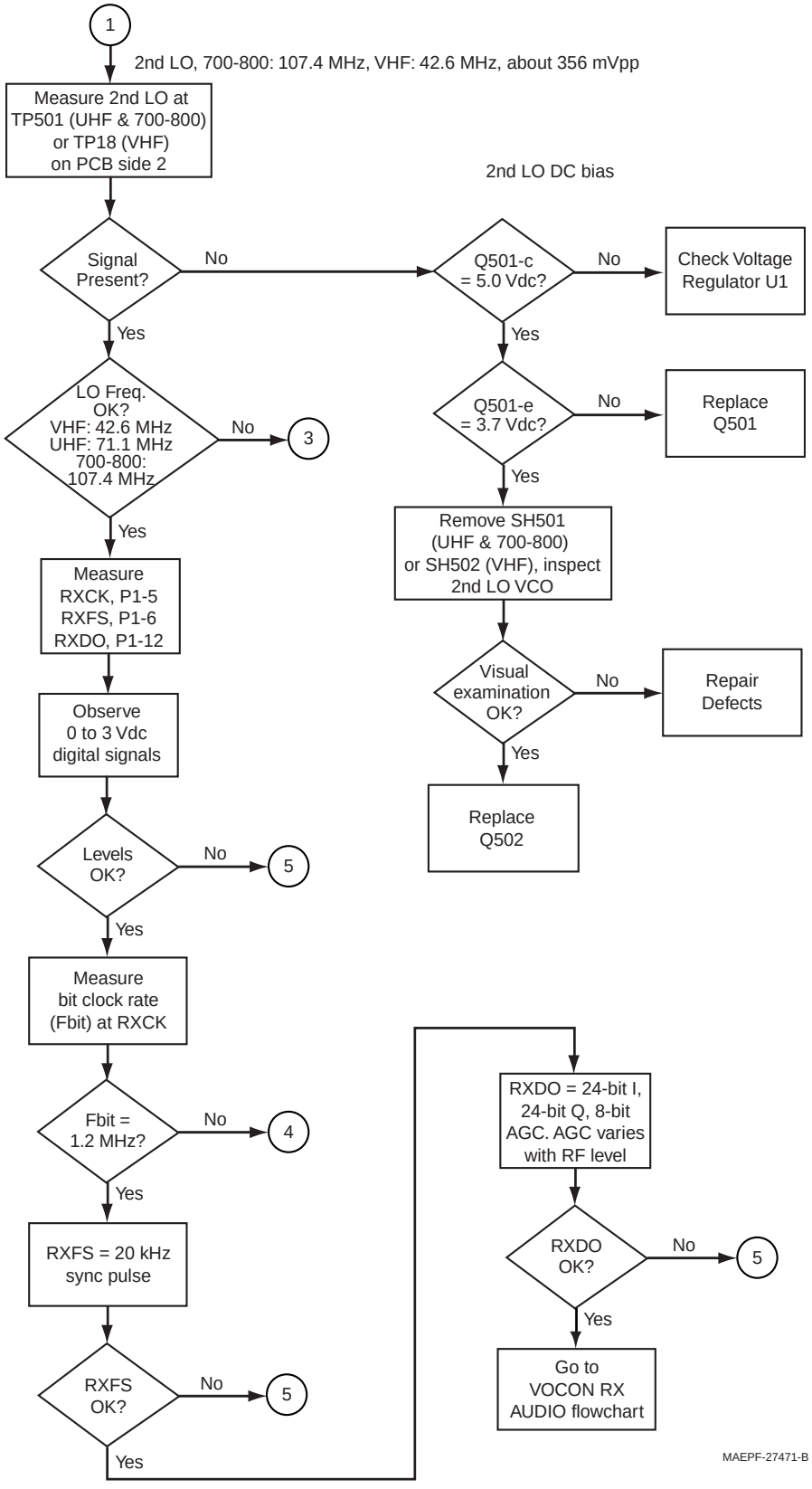
VOCON RX Audio—Page 2



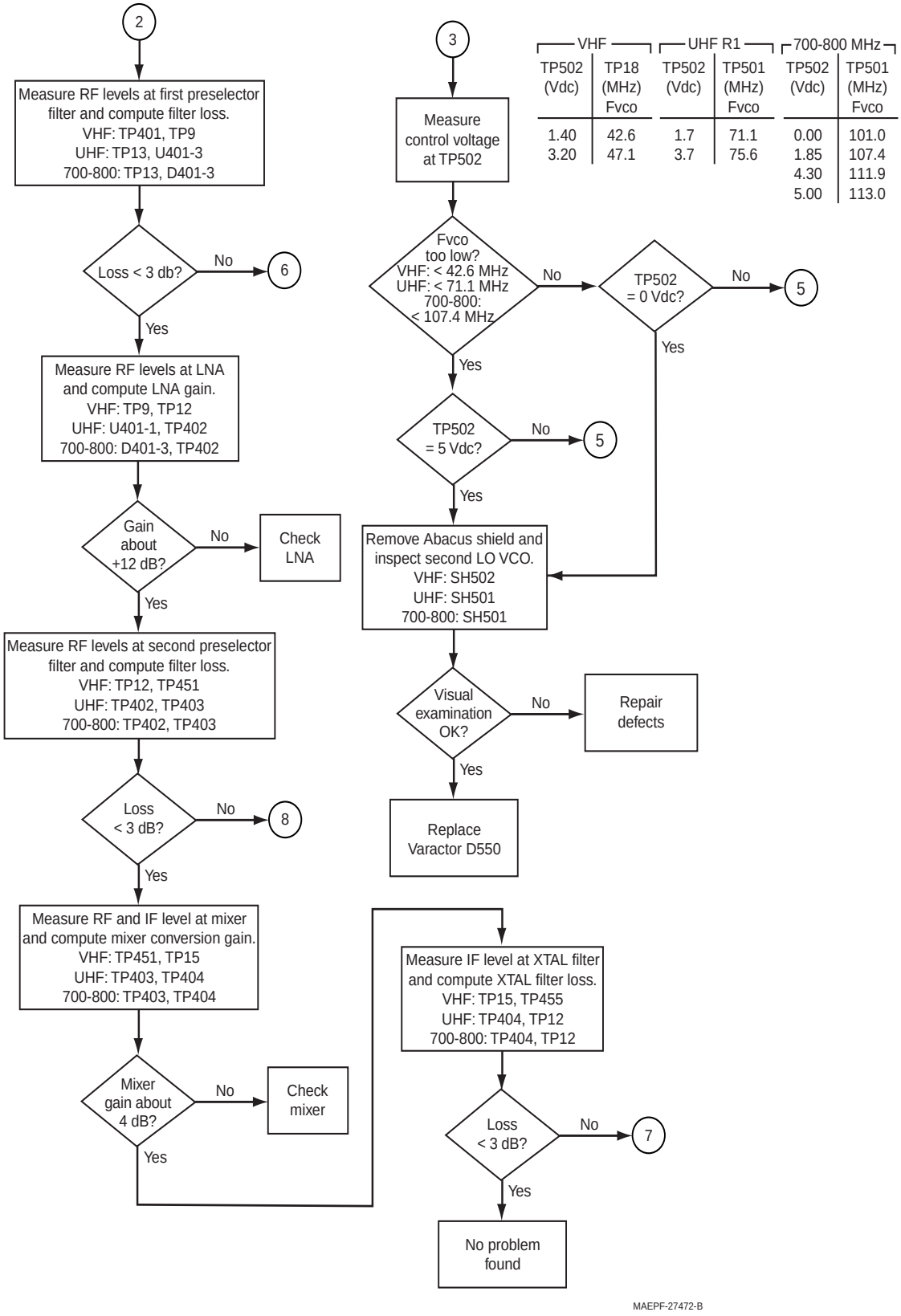
5.14 RX RF—Page 1



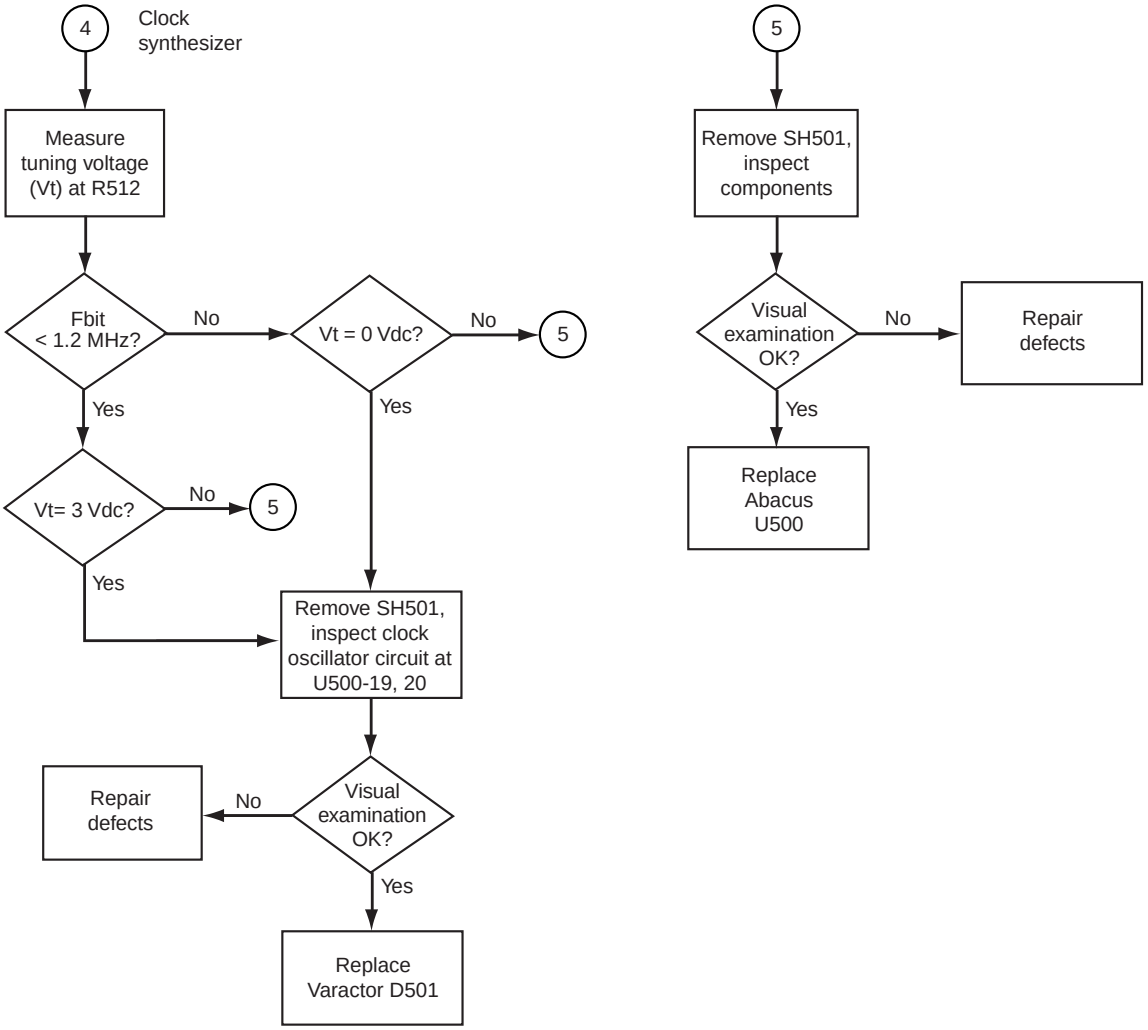
RX RF—Page 2


1
2nd LO, 700-800: 107.4 MHz, VHF: 42.6 MHz, about 356 mVpp
Measure 2nd LO at TP501 (UHF & 700-800) or TP18 (VHF) on PCB side 2
2nd LO DC bias
Signal Present?
No
Q501-c = 5.0 Vdc?
No
Check Voltage Regulator U1
Yes
Yes
LO Freq. OK? VHF: 42.6 MHz UHF: 71.1 MHz 700-800: 107.4 MHz
No
3
Q501-e = 3.7 Vdc?
No
Replace Q501
Yes
Yes
Remove SH501 (UHF & 700-800) or SH502 (VHF), inspect 2nd LO VCO
Measure RXCK, P1-5 RXFS, P1-6 RXDO, P1-12
Visual examination OK?
No
Repair Defects
Yes
Observe 0 to 3 Vdc digital signals
Replace Q502
Levels OK?
No
5
Yes
Measure bit clock rate (Fbit) at RXCK
RXDO = 24-bit I, 24-bit Q, 8-bit AGC. AGC varies with RF level
Fbit = 1.2 MHz?
No
4
RXDO OK?
No
5
Yes
Yes
RXFS = 20 kHz sync pulse
Go to VOCON RX AUDIO flowchart
RXFS OK?
No
5
Yes
MAEPF-27471-B

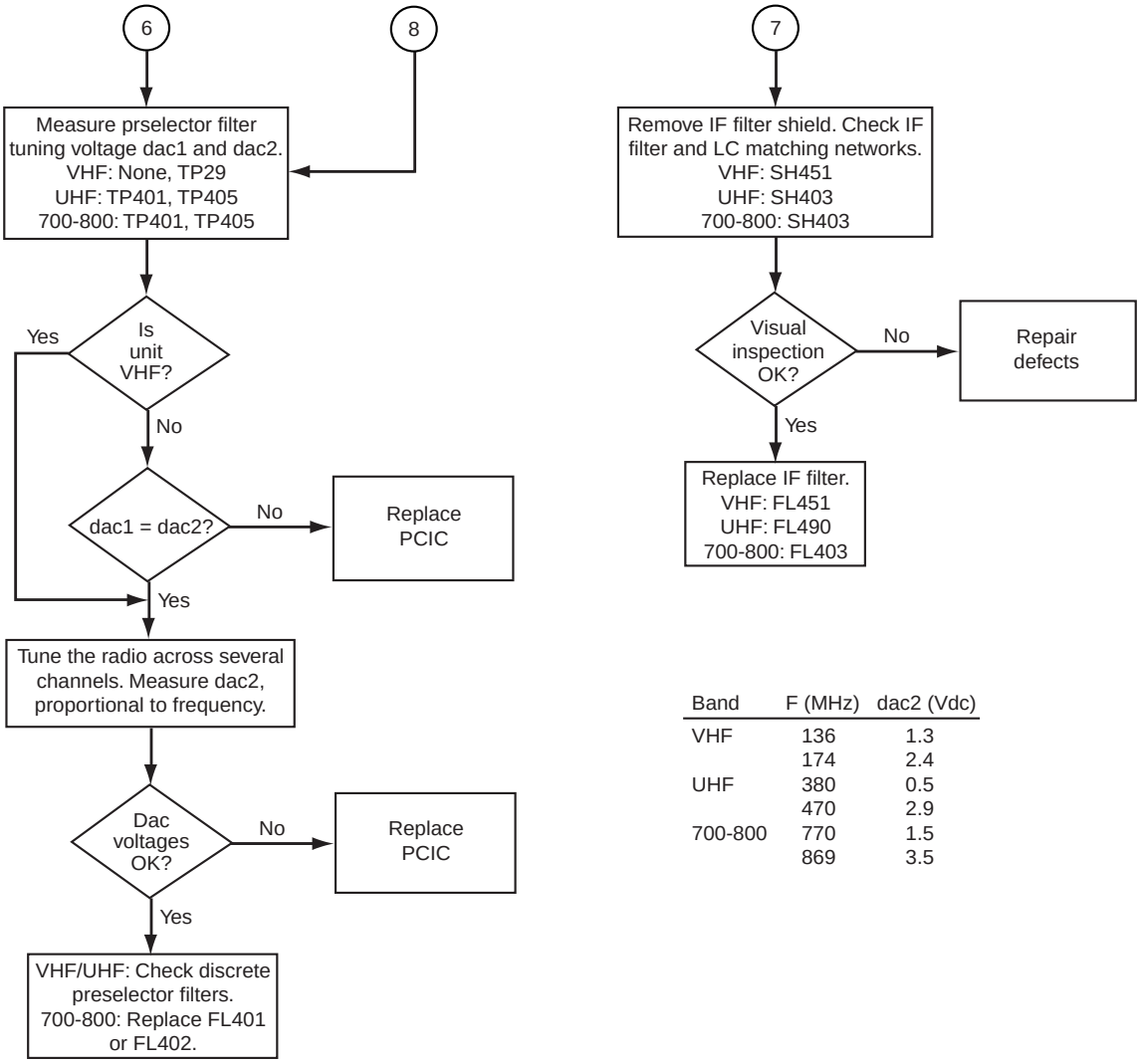
RX RF—Page 3


2
Measure RF levels at first preselector filter and compute filter loss.
VHF: TP401, TP9
UHF: TP13, U401-3
700-800: TP13, D401-3
Loss < 3 db?
No
6
Yes
Measure RF levels at LNA and compute LNA gain.
VHF: TP9, TP12
UHF: U401-1, TP402
700-800: D401-3, TP402
Gain about +12 dB?
No
Check LNA
Yes
Measure RF levels at second preselector filter and compute filter loss.
VHF: TP12, TP451
UHF: TP402, TP403
700-800: TP402, TP403
Loss < 3 dB?
No
8
Yes
Measure RF and IF level at mixer and compute mixer conversion gain.
VHF: TP451, TP15
UHF: TP403, TP404
700-800: TP403, TP404
Mixer gain about 4 dB?
No
Check mixer
Yes
3
Measure control voltage at TP502
VHF
UHF R1
700-800 MHz
TP502 (Vdc) | TP18 (MHz) Fvco
1.40 | 42.6
3.20 | 47.1
TP502 (Vdc) | TP501 (MHz) Fvco
1.7 | 71.1
3.7 | 75.6
TP502 (Vdc) | TP501 (MHz) Fvco
0.00 | 101.0
1.85 | 107.4
4.30 | 111.9
5.00 | 113.0
Fvco too low?
VHF: < 42.6 MHz
UHF: < 71.1 MHz
700-800: < 107.4 MHz
No
TP502 = 0 Vdc?
No
5
Yes
Yes
TP502 = 5 Vdc?
No
5
Yes
Remove Abacus shield and inspect second LO VCO.
VHF: SH502
UHF: SH501
700-800: SH501
Visual examination OK?
No
Repair defects
Yes
Replace Varactor D550
Measure IF level at XTAL filter and compute XTAL filter loss.
VHF: TP15, TP455
UHF: TP404, TP12
700-800: TP404, TP12
Loss < 3 dB?
No
7
Yes
No problem found
MAEPF-27472-B

RX RF—Page 4


4
Clock synthesizer
Measure tuning voltage (Vt) at R512
Fbit < 1.2 MHz?
No
Vt = 0 Vdc?
No
5
Yes
Yes
Vt= 3 Vdc?
No
5
Yes
Remove SH501, inspect clock oscillator circuit at U500-19, 20
Repair defects
No
Visual examination OK?
Yes
Replace Varactor D501
5
Remove SH501, inspect components
Visual examination OK?
No
Repair defects
Yes
Replace Abacus U500
MAEPF-27473-O

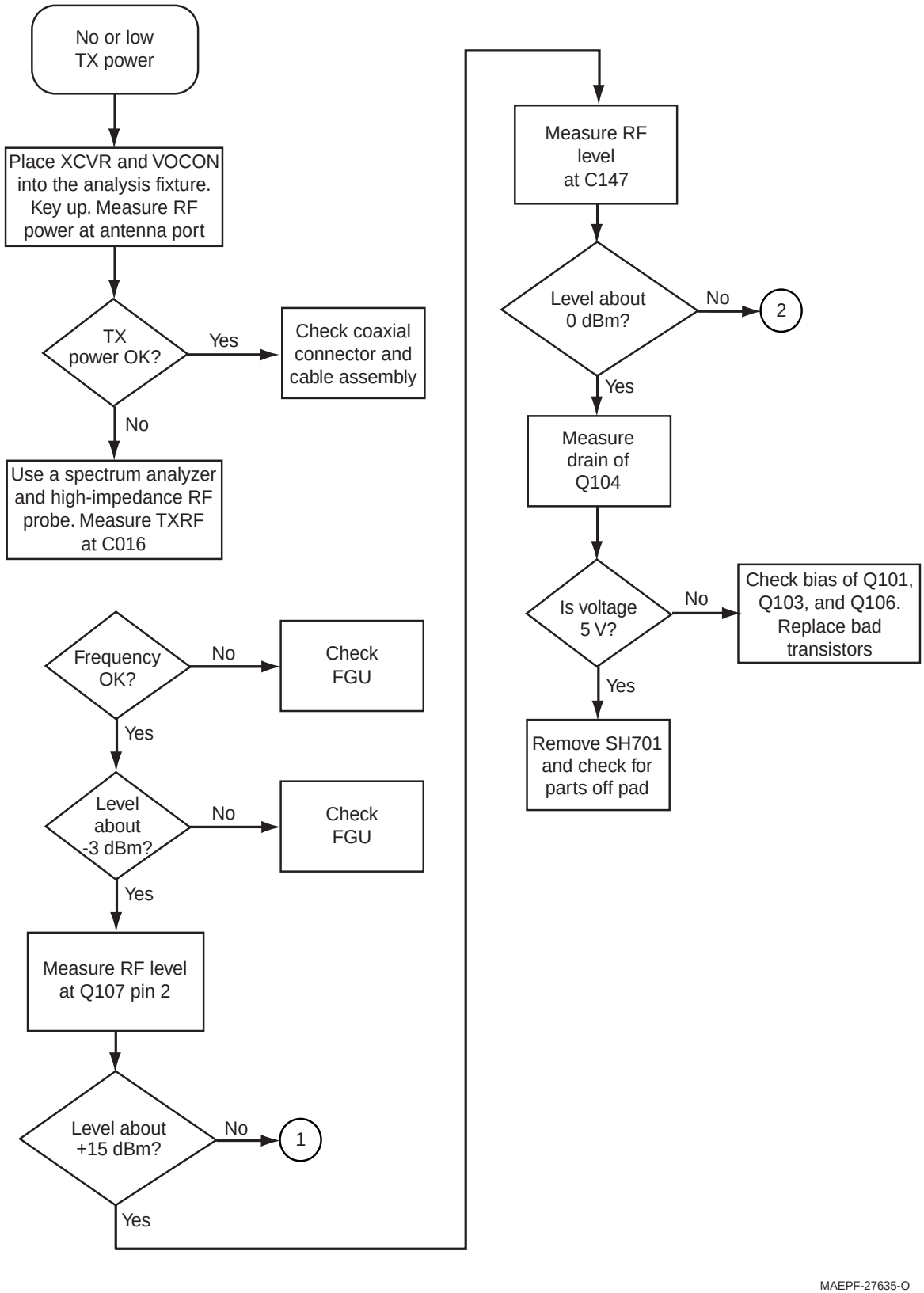
RX RF—Page 5



Band	F (MHz)	dac2 (Vdc)
VHF	136	1.3
	174	2.4
UHF	380	0.5
	470	2.9
700-800	770	1.5
	869	3.5

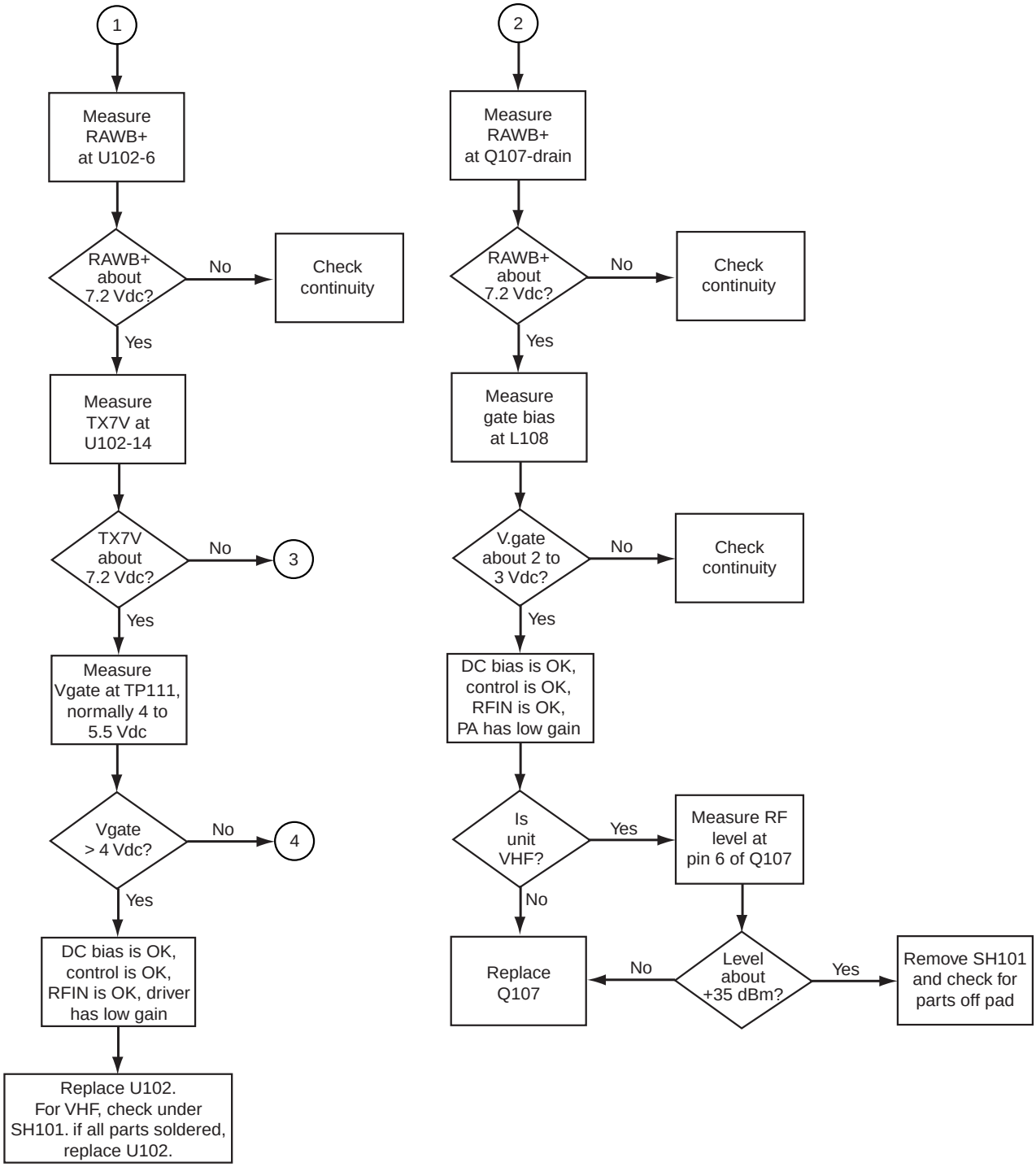
MAEPF-27474-B

5.15 TX RF (VHF)—Page 1

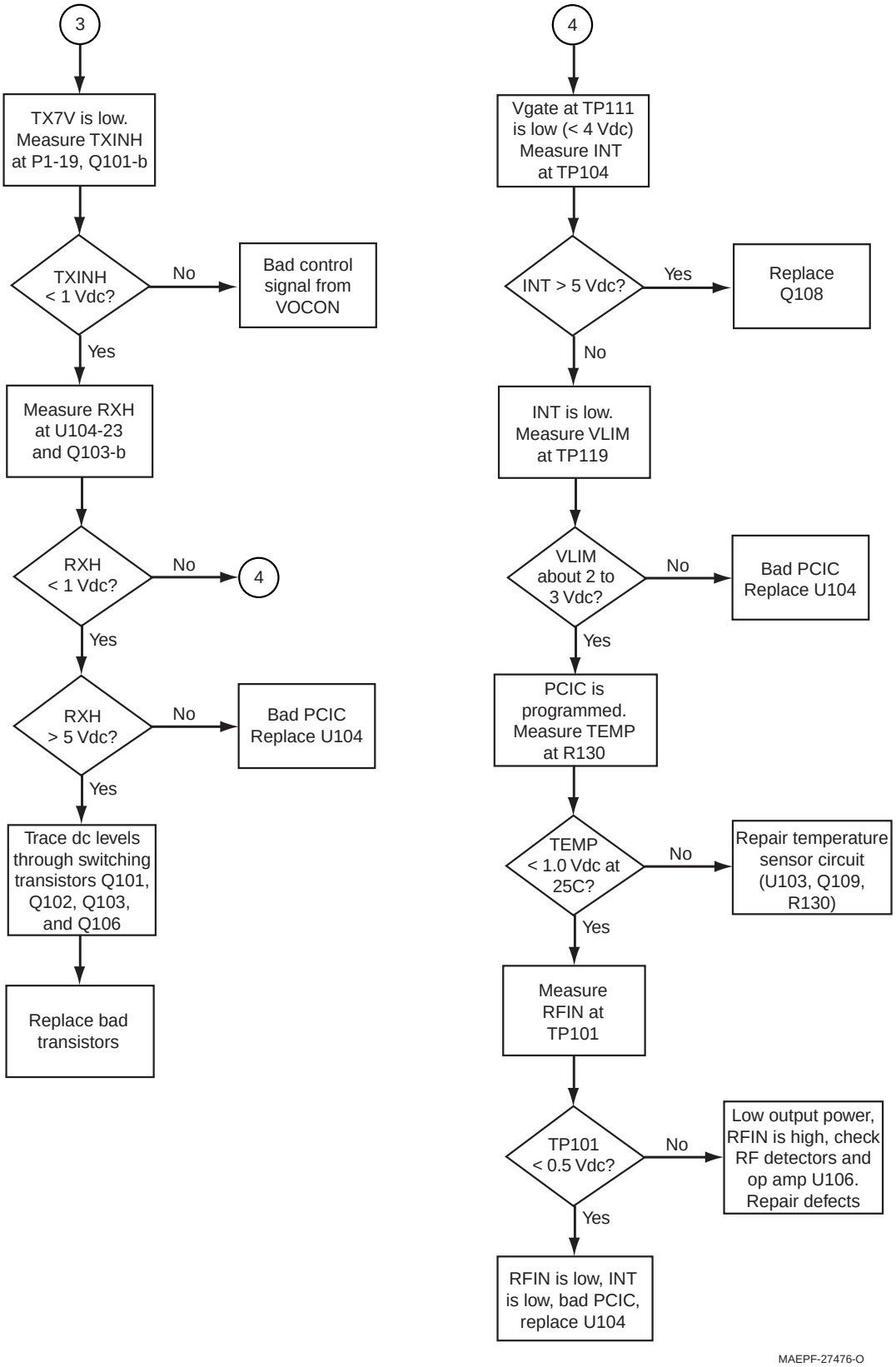


MAEPF-27635-O

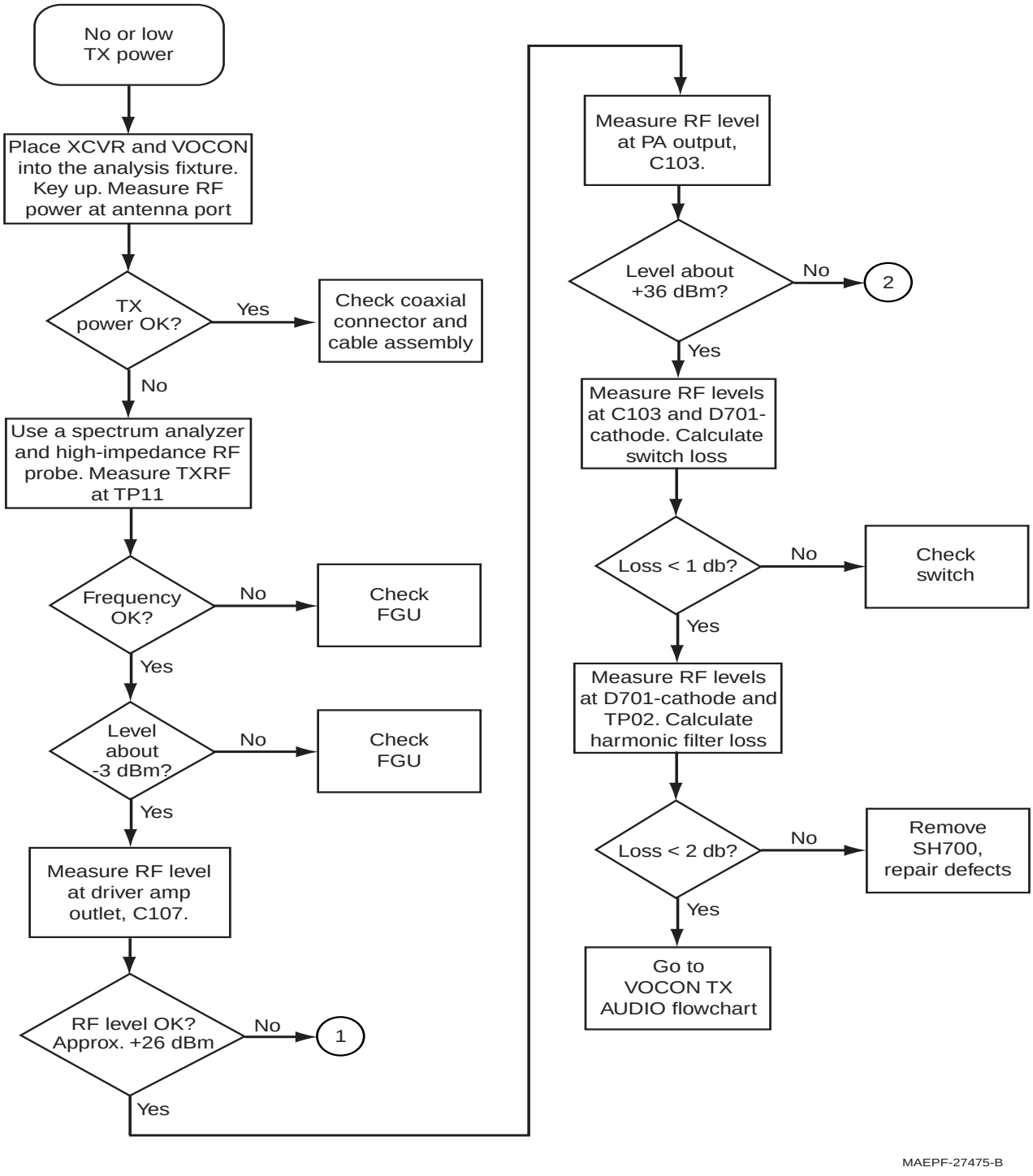
TX RF (VHF)—Page 2



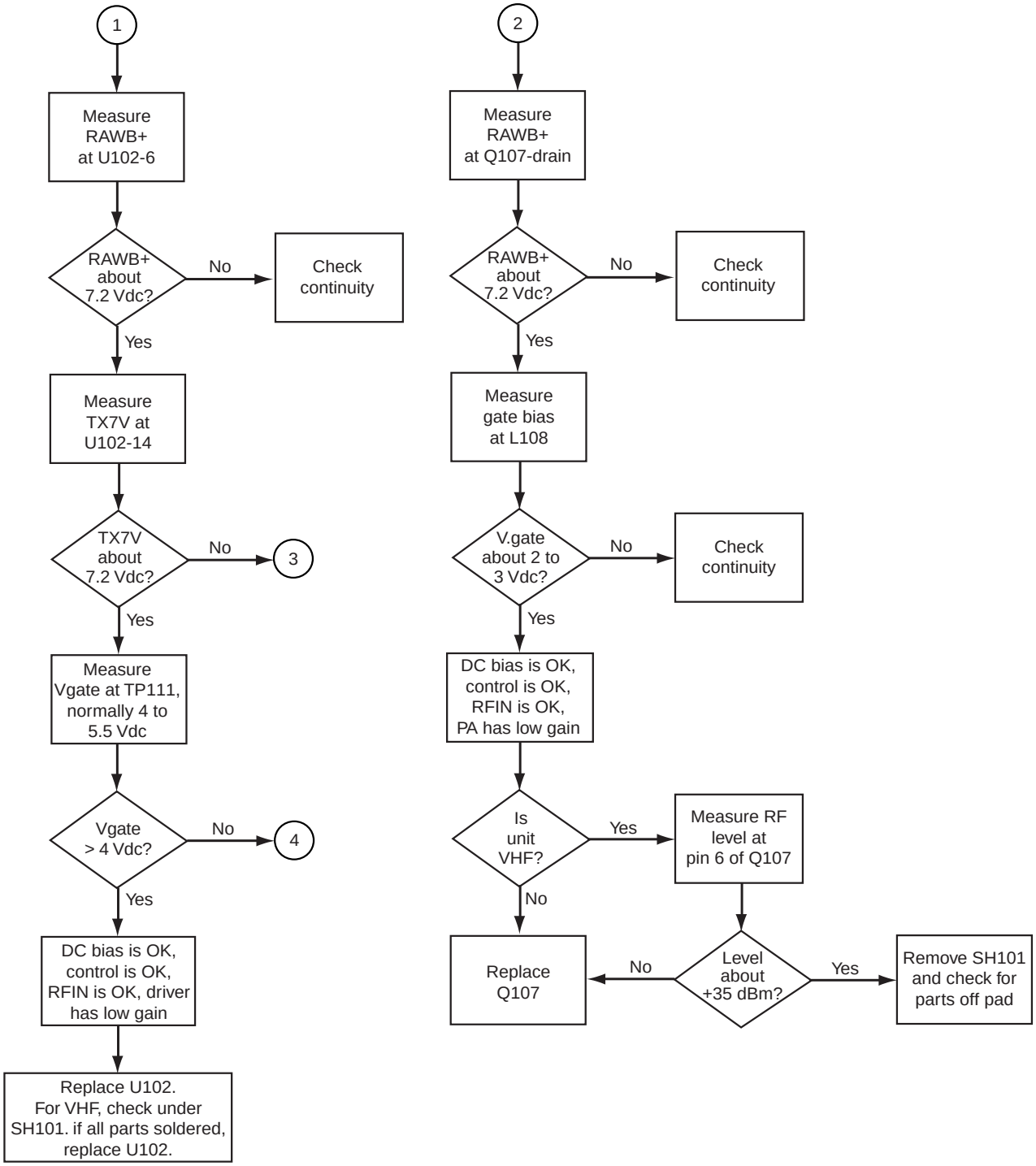
TX RF (VHF)—Page 3



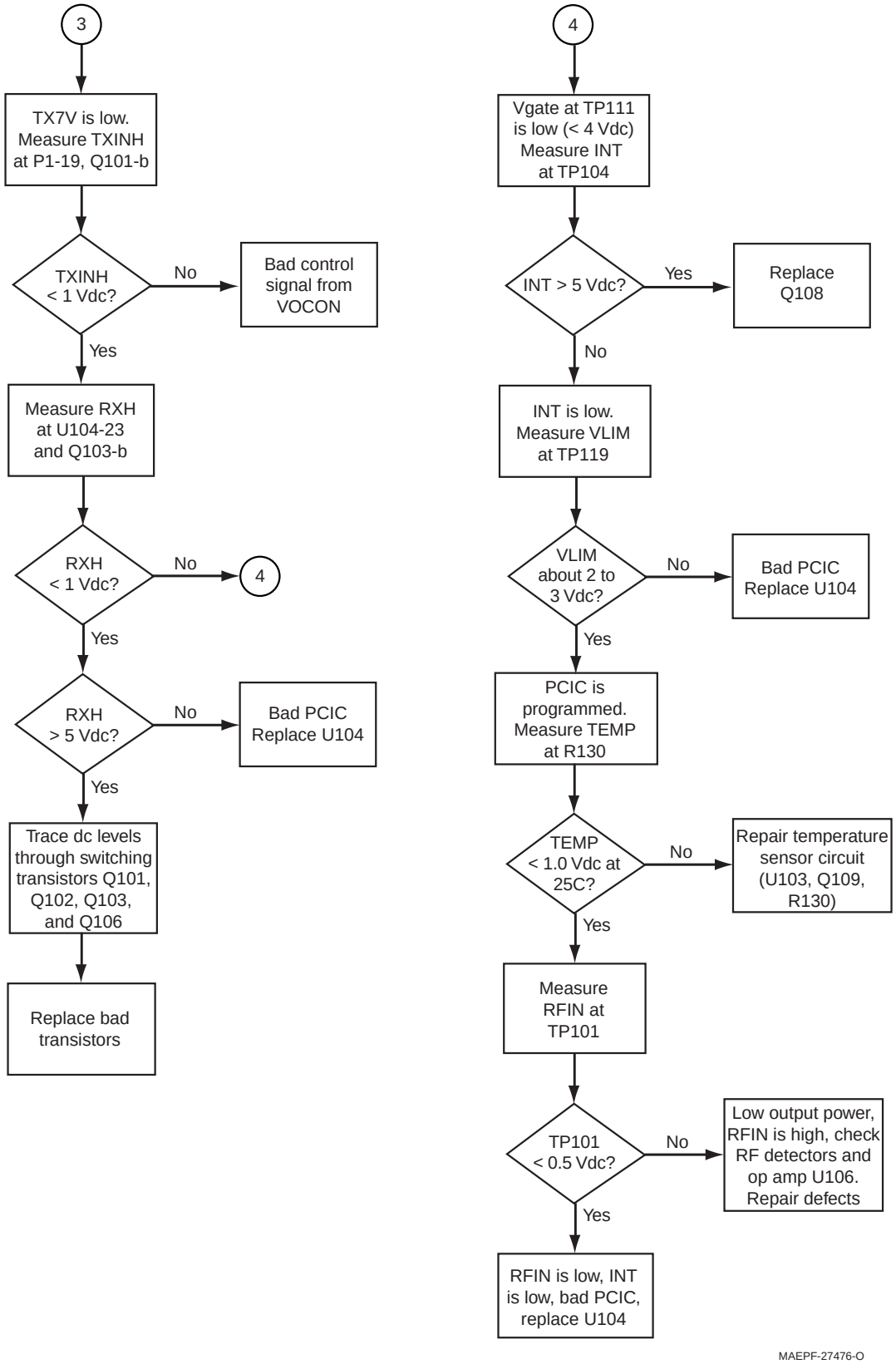
5.16 TX RF (UHF R1/700-800 MHz)—Page 1



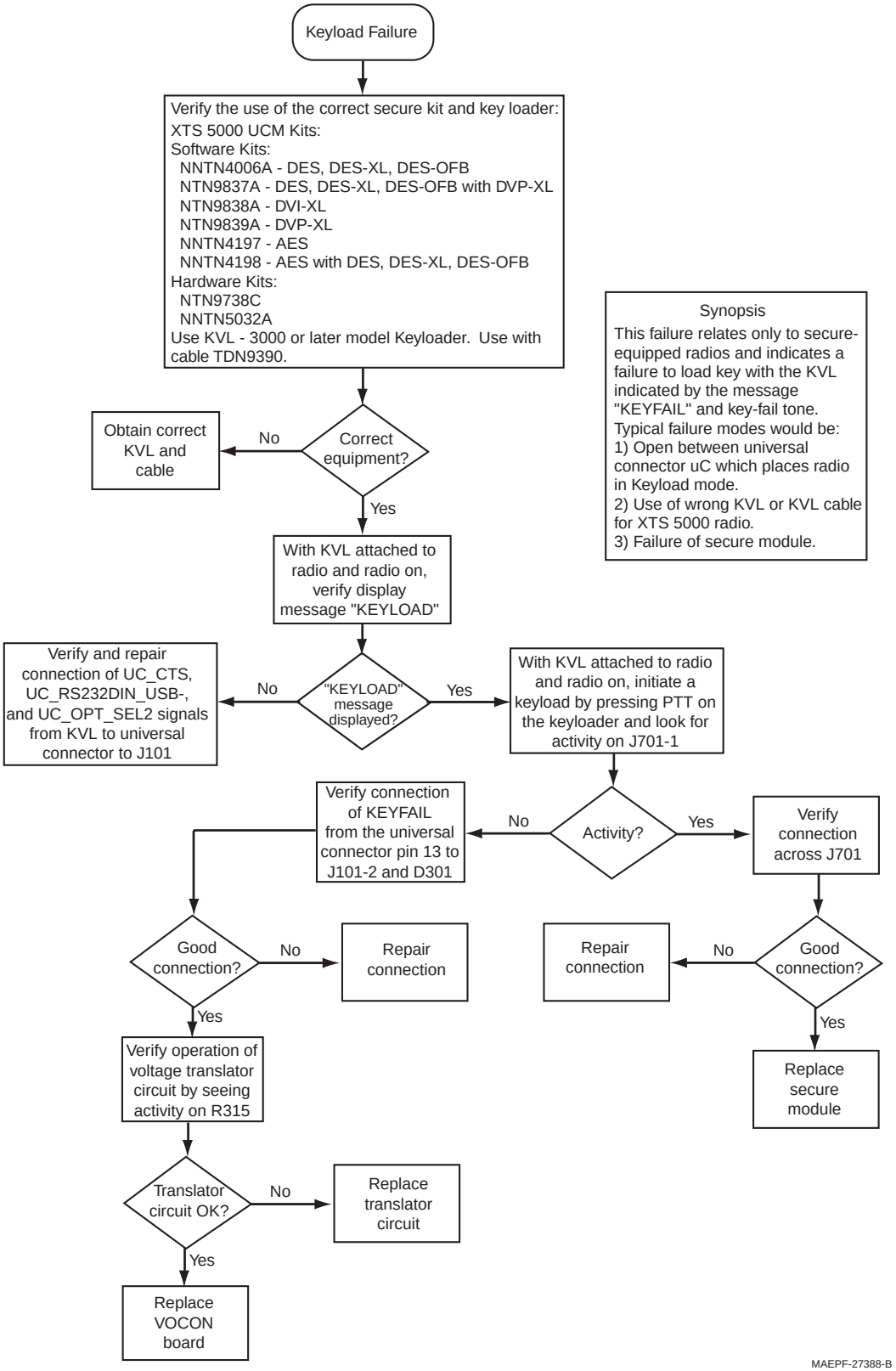
TX RF (UHF R1/700-800 MHz)—Page 2



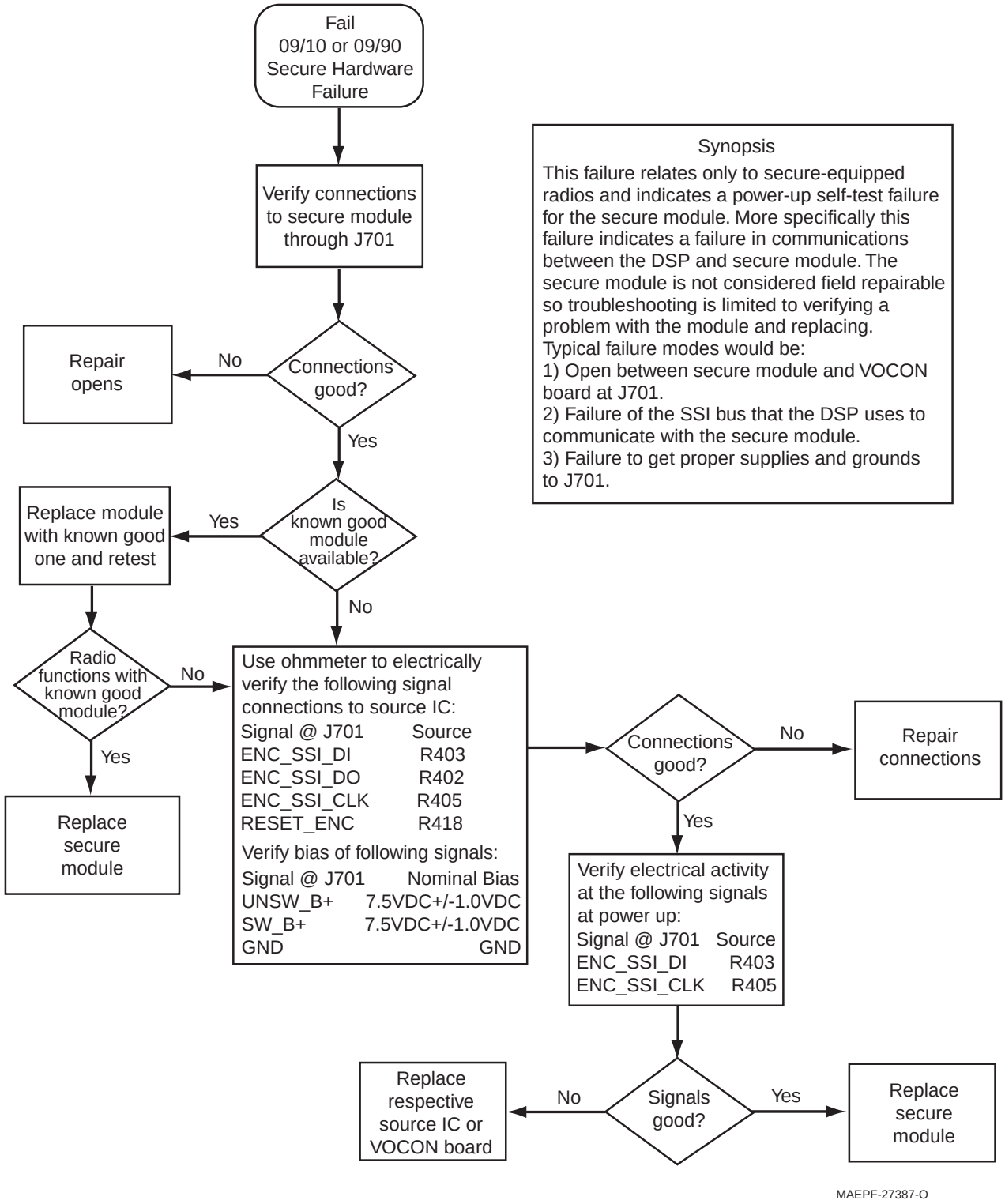
TX RF (UHF R1/700-800 MHz)—Page 3



5.17 Keyload Failure



5.18 Secure Hardware Failure



Notes

Chapter 6 Troubleshooting Waveforms

This chapter contains images of waveforms that might be useful in verifying operation of certain parts of the circuitry. These waveforms are for reference only; the actual data depicted will vary depending on operating conditions.

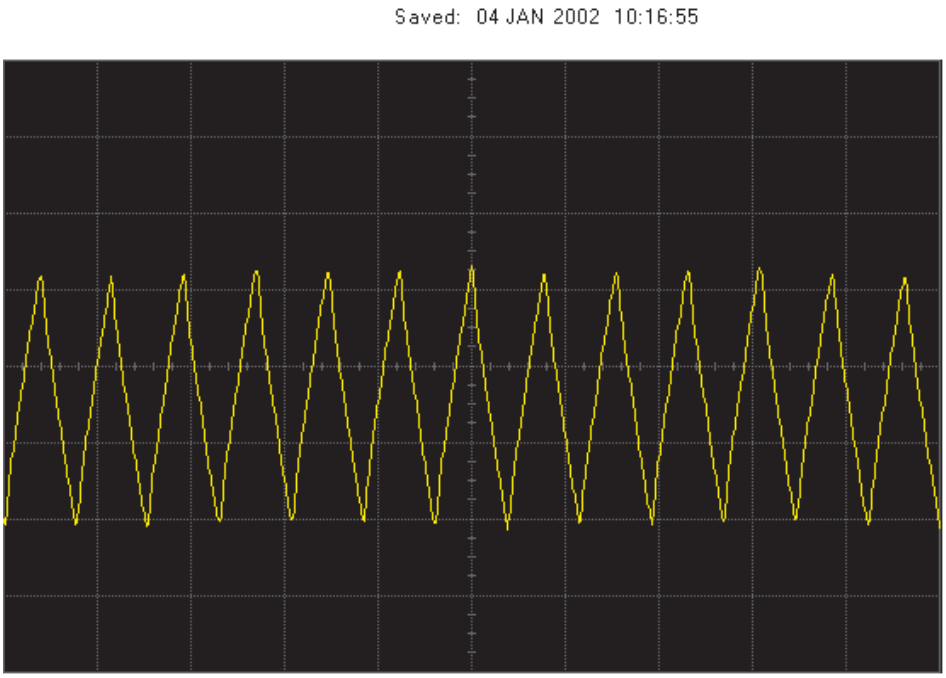
6.1 List of Waveforms

Table 6-1 lists each waveform and the page on which the waveform can be found.

Table 6-1. List of Waveforms

Waveform	Page No.
13 MHz Clock	6-2
16.8 MHz Buffer Input and Output	6-3
32.768 kHz Clock Outputs	6-4
SPI B Data	6-5
Receive Serial Audio Port (SAP)	6-6
Receive Baseband Interface Port (RX BBP)	6-7
Transmit Baseband Interface Port (TX BBP)	6-8

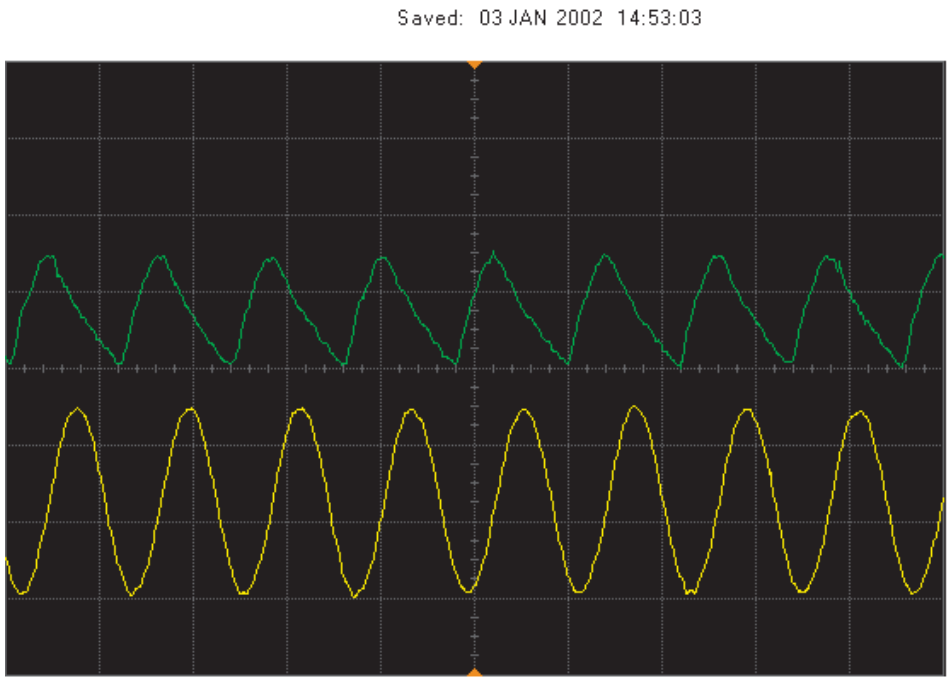
6.2 13 MHz Clock



13 MHz clock from U301 to U501.
Trace 1: Trace recorded at C303 on the NTN9564 board.
Similar waveform is visible on C339 on the NNTN4563, NNTN4819, & NNTN4717 VOCON boards.

Figure 6-1. 13 MHz Clock Waveform

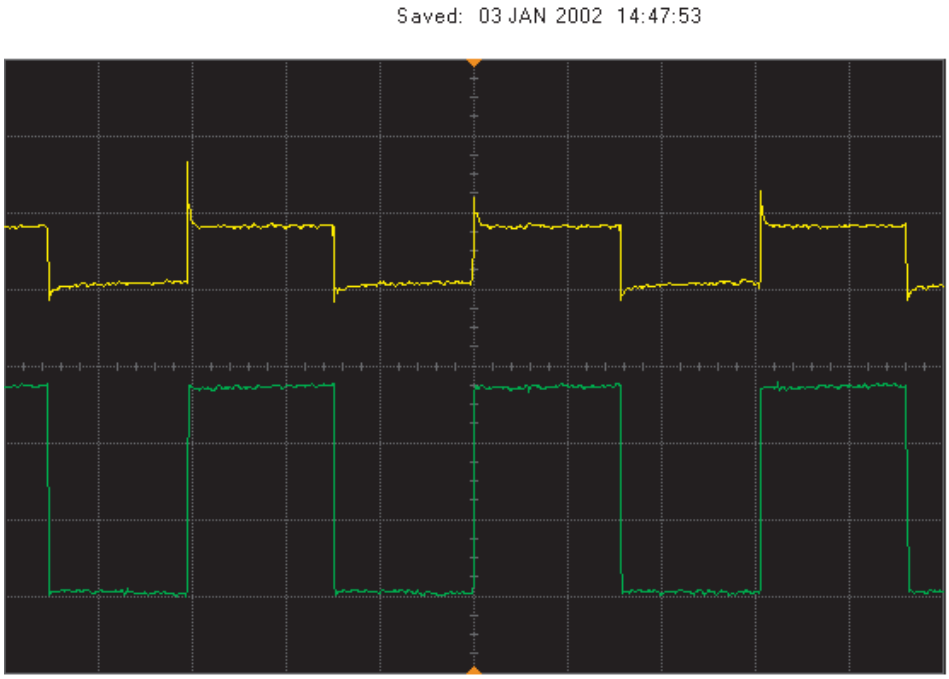
6.3 16.8 MHz Buffer Input and Output



Trace 1: Buffer input at R452.
Trace 2: Buffer output at C452.
Note: These components are under shield SH101 on the NNTN4563, NNTN4819, & NNTN4717 VOCON boards.

Figure 6-2. 16.8 MHz Buffer Input and Output Waveforms

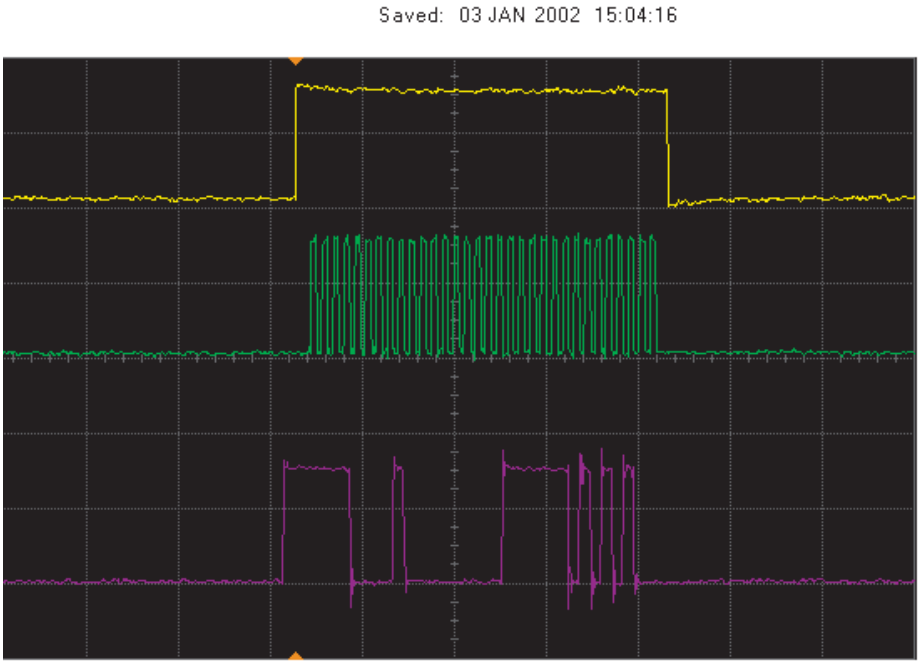
6.4 32.768 kHz Clock Outputs



Trace 1: Output at C313 (to real-time clock of GCAP II IC).
Trace 2: Output at U302, pin 2 (to Patriot IC CKIL input).
Note: These components are under shield SH102 on the NNTN4563, NNTN4819, & NNTN4717 VOCON boards.

Figure 6-3. 32.768 kHz Clock Outputs Waveforms

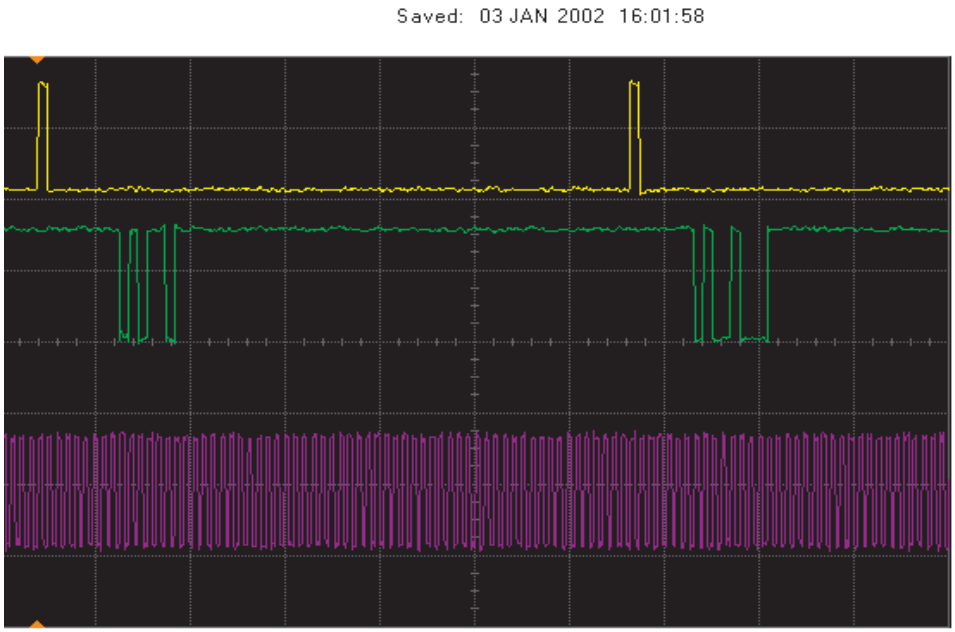
6.5 SPI B Data



Trace 1: GCAP II IC chip enable at R539 (Note active high).
Trace 2: SPI data clock at Test Point SCKB.
Trace 3: SPI data to GCAP II IC at Test Point MOSIB.

Figure 6-4. SPI B Data Waveforms

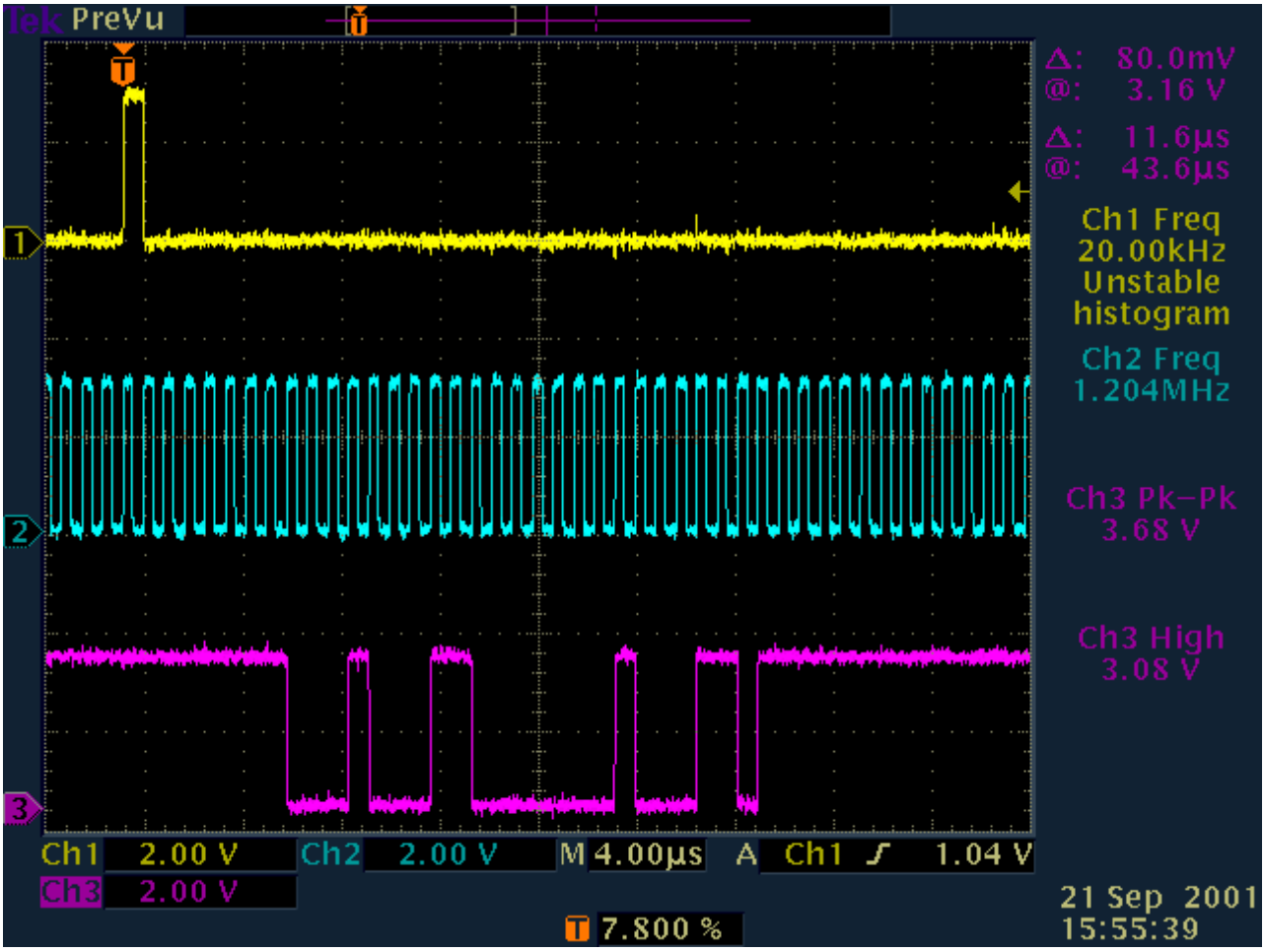
6.6 Receive Serial Audio Port (SAP)



Trace 1: 8 kHz frame sync at R406 (each word is 13 bits after failing edge of FSYNC).
Trace 2: SAP data at R403 (audio data from GCAP II IC CODEC to Patriot IC DSP).
Note: Transmit is identical, except data acquired at R402.
Trace 3: 520 kHz bit clock at R405 on the NTN9564, NNTN4563 & NNTN4819 VOCON boards. 256 kHz bit clock at R405 on the NNTN4717 VOCON board.

Figure 6-5. Receive Serial Audio Port (SAP) Waveforms

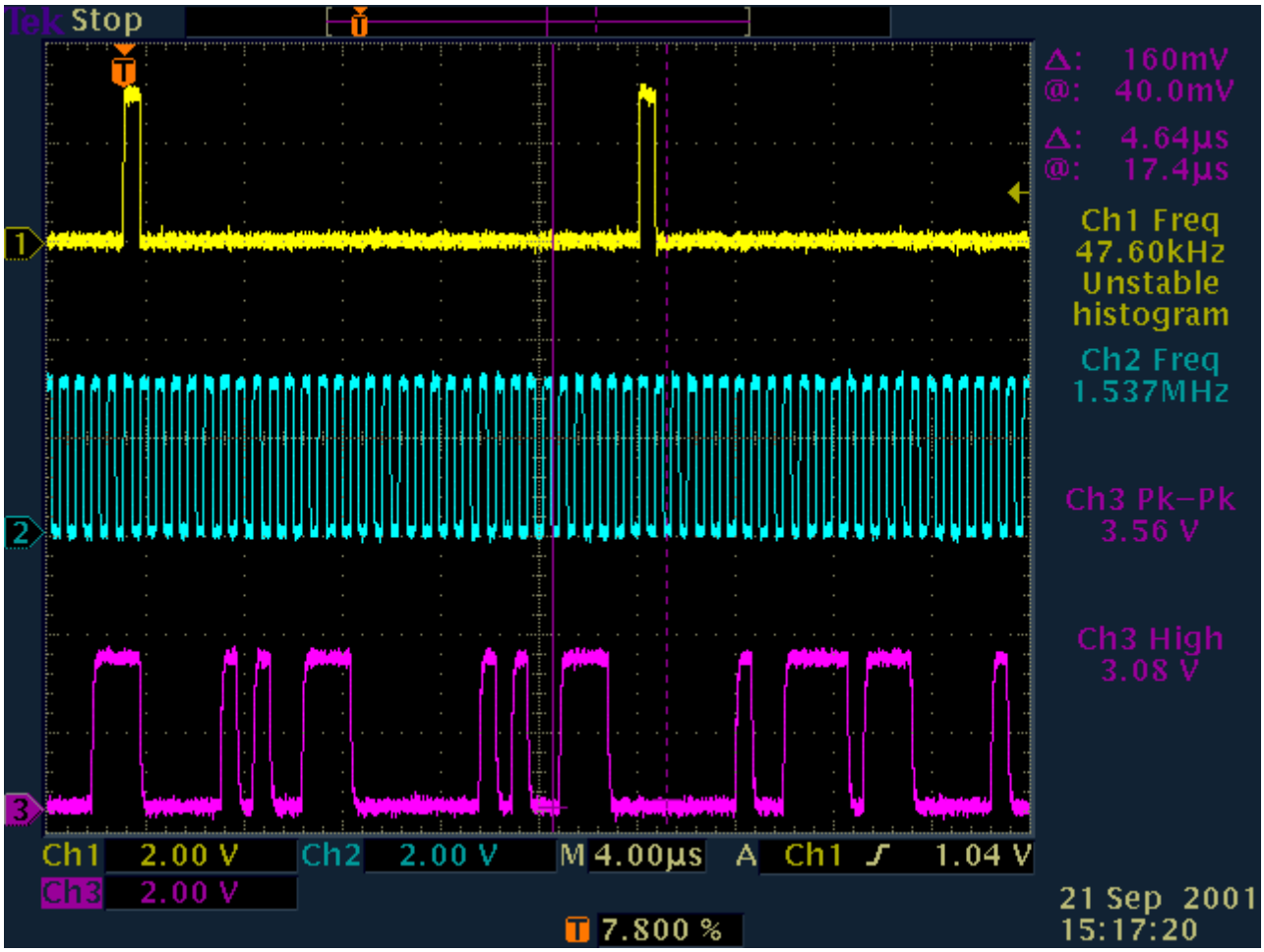
6.7 Receive Baseband Interface Port (RX BBP)



Trace 1: BBP RX frame sync signal at R123.
Trace 2: BBP RX clock signal at R124.
Trace 3: BBP RX data signal at R121.

Figure 6-6. Receive Baseband Interface Port (RX BBP) Waveforms

6.8 Transmit Baseband Interface Port (TX BBP)



Trace 1: BBP TX frame sync signal at R119.
Trace 2: BBP TX clock signal at R125.
Trace 3: BBP TX data signal at R127.

Figure 6-7. Transmit Baseband Interface Port (TX BBP) Waveforms

Chapter 7 Troubleshooting Tables

7.1 List of Board and IC Signals

Due to the nature of the schematic-generating program, signal names might be different when they are not directly connected to the same point. The tables in this chapter provide a cross reference to the various pinouts for these signals. Table 7-1 lists and provides links to each of the tables in this chapter.

Table 7-1. List of Tables of Board and IC Signals

Table No.	Table Name	Page No.
7-2	J101 VOCON Board to Controls Flex Assembly	7-1
7-3	J107 VOCON Board to Keypad Module	7-3
7-4	J701 VOCON Board to Encryption Module	7-3
7-5	U402 FLASH Pinouts	7-5
7-6	U403 SRAM Pinouts	7-7
7-7	U401 Patriot MCU/DSP IC Pinouts	7-9
7-8	U301 Flipper IC Pinouts	7-18
7-9	U501 GCAP II IC Pinouts	7-20

Table 7-2. J101 VOCON Board to Controls Flex Assembly

J101 Pin No.	Description	To/From	Side Connector Number
1	UC_CTS	TP208	10
2	UC_LHDATA_KEYFAIL	TP206	13
3	DGND03	TP202	8
4	UC_RS232DIN_USB-	R253	12
5	UC_EXT_SPKR_NEG-	TP213	6
6	UC_RS232DOUT_USB+	R252	11
7	UC_OPT_SEL2	R218	5
8	UC_SB9600_BUSY	TP207	9
9	UC_EXT_SKPR	TP212	2
10	UC_RTS	TP209	7

Table 7-2. J101 VOCON Board to Controls Flex Assembly (Continued)

J101 Pin No.	Description	To/From	Side Connector Number
11	UC_OPT_SEL1	R217	1
12	UC_OPTB+_VPP	R255	4
13	UC_EXT_MIC	TP214	3
14	UC_EMERG	R233	
15	DGND15	TP202	
16	DGND16	TP202	
17	UC_MONITOR	R244	
18	DGND18	TP202	
19	DGND19	TP202	
20	UC_BL_FREQ	R206	
21	UC_RED_LED	R203	
22	UC_GREEN_LED	R204	
23	UC_TG2	R234	
24	UC_RTA1	R236	
25	UC_RTA3	R241	
26	UC_RTA2	R239	
27	UC_RTA0	R235	
28	DGND28	TP202	
29	DGND29	TP202	
30	DGND30	TP202	
31	UC_VOLUME	R232	
32	BSENS_1	L202	
33	UNSWB+1	L201	
34	UC_TG1	R231	
35	V2A	L203	
36	UC_INT_MICU	L208	
37	C_INT_SPKR_NEG	TP213	
38	UC_INT_PTT	R216	
39	AGND39	L204	
40	UC_INT_SPKR	L205	

Table 7-3. J107 VOCON Board to Keypad Module

J107 Pin No.	Description	To/From	Accessible on VOCON?
1	KP_COLUMN0	C134	Yes
2	KP_COLUMN1	C133	Yes
3	KP_COLUMN2	C132	Yes
4	KP_GND	GROUND	Yes
5	KP_GND	GROUND	Yes
6	KP_BL_EN	C124	Yes
7	KP_5V1	C104	Yes
8	KP_5V2	C104	Yes
9	KP_GND	GROUND	Yes
10	KP_GND	GROUND	Yes
11	KP_GND	GROUND	Yes
12	KP_GND	GROUND	Yes
13	KP_ROW0	C131	Yes
14	KP_ROW1	C130	Yes
15	KP_ROW2	C129	Yes
16	KP_ROW3	C128	Yes
17	KP_ROW4	C127	Yes
18	KP_ROW5	C126	Yes
19	KP_ROW6	C125	Yes
20	KP_GND	GROUND	Yes
21	KP_GND	GROUND	Yes
22	KP_GND	GROUND	Yes

Table 7-4. J701 VOCON Board to Encryption Module

J701 Pin No.	Description	To/From	Accessible on VOCON?
1	KEYFAIL_LH_BDMDATA	Q303 Pin 2	Yes
2	RS232_DIN_ENC	R308	Yes
3	RS232_DIN_UP	R308	Yes
4	RTSIN_ENC	U301 Pin H7	No

Table 7-4. J701 VOCON Board to Encryption Module (Continued)

J701 Pin No.	Description	To/From	Accessible on VOCON?
5	RS232_DOUT_UP	R317	Yes
6	RS232_DOUT_ENC	R317	Yes
7	SW_B+_ENC	C101	Yes
8	Regulated V_ENC	No Connect	N/A
9	RS232_DTR_IN_ENC	No Connect	N/A
10	RS232_RI_OUT_EN	No Connect	N/A
11	USB_MINUS Monitor	No Connect	N/A
12	CONT_3VDC_OUT_ENC	No Connect	N/A
13	RS232_DCD_ENC	No Connect	N/A
14	USB_PLUS Monitor	No Connect	N/A
15	BOOT_ENC	R417	Yes
16	TAMPER	GROUND	Yes
17	SSI_DO_CODEC_ENC	R403	Yes
18	SSI_DI_CODEC_ENC	R402	Yes
19	RTA0_ENC	R246	Yes
20	RTA1_ENC	R247	Yes
21	RTA3_ENC	R251	Yes
22	RTA2_ENC	R250	Yes
23	TG2_ENC	R234	Yes
24	LHDATA_BDMDATA_KEYFAIL	D308 Pin 3	Yes
25	GREEN_LED_ENC	R204	Yes
26	WAKEUP	U401 Pin E1	No
27	TX_INHIBIT	R109	Yes
28	UCM_SS	U301 Pin G4	No
29	RED_LED_ENC	R203	Yes
30	RESET_ENC	R418	Yes
31	MONITOR	R244	Yes
32	SPARE1_ENC	R415	Yes
33	GROUND_ENC	GROUND	Yes
34	SPARE2_ENC	R416	Yes
35	EMERG_ENC	R241	Yes

Table 7-4. J701 VOCON Board to Encryption Module (Continued)

J701 Pin No.	Description	To/From	Accessible on VOCON?
36	UNSW_B+_ENC	C102	Yes
37	ENC_SSI_CLK	R404	Yes
38	ENC_SSI_FS	R406	Yes
39	ENC_SSI_DI	R403	Yes
40	ENC_SSI_DOUT	R402	Yes

* = Component located under a shield on NNTN4563, NNTN4819, & NNTN4717

Table 7-5. U402 FLASH Pinouts

U402 Pin No.	Description	To/From	Comment	Accessible on Vocon?
B4	B_CLK	B_CLK**		Yes
E7	CS0	CS0	Active Low	Yes
F8	EN_OE			No
C5	EN_WE			No
D6	WRITE PROTECT			No
C4	ADV	ADV**		Yes
B5	RESET	D401, pin 2	1.875 V	Yes
E8	ADDRESS 1			No
D8	ADDRESS 2			No
C8	ADDRESS 3			No
B8	ADDRESS 4			No
A8	ADDRESS 5			No
B7	ADDRESS 6			No
A7	ADDRESS 7			No
C7	ADDRESS 8			No
A2	ADDRESS 9			No
B2	ADDRESS 10			No
C2	ADDRESS 11			No
A1	ADDRESS 12			No
B1	ADDRESS 13			No
C1	ADDRESS 14			No

Table 7-5. U402 FLASH Pinouts (Continued)

U402 Pin No.	Description	To/From	Comment	Accessible on Vocon?
D2	ADDRESS 15			No
D1	ADDRESS 16			No
D4	ADDRESS 17			No
B6	ADDRESS 18			No
A6	ADDRESS 19			No
C6	ADDRESS 20			No
B3	ADDRESS 21			No
C3	ADDRESS 22			No
D7	ADDRESS 23	R427*		Yes
A3	GROUND			No
F1	GROUND			No
G2	GROUND			No
G8	GROUND			No
E2	DATA 15			No
F2	DATA 14			No
F3	DATA 13			No
D5	DATA 12			No
F4	DATA 11			No
F5	DATA 10			No
F6	DATA 9			No
G7	DATA 8			No
G1	DATA 7	R435**		Yes
E3	DATA 6	R434**		Yes
G3	DATA 5	R433**		Yes
E4	DATA 4	R432**		Yes
G5	DATA 3	R431**		Yes
E5	DATA 2	R430**		Yes
E6	DATA 1	R429**		Yes
F7	DATA 0	R428**		Yes
A5	VPP	D402, pin 3	1.875 V	Yes
G6	VSW2	C409*	1.875 V	Yes

Table 7-5. U402 FLASH Pinouts (Continued)

U402 Pin No.	Description	To/From	Comment	Accessible on Vocon?
E1	VSW2	C409*	1.875 V	Yes
G4	VSW2	C409*	1.875 V	Yes
A4	VSW2	C409*	1.875 V	Yes

* = Component located under a shield on NNTN4563, NNTN4819, & NNTN4717
** = No test point/component on NNTN4563, NNTN4819, & NNTN4717 - signal not accessible

Table 7-6. U403 SRAM Pinouts

U403 Pin No.	Description	To/From	Comment	Accessible on Vocon?
A2	EN_OE			No
G5	R_W	R_W	W = 0 V	Yes
A1	LB			No
B2	UB			No
B5	CS1	CS2 (TP)	Active Low	Yes
A6	CS2	C411*	Active Low	Yes
A3	ADDRESS 1			Yes
A4	ADDRESS 2			Yes
A5	ADDRESS 3			Yes
B3	ADDRESS 4			Yes
B4	ADDRESS 5			Yes
C3	ADDRESS 6			Yes
C4	ADDRESS 7			Yes
D4	ADDRESS 8			No
H2	ADDRESS 9			No
H3	ADDRESS 10			No
H4	ADDRESS 11			No
H5	ADDRESS 12			No
G3	ADDRESS 13			No
G4	ADDRESS 14			No
F3	ADDRESS 15			No
F4	ADDRESS 16			No

Table 7-6. U403 SRAM Pinouts (Continued)

U403 Pin No.	Description	To/From	Comment	Accessible on Vocon?
E4	ADDRESS 17			No
D3	ADDRESS 18			No
H1	ADDRESS 19			No
D1	GROUND			No
E6	GROUND			No
E3	GROUND			No
H6	NOT USED			No
G2	NOT USED			No
G1	DATA 15			No
F1	DATA 14			No
F2	DATA 13			No
E2	DATA 12			No
D2	DATA 11			No
C2	DATA 10			No
C1	DATA 9			No
B1	DATA 8			No
G6	DATA 7	R435**		No
F6	DATA 6	R434**		No
F5	DATA 5	R433**		No
E5	DATA 4	R432**		No
D5	DATA 3	R431**		No
C6	DATA 2	R430**		No
C5	DATA 1	R429**		No
B6	DATA 0	R428**		No
D6	VSW2	C411*	1.875 V	Yes
E1	VSW2	C411*	1.875 V	Yes

* = Component located under a shield on NNTN4563, NNTN4819, & NNTN4717
** = No test point/component on NNTN4563, NNTN4819, & NNTN4717 - signal not accessible

Table 7-7. U401 Patriot MCU/DSP IC Pinouts

U401 Pin No.	Description	To/From	Comment	Accessible on Vocon?
H10	EEPOT_INC*	C537	Active Low	Yes
J14	EXT_SPKR_SEL	Q505, pin 5		Yes
C14	AUDIO_PA_EN	R575		Yes
B14	HOST_WAKE			No
F6	BATTERY_ID	C556		Yes
E5	MECH_SW_BAR	Q508, pin 3	Active Low	Yes
J6	INT_PTT	R216	Active Low	Yes
J5	GCAP_INT	R538		Yes
J4	OPT_SEL1_IN	U201 pin 1		Yes
J3	UART_INT*			No
C16	8KHZ_INT	R406	8 kHz Pulse	Yes
G11	OPT_SEL2_IN	U202 pin 1		Yes
F1	KP_ROW0	C131		Yes
H4	KP_ROW1	C130		Yes
H6	KP_ROW2	C129		Yes
G2	KP_ROW3	C128		Yes
G11	KP_ROW4	C127		Yes
G7	KP_ROW5	C126		Yes
H7	KP_ROW6	C125		Yes
H1	SPARE1_ENC	J701, pin 32		Yes
D1	KP_COL0	C134		Yes
G5	KP_COL1	C133		Yes
F3	KP_COL2	C132		Yes
G4	ENC_RESET	J701, pin 30		Yes
F2	BOOT*	J701, pin 15		Yes
E1	WAKEUP	J701, pin 26		Yes
H6	SPARE2_ENC	J701, pin 34		Yes
G3	NOT USED			No
E7	NOT USED			No
A8	NOT USED			No
F8	MISOA_SEL	U406, pin 2		Yes

Table 7-7. U401 Patriot MCU/DSP IC Pinouts (Continued)

U401 Pin No.	Description	To/From	Comment	Accessible on Vocon?
E8	NOT USED			No
G8	NOT USED			No
C3	NOT USED			No
D4	LOCK_DET	C123	Active Low	Yes
A2	TG2	R234		Yes
B2	RTA3	R241		Yes
A3	RTA2	R239		Yes
B3	RTA1	R236		Yes
B4	RTA0	R235		Yes
A7	VSW2	E401*	1.875 V	Yes
P3	VSW2	E401*	1.875 V	Yes
P6	VSW2	E401*	1.875 V	Yes
T9	VSW2	E401*	1.875 V	Yes
N10	VSW2	E401*	1.875 V	Yes
R16	VSW2	E401*	1.875 V	Yes
H9	V2	E402*	3.0 V	Yes
G9	V2	E402*	3.0 V	Yes
E15	V2	E402*	3.0 V	Yes
A16	V2	E402*	3.0 V	Yes
K10	V2	E402*	3.0 V	Yes
C12	V2	E402*	3.0 V	Yes
D8	V2	E402*	3.0 V	Yes
B7	V2	E402*	3.0 V	Yes
A4	V2	E402*	3.0 V	Yes
A16	V2	E402*	3.0 V	Yes
H2	V2	E402*	3.0 V	Yes
K3	VSW2	E401*	1.875 V	Yes
R8	VSW2	E401*	1.875 V	Yes
G15	VSW2	E401*	1.875 V	Yes
C10	VSW2	E401*	1.875 V	Yes
K12	URXD1_USB_VMI			No

Table 7-7. U401 Patriot MCU/DSP IC Pinouts (Continued)

U401 Pin No.	Description	To/From	Comment	Accessible on Vocon?
L16	URTS1_XRXD			No
F13	ADTRIG			No
B16	URXD2	U303, pin 4		Yes
D14	BSY_IN_RTS			No
B12	RX_SSI_DATA	R123	Data From Abacus to DSP	Yes
C11	TX_SSI_CLK	R125	1.536 MHz	Yes
B10	RED_LED	Q201, pin 3	Active High	Yes
D10	GREEN_LED	Q201, pin 5	Active High	Yes
B11	TX_SSI_FSYNC	R119	48 kHz	Yes
J10	CODEC_TX	R402	GCAP to DSP Tx Audio Data	Yes
J15	CODEC_DCLK	R405	520 kHz (NTN9564 NNTN4563 NNTN4819) 256 kHz (NNTN4717)	Yes
K16	CODEC_FSYNC	R406	8 kHz Pulse	Yes
D7	SPI_MISOA	MISOA	SPI A Data In	Yes
D3	SPI_MISOB	MISOB	SPI B Data In	Yes
E6	NOT USED			No
F7	NOT USED			No
D6	EEPROM_SEL*	R132	Active Low	Yes
C5	AD_CS*	R133	Active Low	Yes
A9	NOT USED			No
B8	NOT USED			No
B9	NOT USED			No
A10	NOT USED			No
G6	BT_DISABLE			No
D13	NOT USED			No
S15	BT_WAKE			No
F11	RX_SSI_CLK	R124		Yes

Table 7-7. U401 Patriot MCU/DSP IC Pinouts (Continued)

U401 Pin No.	Description	To/From	Comment	Accessible on Vocon?
B15	OPT_SEL2_OUT	R256		Yes
J13	AUDIO_MODE_SEL	R257		Yes
J16	EEPOT_CS_EXT*	U509, pin 1		Yes
J12	EEPOT_U_D*	U509, pin 2		Yes
H11	EEPOT_CS*	U509, pin 10		Yes
A5	GROUND	GROUND		Yes
N6	GROUND	GROUND		Yes
P8	GROUND	GROUND		Yes
P11	GROUND	GROUND		Yes
M11	GROUND	GROUND		Yes
L15	GROUND	GROUND		Yes
H16	GROUND	GROUND		Yes
F14	GROUND	GROUND		Yes
G14	GROUND	GROUND		Yes
E13	GROUND	GROUND		Yes
B13	GROUND	GROUND		Yes
K15	GROUND	GROUND		Yes
D9	GROUND	GROUND		Yes
C8	GROUND	GROUND		Yes
B5	GROUND	GROUND		Yes
C2	GROUND	GROUND		Yes
C1	GROUND	GROUND		Yes
H3	GROUND	GROUND		Yes
K15	GROUND	GROUND		Yes
T8	GROUND	GROUND		Yes
H15	GROUND	GROUND		Yes
C9	GROUND	GROUND		Yes
B6	ABACUS_CS*	R126	Active Low	Yes
E2	UNI_SEL*	R131	Active Low	Yes
D2	FLPR_CS*		Active Low	No
E3	GCAP_CE	R539	Active High	Yes

Table 7-7. U401 Patriot MCU/DSP IC Pinouts (Continued)

U401 Pin No.	Description	To/From	Comment	Accessible on Vocon?
E4	SCKB	SCKB	SPI B Clock	Yes
B1	NOT USED			No
F4	NOT USED			No
F5	SPI_MOSIB	MOSIB	SPI Data Out	Yes
C7	SCKA	SCKA	SPI A Clock	Yes
C6	MOSIA	MOSIA	SPI Data Out	Yes
G10	NOT USED			No
G16	OPT_SEL1_OUT	U201, pin 3		Yes
J11	CODEC_RX	R403	DSP to GCAP Rx Audio Data	Yes
A12	RX_SSI_FSYNC	R123	20 kHz pulse	Yes
A11	RX_SSI_CLK	R124	1.2 MHz	Yes
E9	TX_SSI_DATA	R127	Data From DSP to A/D	Yes
C15	BSY_OUT_CTS*			No
F12	UTXD2	U303, pin 1*		Yes
D15	USB_SUSP			No
E14	DISPLAY_R_W*	D403, pin 3	W = 0 V	Yes
D16	NOT USED			No
G12	UCTS1_USB_SPEED*			No
K11	UTXD1_USB_VPO			No
K14	USB_VMO			No
K13	USB_TX_EN			No
D5	8 KHZ_INT	R406	8 kHz Pulse	Yes
H14	BL_EN	C124		Yes
K4	LV_DETECT	POR	3.0 V	Yes
F9	NOT USED			No
J2	NOT USED			No
A6	16_8_MHZ	C452*	16.8 MHz	Yes

Table 7-7. U401 Patriot MCU/DSP IC Pinouts (Continued)

U401 Pin No.	Description	To/From	Comment	Accessible on Vocon?
J7	FLIP_32K	32 kHZ (NTN9564) U302, pin 2* (NNTN4563 NNTN4819 NNTN4717)	32.768 kHz	Yes
G13	NOT USED			No
J11	MOD	MOD	Bootstrap mode > 2.7 V	Yes
A13	NOT USED			No
M6	NOT USED			No
R1	NOT USED			No
N3	NOT USED			No
M5	NOT USED			No
P2	NOT USED			No
P1	NOT USED			No
N1	NOT USED			No
M4	NOT USED			No
M3	NOT USED			No
M2	NOT USED			No
M1	NOT USED			No
L4	NOT USED			No
L3	NOT USED			No
L1	NOT USED			No
L2	NOT USED			No
K2	NOT USED			No
T1	NOT USED			No
R2	NOT USED			No
T2	NOT USED			No
K7	NOT USED			No
N2	NOT USED			No
L5	NOT USED			No
L6	NOT USED			No
C4	NOT USED			No

Table 7-7. U401 Patriot MCU/DSP IC Pinouts (Continued)

U401 Pin No.	Description	To/From	Comment	Accessible on Vocon?
L13	NOT USED			No
D11	ONE_WIRE_EN*		Active Low	No
E16	KVL_USB_DET*		Active Low	No
F15	NOT USED			No
K5	BAT_BUS_EN*	Q507, pin 2	Active Low	Yes
H8	NOT USED			No
F16	RESET	RESET_OUT (NTN9564) D401, Pin 3 (NNTN4563 NNTN4819, NNTN4717)	Reset = 0 V	Yes
K6	USB_VPI			No
H12	BL_FREQ	Q202, pin 5	Active High	Yes
H13	NOT USED			No
E10	DSP_DE	DSP_DE	ONCE/JTAG	Yes
F10	MCU_DE	MCU_DE	ONCE/JTAG	Yes
D12	TCK	TCK	ONCE/JTAG	Yes
C13	TMS	TMS	ONCE/JTAG	Yes
E11	TRST	TRST	ONCE/JTAG	Yes
A14	TDO	TDO	ONCE/JTAG	Yes
E12	TDI	TDI	ONCE/JTAG	Yes
M16	NOT USED			No
L14	NOT USED			No
P15	NOT USED			No
L11	NOT USED			No
M14	NOT USED			No
N16	NOT USED			No
L12	NOT USED			No
M12	CKO	CKO	Disabled	Yes
N15	NOT USED			No
M15	NOT USED			No

Table 7-7. U401 Patriot MCU/DSP IC Pinouts (Continued)

U401 Pin No.	Description	To/From	Comment	Accessible on Vocon?
R12	ADDRESS 0	J101, pin 7	Not accessible on NNTN4563, NNTN4819, & NNTN4717	Yes
T13	ADDRESS 1			No
M10	ADDRESS 2			No
T12	ADDRESS 3			No
P13	ADDRESS 4			No
M9	ADDRESS 5			No
P10	ADDRESS 6			No
P12	ADDRESS 7			No
N9	ADDRESS 8			No
R10	ADDRESS 9			No
P9	ADDRESS 10			No
L10	ADDRESS 11			No
T10	ADDRESS 12			No
R9	ADDRESS 13			No
L9	ADDRESS 14			No
K9	ADDRESS 15			No
J9	ADDRESS 16			No
L8	ADDRESS 17			No
M8	ADDRESS 18			No
N8	ADDRESS 19			No
K8	ADDRESS 20			No
L7	ADDRESS 21			No
T7	ADDRESS 22			No
R7	ADDRESS 23	R427*		Yes
R3	DATA 15			No
T3	DATA 14			No
N4	DATA 13			No
P4	DATA 12			No
R4	DATA 11			No

Table 7-7. U401 Patriot MCU/DSP IC Pinouts (Continued)

U401 Pin No.	Description	To/From	Comment	Accessible on Vocon?
J8	DATA 10			No
T4	DATA 9			No
N5	DATA 8			No
P5	DATA 7	R435**		Yes
R5	DATA 6	R434**		Yes
T5	DATA 5	R433**		Yes
R6	DATA 4	R432**		Yes
T6	DATA 3	R431**		Yes
M7	DATA 2	R430**		Yes
N7	DATA 1	R429**		Yes
P7	DATA 0	R428**		Yes
N11	R_W	R_W		Yes
T11	NOT USED			No
R14	NOT USED			No
N12	CS3*	R106**	Active Low	Yes
T14	CS2	CS2	Active Low	Yes
R11	NOT USED			No
R15	CS0	CS0	Active Low	Yes
P16	OE_EN			No
M13	EB1_N			No
R13	EBO_N			No
N14	NOT USED			No
T16	WAIT	WAIT**		Yes
P14	NOT USED			No
N13	ADV	ADV**		Yes
T15	B_CLK	B_CLK**		Yes

* = Component located under a shield on NNTN4563, NNTN4819, & NNTN4717
** = No test point/component on NNTN4563, NNTN4819, & NNTN4717 - signal not accessible

Table 7-8. U301 Flipper IC Pinouts

U301 Pin No.	Description	To/From	Comment	Accessible on Vocon?
E7	RXDIN_ENC_3V	R308		Yes
D5	TXDO_BDI_5V	R329*	5 V RS232 Data Out	Yes
C7	RXDIN_5V	R328*	5 V RS232 Data In	Yes
A8	RTS	D303 pin 3	Request to Send (RS232)	Yes
D7	CTS	R303	Clear to Send (RS232)	Yes
H8	CTS_FILLREQ_3V	R306**		Yes
H3	16.8 MHz	C307*	16.8 MHz Clock	Yes
H6	13 MHz	R302 R331*	13 MHz Clock (OUT)	Yes
H5	PLL_LFT	C302*	PLL Loop Filter	Yes
F4	CODEC_DCLK	R405	520 kHz	Yes
E5	CODEC_FSYNC	R406	8 kHz Pulse	Yes
G4	UCM_SS	J701 pin 28		Yes
G2	V2	C304*	3.0 V	Yes
F1	V2	C317*	3.0 V	Yes
F3	VSS3_DC	GROUND		Yes
F2	VSS3_AC	GROUND		Yes
D8	VCC5	C305*	5.0 V	Yes
C8	VSS5	GROUND		Yes
A7	LI_CELL	C312*	3.0-3.3 V	Yes
C6	VSS3_XTL	GROUND		Yes
A4	UART_TX	NC		No
C4	UART_RX	NC		No
G3	ONE_WIRE_UP			No
G7	KVL_USB_DET			No
G1	ONE_WIRE_EN*			No
B5	BSY_IN_RTS			No
C5	BSY_OUT_CTS			No
E4	UCTS1_USB_SPEED*			No
C1	USB_TXENAB			No

Table 7-8. U301 Flipper IC Pinouts (Continued)

U301 Pin No.	Description	To/From	Comment	Accessible on Vocon?
D1	UTXD1_USP_VPO			No
B1	USB_VMO			No
C3	URTS1_XRXD			No
C2	USB_VPI			No
D2	URXD1_USB_VMI			No
E3	USB_SUSP			No
B2	SCKB	SCKB	SPI B Clock	Yes
B3	SPI_MOSIB	MOSIB	SPI Data Write to Flipper IC	Yes
A2	SPI_MISOB	MISOA	SPI Data Read from Flipper IC	Yes
A1	FLPR_CS*			No
A3	UART_INT*			No
F5	GCAP_RESET_X	C310*		Yes
H4	TEST_MODE1	GROUND		Yes
H1	TES_MODE2	GROUND		Yes
G6	OUT_DIS	GROUND		Yes
G5	SCAN_EN	GROUND		Yes
A6	XTAL32_IN			Yes
B6	XTAL32_OUT			Yes
A5	REF32_OUT	R316	32.768 kHz Square Wave	Yes
B7	BYPASS_32	GROUND		Yes
B4	BP_SEN_X	R510	0 V	Yes
D4	WD_OUT	R528	Watchdog Int to GCAP II	Yes
H2	ONE_WIRE_OPT	D306 pin 3		Yes
D6	SB96D_BDO_KF_5V	NC		No
B8	LH_BUSY	D307 pin 3		Yes
D3	USB_DIS	R310*		Yes
E2	USB_DPLUS	Q301 pin 1*	USB Data Plus	Yes
E1	USB_DMINUS	Q301 pin 4*	USB Data Minus	Yes
E8	SB96D_BDO_KF_3V	NC		No
F6	SB96D_BDO_3V	D308 pin 3		Yes

Table 7-8. U301 Flipper IC Pinouts (Continued)

U301 Pin No.	Description	To/From	Comment	Accessible on Vocon?
H7	RTS_FILLSEN_3V	NC		No
G8	CTS_FILLREQ_3V	R309*		Yes
F8	TXDO_BDI_ENC_3V	R317		Yes
F7	TXDO_BDI_UP_3V	R317		Yes
E6	RXDIN_ENC_3V	R308		Yes

* = Component located under a shield on NNTN4563, NNTN4819, & NNTN4717
** = No test point/component on NNTN4563, NNTN4819, & NNTN4717 - signal not accessible

Table 7-9. U501 GCAP II IC Pinouts

U501 Pin No.	Description	To/From	Comment	Accessible on Vocon?
A2	AD4_BD_ID	R525		Yes
B2	AD3_BDTYPE	R524		Yes
B3	AD2_BAT_STAT	R568		Yes
A3	AD_TG1	R523		Yes
D4	AD0_EMERG	R522		Yes
C4	LV_DETECT	R511	Active Low	Yes
B4	AD_TRIG			No
A4	CONV_BYP	C516		Yes
B5	V3	C550	Unused Voltage Regulator	Yes
A5	VIN3	C515	3.77 V	Yes
D5	VSEN1	GROUND	0 V	Yes
C5	VSIN	C515	3.77 V	Yes
C6	VSIM1	C551	Unused Voltage Regulator	Yes
A6	V1	C552	Unused Voltage Regulator	Yes
B6	VIN1	B503	7.5V	Yes
D6	LI_CELL	C553	3.0-3.3V	Yes
D7	CHARGE	NC		No

Table 7-9. U501 GCAP II IC Pinouts (Continued)

U501 Pin No.	Description	To/From	Comment	Accessible on Vocon?
A7	XTAL1	G_32K	32.768 kHz Square Wave	Yes
B7	XTAL2			No
A8	PRSC2	C514	3.77V	Yes
B8	LX2	D502	262.144 kHz Square Wave	Yes
A9	PGND1	GROUND		Yes
B9	FB2	R501	1.85V	Yes
C8	ON	R579		Yes
A10	FB1	R502	3.77V	Yes
B10	LX1	D503	262.144 kHz Square Wave	Yes
C9	PWRON	C529	At Battery Voltage Level	Yes
D8	INT_EXT	GROUND		Yes
C10	PSRC1	C531	At Battery Voltage Level	Yes
E7	WDI	R576	3.0V	Yes
D10	MOSPORTB	C529	At Battery Voltage Level	Yes
D9	ISENSE	NC		No
E8	CHRGC	NC		No
E9	SQ_OUT	NC		No
E10	BPOS	C529	At Battery Voltage Level	Yes
F7	BATTERY	NC		No
F8	AUX_BAT	NC		No
F9	AUX_FET	NC		No
F10	MAIN_FET	NC		No
E6	PGM2	C529	At Battery Voltage Level	Yes
G8	PGM1	C529	At Battery Voltage Level	Yes
G10	AGND1	GROUND		Yes
G9	REF	C528	3.0V	Yes

Table 7-9. U501 GCAP II IC Pinouts (Continued)

U501 Pin No.	Description	To/From	Comment	Accessible on Vocon?
H9	PA_DRV	NC		No
H10	PA_SENSE	NC		No
G7	PGM0	GROUND		Yes
H8	LS3_RX	NC		No
J10	DGND	GROUND		Yes
K10	LS3TX_PABPOS	GROUND		Yes
K1	MIC_OUT	U509 pin 6	AC Mic Signal	Yes
G4	STANDBY	R557	3.0V	Yes
K2	AUX_OUT	U509 pin 6	AC Mic Signal	Yes
H3	AUX_MIC_NEG	C538	Virtual Ground	Yes
J3	MB_CAP	C535		Yes
H4	EXT_MIC	NC		No
K3	MIC_BIAS	C535		Yes
J4	CD_CAP	C543		Yes
K4	VAG	C544		Yes
J5	V2	R560	3.0V	Yes
K5	VIN2	R502	3.77V	Yes
G5	ON2	NC		No
H5	EXTOUT	C533	AC RX Audio Signal	Yes
K6	SPKR_OUT	NC		No
J6	SPKR_IN	NC		No
H6	SPKR_NEG	NC		No
H7	SPKR_POS	NC		No
K7	LS1IN_TG1A	GROUND		Yes
J7	LS1OUT_TG1	NC		No
G6	LS2IN_TG2A	GROUND		Yes
F6	LS2OUT_TG2			No
K8	ALRT_GND			No
K9	ALRT_OUT	NC		No
J9	ALRT_VCC	NC		No

Table 7-9. U501 GCAP II IC Pinouts (Continued)

U501 Pin No.	Description	To/From	Comment	Accessible on Vocon?
J8	SIMI_O	NC		No
A1	AD5_VOLUME	R526	0-2.5V	Yes
B1	AGND3	GROUND		Yes
C3	DWN_OUT	NC		No
C2	DWN_IN	GROUND		Yes
C1	CMP_OUT	NC		No
D3	DSC_INN	GROUND		Yes
D2	DSC_INP	GROUND		Yes
D1	SPI_CLK	SCKB	SPI Data Clock	Yes
E4	SPI_DR	MISOB	SPI Data Read From GCAP	Yes
E3	SPI_DW	MOSIB	SPI Data Write To GCAP	Yes
E2	SR_VCCIN	NC		No
E1	SR_VCCOUT	NC		No
F3	SR_IN	NC		No
F2	SR_OUT	NC		No
F1	INTERRUPT	R538	GCAP Interrupt	Yes
F4	CE	R539	Active High GCAP Chip EN	Yes
F5	CLK_IN	R302 R331*	13 MHz	Yes
E5	CODEC_DCLK	R405	520 kHz (NTN9564 NNTN4563 NNTN4819) 256 kHz (NNTN4717)	Yes
G1	CODEC_TX	R402	TX Audio Data To DSP	Yes
G2	CODEC_RX	R403	RX Audio Data From DSP	Yes
G3	CODEC_FSYNC	R406	8 kHz Frame Sync	Yes

Table 7-9. U501 GCAP II IC Pinouts (Continued)

U501 Pin No.	Description	To/From	Comment	Accessible on Vocon?
H1	AGND4	GROUND		Yes
J1	AGND2	GROUND		Yes
H2	MICIN_POS	C534		Yes
J2	MICIN_NEG		Virtual Ground	No

* = Component located under a shield on NNTN4563, NNTN4819, & NNTN4717

Notes

Appendix A Replacement Parts Ordering

A.1 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.

Crystal orders should specify the crystal type number, crystal and carrier frequency, and the model number in which the part is used.

A.2 Transceiver Board and VOCON Board Ordering Information

When ordering a replacement Transceiver Board or VOCON Board, refer to the applicable Model Chart in the front of this manual, read the Transceiver Board or VOCON Board note, and include the proper information with your order.

A.3 Motorola Online

Motorola Online users can access our online catalog at

https://www.motorola.com/businessonline

To register for online access, please call 800-814-0601 (for U.S. and Canada Service Centers only). International customers can obtain assistance at https://businessonline.motorola.com.

A.4 Mail Orders

Send written orders to the following addresses:

Replacement Parts/ Test Equipment/Manuals/ Crystal Service Items (United States and Canada)**:**

Motorola Inc.
Radio Products Services Division*
Attention: Order Processing
1307 E. Algonquin Road
Schaumburg, IL 60196
U.S.A.

Federal Government Orders:

Motorola Inc.
U.S. Federal Government
Markets Division
Attention: Order Processing
7230 Parkway Drive
Landover, MD 21076
U.S.A.

International Orders:

Motorola Inc.
Radio Products Services Division*
(United States and Canada)
Attention: Order Processing
1307 E. Algonquin Road
Schaumburg, IL 60196
U.S.A.

* The Radio Products Services Division (RPSD) was formerly known as the Customer Care and Services Division (CCSD) and/or the Accessories and Aftermarket Division (AAD).

A.5 Telephone Orders

Radio Products Services Division*
(United States and Canada)
7:00 AM to 7:00 PM (Central Standard Time)
Monday through Friday (Chicago, U.S.A.)
1-800-422-4210
(International Orders)
1-847-538-8023

U.S. Federal Government Markets Division (USFGMD)
1-800-826-1913 Federal Government Parts - Credit Cards Only
8:30 AM to 5:00 PM (Eastern Standard Time)

A.6 Fax Orders

Radio Products Services Division*
(United States and Canada)
1-800-622-6210
(International)
1-847-576-3023

USFGMD
(Federal Government Orders)
1-800-526-8641 (For Parts and Equipment Purchase Orders)

A.7 Parts Identification

Radio Products Services Division*
(United States and Canada)
1-800-422-4210, menu 3

A.8 Product Customer Service

Customer Response Center
(Non-technical Issues)
1-800-247-2346
FAX:1-800-247-2347

* The Radio Products Services Division (RPSD) was formerly known as the Customer Care and Services Division (CCSD) and/or the Accessories and Aftermarket Division (AAD).

Glossary

This glossary contains an alphabetical listing of terms and their definitions that are applicable to ASTRO portable and mobile subscriber radio products. All terms do not necessarily apply to all radios, and some terms are merely generic in nature.

Term	Definition
A/D	*See analog-to-digital conversion.*
Abacus IC	A custom integrated circuit providing a digital receiver intermediate frequency (IF) backend.
ADC	*See analog-to-digital converter.*
ADDAG	*See Analog-to-Digital, Digital-to-Analog and Glue.*
ALC	*See automatic level control.*
analog	Refers to a continuously variable signal or a circuit or device designed to handle such signals. *See also digital.*
Analog-to-Digital, Digital-to-Analog and Glue	An integrated circuit designed to be an interface between the radio's DSP, which is digital, and the analog transmitter and receiver ICs.
analog-to-digital conversion	Conversion of an instantaneous dc voltage level to a corresponding digital value. *See also D/A.*
analog-to-digital converter	A device that converts analog signals into digital data. *See also DAC.*
automatic level control	A circuit in the transmit RF path that controls RF power amplifier output, provides leveling over frequency and voltage, and protects against high VSWR.
band	Frequencies allowed for a specific purpose.
BBP	*See baseband interface port.*
baseband interface port	Synchronous serial interface to the transceiver board used to transfer transmit and receive audio data.
BGA	*See ball grid array.*
ball grid array	A type of IC package characterized by solder balls arranged in a grid that are located on the underside of the package.
CODEC	*See coder/decoder.*

Term	Definition
codeplug	Firmware that contains the unique personality for a system or device. A codeplug is programmable and allows changes to system and unit parameters. *See also firmware.*
coder/decoder	A device that encodes or decodes a signal.
CPS	*See Customer Programming Software.*
Customer Programming Software	Software with a graphical user interface containing the feature set of an ASTRO radio. *See also RSS.*
D/A	*See digital-to-analog conversion.*
DAC	*See digital-to-analog converter.*
Data communication equipment	Definition for device (such as radio) data communications using the RS232 protocol. The correct data communication wiring requires the device's TX pins (output) to connect to the RX pins (input) and the RTS pins (output) to connect to the CTS pins (input). It is incorrect to attach device pins having the same name to to each other.
Data terminal equipment	Data terminal equipment; for example, a computer.
DCE	*See Data communication equipment.*
default	A pre-defined set of parameters.
digital	Refers to data that is stored or transmitted as a sequence of discrete symbols from a finite set; most commonly this means binary data represented using electronic or electromagnetic signals. *See also analog.*
digital-to-analog conversion	Conversion of a digital signal to a voltage that is proportional to the input value. *See also A/D.*
digital-to-analog converter	A device that converts digital data into analog signals. *See also ADC.*
Digital Private-Line	A type of digital communication that utilizes privacy call, as well as memory channel and busy channel lock-out to enhance communication efficiency.
digital signal processor	A microcontroller specifically designed for performing the mathematics involved in manipulating analog information, such as sound, that has been converted into a digital form. DSP also implies the use of a data compression technique.
digital signal processor code	Object code executed by the Digital Signal Processor in an ASTRO subscriber radio. The DSP is responsible for computation-intensive tasks, such as decoding ASTRO signaling.

Term	Definition
DPL	*See Digital Private-Line. See also PL.*
DSP	*See digital signal processor.*
DSP code	*See digital signal processor code.*
DTE	*See Data terminal equipment.*
DTMF	*See dual tone multi-frequency.*
dual tone multi-frequency	The system used by touch-tone telephones. DTMF assigns a specific frequency, or tone, to each key so that it can easily be identified by a microprocessor.
EEPOT	Electrically Programmable Digital Potentiometer.
EEPROM	*See Electrically Erasable Programmable Read-Only Memory.*
Electrically Erasable Programmable Read-Only Memory	A special type of PROM that can be erased by exposing it to an electrical charge. An EEPROM retains its contents even when the power is turned off.
FCC	Federal Communications Commission.
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	*See frequency generation unit.*
flash	A non-volatile memory device similar to an EEPROM. Flash memory can be erased and reprogrammed in blocks instead of one byte at a time.
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.
FMR	*See Florida Manual Revision.*
Florida Manual Revision	A document that provides interim updates to a publication until the entire publication can be updated and reissued.
frequency	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).

Term	Definition
frequency generation unit	This unit generates ultra-stable, low-phase noise master clock and other derived synchronization clocks that are distributed throughout the communication network.
General-Purpose Input/Output	Pins whose function is programmable.
GPIO	*See General-Purpose Input/Output.*
host code	Object code executed by the host processor in an ASTRO subscriber radio. The host is responsible for control-oriented tasks such as decoding and responding to user inputs.
IC	*See integrated circuit.*
IF	Intermediate Frequency.
IMBE	A sub-band, voice-encoding algorithm used in ASTRO digital voice.
inbound signaling word	Data transmitted on the control channel from a subscriber unit to the central control unit.
integrated circuit	An assembly of interconnected components on a small semiconductor chip, usually made of silicon. One chip can contain millions of microscopic components and perform many functions.
ISW	*See inbound signaling word.*
keep-alive mode	A software-controlled operational mode in which power for the radio remains on after the On/Off/volume control knob is turned off to allow the microcontroller unit to complete its power-down sequence. Then, the radio completely powers off.
key-variable loader	A device used to load encryption keys into a radio.
kHz	*See kilohertz.*
kilohertz	One thousand cycles per second. Used especially as a radio-frequency unit.
KVL	*See key-variable loader.*
LCD	*See liquid-crystal display.*
LED	*See light emitting diode.*
light emitting diode	An electronic device that lights up when electricity is passed through it.
liquid-crystal display	An LCD uses two sheets of polarizing material with a liquid-crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.
LO	Local oscillator.

Term	Definition
low-speed handshake	150-baud digital data sent to the radio during trunked operation while receiving audio.
LSH	*See low-speed handshake.*
Master In Slave Out	SPI data line from a peripheral to the MCU.
Master Out Slave In	SPI data line from the MCU to a peripheral.
MCU	*See microcontroller unit.*
MDC	Motorola Digital Communications.
MDI	MCU/DSP Interface internal to the Patriot IC.
MHz	*See Megahertz.*
Megahertz	One million cycles per second. Used especially as a radio-frequency unit.
microcontroller unit	Also written as µC. A microprocessor that contains RAM and ROM components, as well as communications and programming components and peripherals.
MISO	*See Master In Slave Out.*
MOSI	*See Master Out Slave In.*
multiplexer	An electronic device that combines several signals for transmission on some shared medium (e.g., a telephone wire).
MUX	*See multiplexer.*
NiCd	Nickel-cadmium.
NiMH	Nickel-metal-hydride.
OMPAC	*See over-molded pad-array carrier.*
open architecture	A controller configuration that utilizes a microprocessor with extended ROM, RAM, and EEPROM.
oscillator	An electronic device that produces alternating electric current and commonly employs tuned circuits and amplifying components.
OSW	*See outbound signaling word.*
OTAR	*See over-the-air rekeying.*
outbound signaling word	Data transmitted on the control channel from the central controller to the subscriber unit.
over-molded pad-array carrier	A Motorola custom IC package, distinguished by the presence of solder balls on the bottom pads.

Term	Definition
over-the-air rekeying	Allows the dispatcher to remotely reprogram the encryption keys in the radio.
PA	Power amplifier.
paging	One-way communication that alerts the receiver to retrieve a message.
Patriot IC	A dual-core processor that contains an MCU and a DSP in one IC package.
PC Board	Printed Circuit Board. Also referred to as a PCB.
phase-locked loop	A circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PL	*See private-line tone squelch.*
PLL	*See phase-locked loop.*
private-line tone squelch	A continuous sub-audible tone that is transmitted along with the carrier. *See also DPL.*
Programmable Read-Only Memory	A memory chip on which data can be written only once. Once data has been written onto a PROM, it remains there forever.
PROM	*See Programmable Read-Only Memory.*
PTT	*See Push-to-Talk.*
Push-to-Talk	The switch or button usually located on the left side of the radio which, when pressed, causes the radio to transmit. When the PTT is released, the unit returns to receive operation.
radio frequency	The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).
radio frequency power amplifier	Amplifier having one or more active devices to amplify radio signals.
Radio Interface Box	A service aid used to enable communications between a radio and the programming software.
Radio Service Software	DOS-based software containing the feature set of an ASTRO radio. *See also CPS.*
RAM	*See random access memory.*
random access memory	A type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the preceding bytes.
read-only memory	A type of computer memory on which data has been prerecorded. Once data has been written onto a ROM chip, it cannot be removed and can only be read.

Term	Definition
real-time clock	A module that keeps track of elapsed time even when a computer is turned off.
receiver	Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.
registers	Short-term data-storage circuits within the microcontroller unit or programmable logic IC.
repeater	Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).
repeater/talkaround	A conventional radio feature that permits communication through a receive/transmit facility, which re-transmits received signals in order to improve communication range and coverage.
RESET	Reset line: an input to the microcontroller that restarts execution.
RF	*See radio frequency.*
RF PA	*See radio frequency power amplifier.*
RIB	*See Radio Interface Box.*
ROM	*See read-only memory.*
RPCIC	Regulator/power control IC.
RSS	*See Radio Service Software.*
RTC	*See real-time clock.*
RX	Receive.
RX DATA	Recovered digital data line.
SAP	*See Serial Audio CODEC Port.*
SCI IN	*See Serial Communication Interface Input Line.*
Serial Audio CODEC Port	SSI to and from the GCAP II IC CODEC used to transfer transmit and receive audio data.
Serial Communication Interface Input Line	A full-duplex (receiver/transmitter) asynchronous serial interface.
Serial Input/Output IC	An integrated circuit that provides SB9600 serial and power-control functions.
Serial Peripheral Interface	How the microcontroller communicates to modules and ICs through the CLOCK and DATA lines.

Term	Definition
signal	An electrically transmitted electromagnetic wave.
Signal Qualifier mode	An operating mode in which the radio is muted, but still continues to analyze receive data to determine RX signal type.
SIO IC	*See Serial Input/Output IC.*
Smart Radio Interface Box	A service aid containing microcontroller buffered RAM that enhances the speed and capability of programming a radio with programming software.
softpot	*See software potentiometer.*
software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
software potentiometer	A computer-adjustable electronic attenuator.
spectrum	Frequency range within which radiation has specific characteristics.
SPI	*See Serial Peripheral Interface.*
squelch	Muting of audio circuits when received signal levels fall below a pre-determined value. With carrier squelch, all channel activity that exceeds the radio's preset squelch level can be heard.
SRAM	*See static RAM.*
SRIB	*See Smart Radio Interface Box.*
SSI	*See Synchronous Serial Interface.*
Standby mode	An operating mode in which the radio is muted but still continues to monitor data.
static RAM	A type of memory used for volatile, program/data memory that does not need to be refreshed.
Synchronous Serial Interface	DSP interface to peripherals that consists of a clock signal line, a frame synchronization signal line, and a data line.
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).
talkaround	A conventional radio feature that lets you bypass the repeater and connect directly to another radio. The transmit and receive frequencies are the same.
thin small-outline package	A type of dynamic random-access memory (DRAM) package that is commonly used in memory applications.

Term	Definition
time-out timer	A timer that limits the length of a transmission.
TOT	*See time-out timer.*
transceiver	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
transmitter	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
TSOP	*See thin small-outline package.*
TX	Transmit.
UART	*See also Universal Asynchronous Receiver Transmitter.*
UHF	Ultra-High Frequency.
Universal Asynchronous Receiver Transmitter	A microchip with programming that controls a computer's interface to its attached serial devices.
Universal Serial Bus	An external bus standard that supports data transfer rates of 12 Mbps.
USB	*See Universal Serial Bus.*
VCO	*See voltage-controlled oscillator.*
vector sum excited linear predictive coding	A voice-encoding technique used in ASTRO digital voice.
VHF	Very-High Frequency.
VIP	Vehicle Interface Port.
VOCON	*See vocoder/controller.*
vocoder	An electronic device for synthesizing speech by implementing a compression algorithm particular to voice. *See also voice encoder.*
vocoder/controller	A PC board that contains an ASTRO radio's microcontroller, DSP, memory, audio and power functions, and interface support circuitry.
voice encoder	The DSP-based system for digitally processing analog signals, and includes the capabilities of performing voice compression algorithms or voice encoding. *See also vocoder.*
voltage-controlled oscillator	An oscillator in which the frequency of oscillation can be varied by changing a control voltage.
VSELP	*See vector sum excited linear predictive coding.*

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