

*TECHNICAL MANUAL*  
*888-2621-001*

*Z3-48HD+*

*Z3-48HD+*

***HARRIS***

T.M. No. 888-2621-001

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## Returns And Exchanges

Damaged or undamaged equipment should not be returned unless written approval and a Return Authorization is received from HARRIS Broadcast Communications Division. Special shipping instructions and coding will be provided to assure proper handling. Complete details regarding circumstances and reasons for return are to be included in the request for return. Custom equipment or special order equipment is not returnable. In those instances where return or exchange of equipment is at the request of the customer, or convenience of the customer, a restocking fee will be charged. All returns will be sent freight prepaid and properly insured by the customer. When communicating with HARRIS Broadcast Communications Division, specify the HARRIS Order Number or Invoice Number.

## Unpacking

Carefully unpack the equipment and preform a visual inspection to determine that no apparent damage was incurred during shipment. Retain the shipping materials until it has been determined that all received equipment is not damaged. Locate and retain all PACKING CHECK LISTS. Use the PACKING CHECK LIST to help locate and identify any components or assemblies which are removed for shipping and must be reinstalled. Also remove any shipping supports, straps, and packing materials prior to initial turn on.

## Technical Assistance

HARRIS Technical and Troubleshooting assistance is available from HARRIS Field Service during normal business hours (8:00 AM - 5:00 PM Central Time). Emergency service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, HARRIS Broadcast Communications Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. Technical Support by e-mail: [tsupport@harris.com](mailto:tsupport@harris.com). The HARRIS factory may also be contacted through a FAX facility (217/221-7096).

## Replaceable Parts Service

Replacement parts are available 24 hours a day, seven days a week from the HARRIS Service Parts Department. Telephone 217/222-8200 to contact the service parts department or address correspondence to Service Parts Department, HARRIS CORPORATION, Broadcast Systems Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a FAX facility (217/221-7096).

### NOTE:

The # symbol used in the parts list means used with (e.g. #C001 = used with C001).

## *Manual Revision History*

### ***Z3-48HD+ Technical Manual***

REV.	DATE	ECN	Pages Affected
A	Nov., 2007		Entire Manual
A1	Dec., 2007		Minor changes in Manual



## Guide to Using Harris Parts List Information

The Harris Replaceable Parts List Index portrays a tree structure with the major items being leftmost in the index. The example below shows the Transmitter as the highest item in the tree structure. If you were to look at the bill of materials table for the Transmitter you would find the Control Cabinet, the PA Cabinet, and the Output Cabinet. In the Replaceable Parts List Index the Control Cabinet, PA Cabinet, and Output Cabinet show up one indentation level below the Transmitter and implies that they are used in the Transmitter. The Controller Board is indented one level below the Control Cabinet so it will show up in the bill of material for the Control Cabinet. The tree structure of this same index is shown to the right of the table and shows indentation level versus tree structure level.

Example of Replaceable Parts List Index and equivalent tree structure:

Replaceable Parts List Index	Part Number	Page	
Table 7-1. Transmitter	994 9283 001	7-2	<pre> graph TD     Transmitter["Transmitter 994 9283 001"] --&gt; ControlCabinet["Control Cabinet 992 9244 002"]     Transmitter --&gt; PACabinet["PA Cabinet 992 9400 002"]     Transmitter --&gt; OutputCabinet["Output Cabinet 992 9450 001"]     ControlCabinet --&gt; ControllerBoard["Controller Board 992 8344 002"]     PACabinet --&gt; PAAmplifier["PA Amplifier 992 7894 002"]     PAAmplifier --&gt; PAAmplifierBoard["PA Amplifier Board 992 7904 002"]         </pre>
Table 7-2. Control Cabinet	992 9244 002	7-3	
Table 7-3. Controller Board	992 8344 002	7-6	
Table 7-4. PA Cabinet	992 9400 002	7-7	
Table 7-5. PA Amplifier	994 7894 002	7-9	
Table 7-6. PA Amplifier Board	992 7904 002	7-10	
Table 7-7. Output Cabinet	992 9450 001	7-12	

The part number of the item is shown to the right of the description as is the page in the manual where the bill for that part number starts. Inside the actual tables, four main headings are used:

- Table #-#. ITEM NAME - HARRIS PART NUMBER - this line gives the information that corresponds to the Replaceable Parts List Index entry;
- HARRIS P/N column gives the ten DIGIT Harris part number (usually in ascending order);
- DESCRIPTION column gives a 25 character or less description of the part number;
- REF. SYMBOLS/EXPLANATIONS column 1) gives the reference designators for the item (i.e., C001, R102, etc.) that corresponds to the number found in the schematics (C001 in a bill of material is equivalent to C1 on the schematic) or 2) gives added information or further explanation (i.e., “Used for 208V operation only,” or “Used for HT 10LS only,” etc.).

Inside the individual tables some standard conventions are used:

- A # symbol in front of a component such as #C001 under the REF. SYMBOLS/EXPLANATIONS column means that this item is used on or with C001 and is not the actual part number for C001.
- In the ten digit part numbers, if the last three numbers are 000, the item is a part that Harris has purchased and has not manufactured or modified. If the last three numbers are other than 000, the item is either manufactured by Harris or is purchased from a vendor and modified for use in the Harris product.
- The first three digits of the ten DIGIT part number tell which family the part number belongs to - for example, all electrolytic (can) capacitors will be in the same family (524 xxxx 000). If an electrolytic (can) capacitor is found to have a 9xx xxxx xxx part number (a number outside of the normal family of numbers), it has probably been modified in some manner at the Harris factory and will therefore show up farther down into the individual parts list (because each table is normally sorted in ascending order). Most Harris made or modified assemblies will have 9xx xxxx xxx numbers associated with them.

The term “SEE HIGHER LEVEL BILL” in the description column implies that the reference designated part number will show up in a bill that is higher in the tree structure. This is often the case for components that may be frequency determinant or voltage determinant and are called out in a higher level bill structure that is more customer dependent than the bill at a lower level.





**⚠ WARNING:**  
*THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS. PERSONNEL MUST AT ALL TIMES OBSERVE SAFETY WARNINGS, INSTRUCTIONS AND REGULATIONS.*

This manual is intended as a general guide for trained and qualified personnel who are aware of the dangers inherent in handling potentially hazardous electrical/electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

The installation, operation, maintenance and service of this equipment involves risks both to personnel and equipment, and must be performed only by qualified personnel exercising due care. HARRIS CORPORATION shall not be responsible for injury or damage resulting from improper procedures or from the use of improperly trained or inexperienced personnel performing such tasks. During installation and operation of this equipment, local building codes and fire protection standards must be observed.

The following National Fire Protection Association (NFPA) standards are recommended as reference:

- Automatic Fire Detectors, No. 72E
- Installation, Maintenance, and Use of Portable Fire Extinguishers, No. 10
- Halogenated Fire Extinguishing Agent Systems, No. 12A

**⚠ WARNING:**  
*ALWAYS DISCONNECT POWER BEFORE OPENING COVERS, DOORS, ENCLOSURES, GATES, PANELS OR SHIELDS. ALWAYS USE GROUNDING STICKS AND SHORT OUT HIGH VOLTAGE POINTS BEFORE SERVICING. NEVER MAKE INTERNAL ADJUSTMENTS, PERFORM MAINTENANCE OR SERVICE WHEN ALONE OR WHEN FATIGUED.*

Do not remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances.

**⚠ WARNING:**  
*IN CASE OF EMERGENCY ENSURE THAT POWER HAS BEEN DISCONNECTED.*

**⚠ WARNING:**  
*IF OIL FILLED OR ELECTROLYTIC CAPACITORS ARE UTILIZED IN YOUR EQUIPMENT, AND IF A LEAK OR BULGE IS APPARENT ON THE CAPACITOR CASE WHEN THE UNIT IS OPENED FOR SERVICE OR MAINTENANCE, ALLOW THE UNIT TO COOL DOWN BEFORE ATTEMPTING TO REMOVE THE DEFECTIVE CAPACITOR. DO NOT ATTEMPT TO SERVICE A DEFECTIVE CAPACITOR WHILE IT IS HOT DUE TO THE POSSIBILITY OF A CASE RUPTURE AND SUBSEQUENT INJURY.*



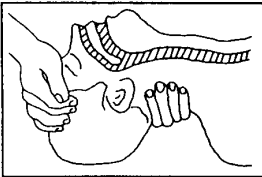
## TREATMENT OF ELECTRICAL SHOCK

1. IF VICTIM IS NOT RESPONSIVE FOLLOW THE A-B-C'S OF BASIC LIFE SUPPORT.

PLACE VICTIM FLAT ON HIS BACK ON A HARD SURFACE

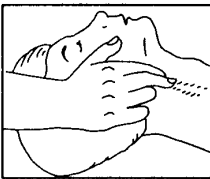
### **(A) AIRWAY**

IF UNCONSCIOUS,  
OPEN AIRWAY



LIFT UP NECK  
PUSH FOREHEAD BACK  
CLEAR OUT MOUTH IF NECESSARY  
OBSERVE FOR BREATHING

CHECK  
CAROTID PULSE



IF PULSE ABSENT,  
BEGIN ARTIFICIAL  
CIRCULATION

### **(B) BREATHING**

IF NOT BREATHING,  
BEGIN ARTIFICIAL BREATHING



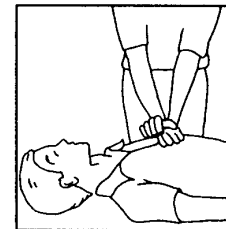
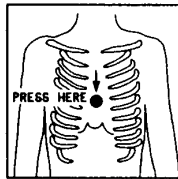
TILT HEAD  
PINCH NOSTRILS  
MAKE AIRTIGHT SEAL  
4 QUICK FULL BREATHS  
REMEMBER MOUTH TO MOUTH  
RESUSCITATION MUST BE  
COMMENCED AS SOON AS POSSIBLE

### **(C) CIRCULATION**

DEPRESS STERNUM 1 1/2 TO 2 INCHES

APPROX. RATE  
OF COMPRESSIONS { ONE RESCUER  
--80 PER MINUTE { 15 COMPRESSIONS  
2 QUICK BREATHS

APPROX. RATE  
OF COMPRESSIONS { TWO RESCUERS  
--60 PER MINUTE { 5 COMPRESSIONS  
1 BREATH



NOTE: DO NOT INTERRUPT RHYTHM OF COMPRESSIONS  
WHEN SECOND PERSON IS GIVING BREATH

CALL FOR MEDICAL ASSISTANCE AS SOON AS POSSIBLE.

2. IF VICTIM IS RESPONSIVE.

- A. KEEP THEM WARM
- B. KEEP THEM AS QUIET AS POSSIBLE
- C. LOOSEN THEIR CLOTHING
- D. A RECLINING POSITION IS RECOMMENDED

# FIRST-AID

Personnel engaged in the installation, operation, maintenance or servicing of this equipment are urged to become familiar with first-aid theory and practices. The following information is not intended to be complete first-aid procedures, it is a brief and is only to be used as a reference. It is the duty of all personnel using the equipment to be prepared to give adequate Emergency First Aid and there by prevent avoidable loss of life.

## Treatment of Electrical Burns

1. Extensive burned and broken skin
  - a. Cover area with clean sheet or cloth. (Cleanest available cloth article.)
  - b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply any salve or ointment.
  - c. Treat victim for shock as required.
  - d. Arrange transportation to a hospital as quickly as possible.
  - e. If arms or legs are affected keep them elevated.

### NOTE:

If medical help will not be available within an hour and the victim is conscious and not vomiting, give him a weak solution of salt and soda: 1 level teaspoonful of salt and 1/2 level teaspoonful of baking soda to each quart of water (neither hot or cold). Allow victim to sip slowly about 4 ounces (a half of glass) over a period of 15 minutes. Discontinue fluid if vomiting occurs. (Do not give alcohol.)

2. Less severe burns - (1st & 2nd degree)
  - a. Apply cool (not ice cold) compresses using the cleanest available cloth article.
  - b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply salve or ointment.
  - c. Apply clean dry dressing if necessary.
  - d. Treat victim for shock as required.
  - e. Arrange transportation to a hospital as quickly as possible.
  - f. If arms or legs are affected keep them elevated.

### REFERENCE:

ILLINOIS HEART ASSOCIATION  
AMERICAN RED CROSS STANDARD FIRST AID AND PERSONAL SAFETY  
MANUAL (SECOND EDITION)

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# Section I

# Operator Guide

# 1

## 1.1 Introduction

This manual is to provide information regarding the Z3-48HD+ Transmitter System's operation. In addition to the System Controllers, other System-specific functions are discussed. Any further *site*-specific functionality will be discussed in the site-specific data packages provided with the Z3-48HD+ Transmitter System, including the individual Z16HD+ transmitter manuals.

The Z3-48HD+ System is made of a ZD32HD+ dual transmitter and one additional Z16HD+ transmitter cabinet. The ZD32HD+ is made of two Z16HD+ transmitter cabinets. Most everything in the ZD32HD+ remains as the instruction book and drawings describe except for the Drive. There are two System Controllers in the Z3-48 system. One System Controller controls and monitors only the ZD32 (transmitters A and B). The second System Controller controls and monitors the Z3-48 which includes the Z16 and the ZD32.

### ⇒ NOTE:

It is important to have and study all documentation of *all units involved* in a Z3-48HD+ system prior to beginning installation of this complex system.

The ZD32 consists of the two cabinets on the right hand side of the system. These are known as transmitters A and B to keep the ZD32 documentation consistent with that of the Z3-48 system. The extra cabinet required to make up the Z3-48 system will be on the left and be known as transmitter C. This arrangement also keeps the RF line and combiner arrangement to a minimum for those sites that may require equipment to go in a small space. Both of the System Controllers will be located in a separate rack next to the system if dual exciters and Boost amps are required. Space for the System Controllers is not available in the transmitter for this configuration.

Operation of the Z3-48HD+ in any of several modulation format modes can be accomplished from the FlexStar HDx-FM exciter GUI panel. See exciter manual for further details. HD modes are only available with the FMHD22 version of the FlexStar™ Exciter.



There are several methods of combining the analog (FM) and digital (HD) RF to create an IBOC signal - also known as Modulation Format - that may be used in a typical IBOC system including a backup mode. The four modes of operation are:

**FM** - Analog RF only; this could be the analog backup mode in the event of a digital failure.

**FM+HD** - Analog & digital (at -20dB) RF, also known as Common Combining.

**HD** - Digital RF only, used for Separate Combining, such as 10dB combined, dual-feed and interleaved antenna, and dual antennas.

**SLC** - Analog & digital (at various ratios) RF, also known as Split-level or Mid-level Combining.

Transmitter operation can be initiated or terminated as desired by depressing the ON HI, ON LOW, or OFF push-buttons. All three transmitters will be commanded into the selected mode when the Z3-48 System Controller switch is depressed.

The System Controllers also provide the necessary RF metering, common external transmitter interlock and transmitter interface, and combined transmitter remote control functions. APC function is retained by the individual transmitters and its RF source.

- System Controller P/N 992-8850-005
  - System Control Board
    - Assembly # 992-8853-001
    - PWB # 843-5293-076
    - Schematic # 839-8118-181
  - Display Board
    - Assembly # 992-8388-005
    - PWB # 843-5215-004
    - Schematic # 839-8025-004

**NOTE:**

Parts list is in Section II.



## 1.2 Installation Instruction

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### 1.2.1 Returns And Exchanges

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Damaged or undamaged equipment should not be returned unless a Return Authorization is issued. When communicating with Harris Corporation, Broadcast Division, specify the order number or invoice number. Include complete details regarding circumstances and reasons for return in the request. Custom or special order equipment is not returnable. In instances where return or exchange of equipment is at the request or convenience of the customer, a restocking fee will be charged. Special shipping instructions and coding will be provided to insure proper handling. All returns will be sent freight prepaid and properly insured by the customer.

### 1.2.2 Unpacking

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Carefully unpack the transmitter and save all packing material. Inspect thoroughly for any damage incurred in shipment. Retain all PACKING CHECK LISTS to help locate and identify any components or assemblies removed for shipping. Remove any shipping supports, and straps prior to initial turn on.

Before cabinet placement takes place, it is important to determine which cabinet is transmitter C (left side as viewed from the front), transmitter A (middle), and transmitter B (right side). This can be determined by looking at the tags on the front of the transmitter or matching serial numbers of the cabinet to the provided test data. The serial numbers of the cabinets can be found on the left side wall inside the module compartment. A typical system will have the FlexStar HDx-FM Exciter(s) in the left cabinet.

### 1.2.3 Installation

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 **NOTE:**

It is important to have and study all documentation of *all units involved* in a Z3-48HD+ system prior to beginning installation of this complex system.

The cabinets may be mounted together using four Cabinet Brackets and hardware provided with the system. The Cabinet Brackets mount between the transmitters on top using the 3/8" hardware into threads found near the front and back of any two cabinets. 1/2" hardware is provided to bolt two cabinets together near the bottom. These holes may be accessed inside the power supply compartments of all three cabinets. The supply may need to be pushed forward a few inches in order to gain access to the back hole.



Several cables will be secured inside the cabinets that need routed to the other cabinets. A hole located in each cabinet is provided for cable routing between cabinets. If a hole cap is still in place, remove cap from both cabinets for interconnecting cables. Refer to the wiring diagrams in the System Drawing Package for wire destinations. Each wire will be marked with a wire or cable number located near the end of each wire. After routing, cables may be permanently attached to other existing cabling. Keep in mind some units are mounted on slides and cables are long enough to slide out with the unit for continuous operation.

The exciter interconnect consists of various cables. Not all of these cables are necessary in some applications. Depending on how many exciters and what type of IBOC system, some cables may not be needed. See drawings in the Z16 manual drawing package for further information.

The combiners and loads are usually placed where specified by the layout diagram in the System Drawing Package. Placement of Directional Coupler assemblies are also specified by the layout diagram. A provided coax cable should be connected between the System Controllers and three coupler ports each; the forward power, reflected power, and the reject load forward power.

The reject load's (if provided) interlock cables should be connected. Connections for addition station interlocks may be provided depending on the configuration of the system. Refer to the System Drawing Package for further information.

AC connections for the transmitters are located near the top in the back left side of each cabinet. See the Z16 manual for further information. One AC connection must be made for the Z3-48HD+ exciter(s). This TB7 terminal block is located inside the AC input compartment of transmitter cabinet C. This input should be on a separate AC feed in case this transmitter's breaker is off, the exciters can operate the remaining operating transmitters at a reduced power level. Another AC feed must be connected to the controller rack (if provided) or each piece of equipment if a rack is not provided. This AC feed should again be on a separate AC feed from the transmitter in case one transmitter breaker is off. Each Harris-made piece of equipment to be placed in an existing rack can be operated at 120 or 240 VAC depending on the AC input card position.

Connect transmission line between the transmitters and the combiners per the layout supplied in the System Drawing Package. Any unequal change to the transmission line length from transmitter to combiner will have to be adjusted for in the drive circuit. Combiner input phasing is important for proper operation. Confirm the ports of the 4.77dB hybrid are aligned according to the markings on the combiner. This combiner is not symmetrical so it must be connected properly. Also connect transmission line to the reject loads. Placement of the loads and length of line to the loads is not critical. Only transmission line for the typical layout is supplied with the system unless otherwise specified with the order.





## 1.3 Transmitter Operation

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- a. Ensure all RF connections are tight, and that all control and AC service (mains) connections are correct and secure using the correct voltage and frequency settings.
- b. Set the REMOTE/DISABLE switches on all transmitters to the REMOTE position.
- c. Start transmitter A (middle cabinet) by depressing the ON HI pushbutton on the transmitter cabinet A. Operate transmitter at or near 100%. The ZD32 System Controller FWD PWR should read near 25%. Press LOWER button until transmitter cabinet A FWD PWR is near 20%. Turn off transmitter cabinet A by depressing the OFF pushbutton.
- d. Start transmitter B (right side) by depressing the ON HI pushbutton on the transmitter cabinet B. Operate transmitter at or near 100%. The ZD32 System Controller FWD PWR should again read near 25%. Press LOWER button until transmitter cabinet B FWD PWR is 20%. Turn off transmitter cabinet B by depressing the OFF pushbutton.
- e. Start transmitter C (left side) by depressing the ON HI pushbutton on the transmitter cabinet C. Operate transmitter at or near 100%. The Z3-48 System Controller FWD PWR should read near 22%. Press LOWER button until transmitter cabinet C FWD PWR is 20%. Turn off transmitter cabinet C by depressing the OFF pushbutton.
- f. Start combined transmitter operation by depressing the ON HI pushbutton switch on the ZD32 System Controller. Both A & B transmitters should begin operation and be producing RF power.
- g. The ZD32 System Controller FWD PWR meter should be reading near 20%. Select the REJ PWR meter position on the ZD32 System Controller and verify its reading is near 0%. If this reading is more than 2-3%, this may be the result of either amplitude or phase mismatch between the two combiner inputs. Adjust the power level 2-3% out of just one transmitter, A or B. If this minimizes the reject power to near zero, continue on to the next step. If power from each transmitter is back to the same and more than 10% reject power exists, a phase mismatch may be adjusted by changing the physical length of W901A or W901B in the drive circuit. Some experimentation will be required. Add or remove BNC elbow adapters or a very short length of cable (2-6 inches) to one or the other existing cables at the drive splitter SP2 outputs located in cabinet A (middle). Any reject power may be the result of a different connection from what was originally used at the Harris test facility. Additionally, some phase adjustment can be accomplished on the BoostPro GUI screen. See the BoostPro documentation for more details. Usually, no adjustment of amplitude or phase will be necessary.
- h. Start the third cabinet C by depressing the ON HI pushbutton on the Z3-48 System Controller. All three transmitters should be operating and producing power.



- i. The Z3-48 System Controller FWD PWR meter should be reading near 20%. Select the REJ PWR meter position on the Z3-48 system Controller and verify its reading is near 0%. If this reading is more than 2-3%, this again may be the result of either amplitude or phase mismatch between the two combiner inputs to the 4.77dB combiner. Adjust the power level 2-3% out of just transmitter C. If this minimizes the reject power to near zero, continue on to the next step. If power from each transmitter is back to the same or more than 10% reject power exists, a phase mismatch may be adjusted by changing the physical length of W900 in the drive circuit. Some experimentation will be required. Add or remove BNC elbow adaptors or a very short length of cable (2-6 inches) to W900 at the transmitter C Exciter Switch board output. Reject power may be the result of a different connection from what was originally used at the Harris test facility. Usually, no adjustment of amplitude of phase will be necessary.
- j. Once reject power is down below 5% on both System Controllers, raise power in all three transmitters to 100% watching that reject power does not exceed 10%. If any reject power exists, repeat the above steps for adjustment of amplitude or phase of all combiner inputs. Some fluctuation of power will be noticed due to the type of detection used for an IBOC signal and its peaks.
- k. Select the RFL PWR position on the transmitters and the System Controllers and verify that they all read at or near 1.01VSWR.
- l. Depress the LOW ON push-button switch on both System Controllers and verify that all transmitter output levels drop to approximately 50% and that the System Controllers also indicate near 50% in the FWD PWR positions.

### 1.3.1 RF Metering

Three metering functions are provided by each System Controller. They are: Forward output power in percent of allowed forward power (FWD PWR); reflected power displayed as load VSWR (RFL PWR); and combiner reject load power in percent of normal (REJ PWR). Below are the approximate values of the normal average RF levels for a Z3-48HD+ combined transmitter system calibrated at full output in the combined mode. See Table 1-1.

**Table 1-1 System Controller Average Power Metering**

	Indication		
	FWD PWR 100%	RFL PWR 1.00	REJ PWR 100%
<b>Z3-48 System Controller</b>			
<b>FM+HD</b>	<b>21kW</b>	<b>As Indicated</b>	<b>4.67kW</b>
<b>HD only</b>	<b>10.5kW</b>	<b>As Indicated</b>	<b>2.33kW</b>
<b>FM only</b>	<b>30kW</b>	<b>As Indicated</b>	<b>6.67kW</b>



**Table 1-1 System Controller Average Power Metering**

<b>ZD32 System Controller</b>			
<b>FM+HD</b>	<b>14kW</b>	<b>As Indicated</b>	<b>3.5kW</b>
<b>HD only</b>	<b>7kW</b>	<b>As Indicated</b>	<b>1.75kW</b>
<b>FM only</b>	<b>20kW</b>	<b>As Indicated</b>	<b>5kW</b>

A REJ PWR reading of 100% will be one-fourth the total output power when the 3 dB hybrid combiner is used, such as with the ZD32 System Controller. The REJ PWR reading of 100% will be set for 2/3 the total output power from one transmitter when the 4.77dB hybrid combiner is used such as with the Z3-48 System Controller. Up to 2/3 of the power from transmitter C or 1/3 of the power from the ZD32 could be present at the 4.77dB reject load. See Table 1-2 on page 1-8 for power results when one or two transmitters are OFF. When a backup mode is used, consideration must be given to the maximum power in the reject load allowed by the overload and the maximum power the load is capable of. As a result of this consideration, some variations from the chart exist and are noted in the Factory Test Data Sheet.

The following formula can be used for calculating expected power results at the antenna port given different power level inputs as in the last two columns of Table 1-2:

$$P_{out} = \frac{(\sqrt{P1} + \sqrt{P2} + \sqrt{P3})^2}{3}$$

where P1, P2, and P3 are the power levels from each transmitter.

Below is an Expected Power Results for Failure Conditions table.



**Table 1-2 Expected Power Results for Failure Conditions**

	<i>Full Operation</i>		<i>One TX OFF</i>		<i>One TX OFF</i>		<i>Two TX OFF</i>		<i>Two TX OFF</i>		<i>One TX ½ Power</i>		<i>One TX ½ Power</i>	
	<i>Power</i>	<i>%</i>	<i>Power</i>	<i>%</i>	<i>Power</i>	<i>%</i>	<i>Power</i>	<i>%</i>	<i>Power</i>	<i>%</i>	<i>Power</i>	<i>%</i>	<i>Power</i>	<i>%</i>
<b>FM + HD</b>														
TX C	7kW	100	7kW	100	0	0	7kW	100	0	0	7kW	100	3.5kW	50
TX A	7kW	100	0	0	7kW	100	0	0	0	0	3.5kW	50	7kW	100
TX B	7kW	100	7kW	100	7kW	100	0	0	7kW	100	7kW	100	7kW	100
Z3-48 System														
FWD	21kW	100	9.33kW	44	9.33kW	44	2.33kW	11	2.33kW	11	17.1kW	81	17.1kW	81
REJ	0	0	1.17kW	25	4.67kW	100	4.67kW	100	1.17kW	25	0.1kW	2	0.4kW	8
ZD32(A/B) System														
FWD	14kW	100	3.5kW	25	14kW	100	0	0	3.5kW	25	10.2kW	72	14kW	100
REJ	0	0	3.5kW	100	0	0	0	0	3.5kW	100	0.3kW	8	0	0
<b>HD Only</b>														
TX C	3.5kW	100	3.5kW	100	0	0	3.5kW	100	0	0	3.5kW	100	1.75kW	50
TX A	3.5kW	100	0	0	3.5kW	100	0	0	0	0	1.75kW	50	3.5kW	100
TX B	3.5kW	100	3.5kW	100	3.5kW	100	0	0	3.5kW	100	3.5kW	100	3.5kW	100
Z3-48 System														
FWD	10.5kW	100	4.67kW	44	4.67kW	44	1.17kW	11	1.67kW	11	8.55kW	81	8.54kW	81
REJ	0	0	0.58kW	25	2.33kW	100	2.33kW	100	0.58kW	25	0.05kW	2	0.2kW	8
ZD32(A/B) System														
FWD	7kW	100	1.75kW	25	7kW	100	0	0	1.75kW	25	5.1kW	72	7kW	100
REJ	0	0	1.75kW	100	0	0	0	0	1.75kW	100	0.15kW	8	0	0
<b>FM Only</b>														
TX C	10kW	100	10kW	100	0	0	10kW	100	0	0	10kW	100	5kW	50
TX A	10kW	100	0	0	10kW	100	0	0	0	0	5kW	50	10kW	100
TX B	10kW	100	10kW	100	10kW	100	0	0	10kW	100	10kW	100	10kW	100
Z3-48 System														
FWD	30kW	100	13.33kW	44	13.33kW	44	3.33kW	11	3.33kW	11	24.4kW	81	24.4kW	81
REJ	0	0	1.67kW	25	6.67kW	100	6.67kW	100	1.67kW	25	0.14kW	2	0.57kW	8
ZD32(A/B) System														
FWD	20kW	100	5kW	25	20kW	100	0	0	5	25	14.57kW	72	20kW	100
REJ	0	0	5kW	100	0	0	0	0	5	100	0.43kW	8	0	0

The System Controllers each display values of the selected functions on a 3-1/2” digit panel meter. Three momentary pushbutton switches allow selection of the metering mode for the System Controller. A momentary depression of one of the three meter select switches will put the digital metering system into the desired mode. The meter will remain in that selected mode until another metering selection pushbutton switch is depressed. Following an AC power interruption the metering system will automatically power on in the FWD PWR mode, displaying the forward output power level, in percent of normal.



## 1.3.2 Control Functions

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Three momentary push-button switches allow system ON and OFF control functions to be exercised from the front of the System Controllers. These pushbuttons are: OFF, ON HI, and ON LOW. Depressing one of these three pushbutton switches will simultaneously command both transmitters controlled by that System Controller into the selected ON mode, or will return both transmitters controlled by that System Controller to the OFF mode simultaneously.

Three LEDs indicate actual transmitter status, LOW, HI and OFF. The indicators are controlled by the transmitter status outputs of both transmitters controlled by that System Controller.

**⇒ NOTE:**

In order for these System Controller commands to be accepted by the individual transmitter control units, the REMOTE/DISABLE switches on each individual transmitter MUST be in the REMOTE position; or red LED off.

## 1.3.3 Status Indicators

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The System Controllers each incorporate four LED status indicators to provide important information about the operation conditions of the combined transmitter system controlled by that System Controller. These indicators are RF POWER, SWR, EXT INTERLOCK, and REJ LOAD.

The RF POWER indicator illuminates red if the system is in operation and the forward output power level at the combiner output drops below a preset level, usually 90%. The indicator will extinguish if the level rises above the preset level or the system is turned off.

The SWR FAULT LED indicator will illuminate if the reflected RF power level at the combiner output rises above a preset level, 1.3:1. If this level has been exceeded, the LED will illuminate. The System Controller takes no action but the transmitters themselves will either foldback or turn off depending on the level of VSWR. The indicator will extinguish with the next System Controller ON command.

The EXT INTLK LED indicator will illuminate if the connection between J1-6 and J1-25 is broken. System operation, controlled by that System Controller, will automatically be terminated and returned to the OFF state. Once the connection between J1-6 and J1-25 is restored, an ON command is required to restore operation. These connections are routed through the Reject Load interlock terminals. The 5kW load interlock is connected to the ZD32 System Controller. The 10kW load interlock is connected to the Z3-48 System Controller.



The REJ LOAD LED indicator is actually two indicators in one. One half of the indicator is an amber LED, the other is a red LED. If the RF power delivered to the combiner reject load associated with that System Controller exceeds a preset warning level, usually 90%, the amber portion of the LED will illuminate. It will remain illuminated until the RF level drops below the preset level. If the RF power delivered to the reject load associated with that System Controller exceeds the safe operation level for the load, the System Controller will terminate operation of the transmitters that feed that particular load and the red portion of the REJ LOAD will be illuminated. It will remain illuminated until the next ON command of that particular System Controller is exercised.

### 1.3.4 Remote Control

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The REMOTE/LOCAL push-button switch on the front panel of the System Controllers allow the operator to determine if the unit will accept remote system level ON or OFF commands. In the LOCAL mode (red LED illuminated) only the front panel switches on the System Controller may be used to turn the system on or off. For normal operation, the ZD32 System Controller should always remain in the REMOTE mode as the Z3-48 System Controller uses the ZD32 remote inputs to control that portion of the system.

Remote system level commands, status and metering functions are available at J1 and J11 on the System Controller. System commands are active when the REMOTE/LOCAL switch on the front of the System Controller is in the REMOTE position. Status and metering information is always available at J1 and J11 regardless of the position of the REMOTE/LOCAL switch.

Table 1-10 on page 1-17, System Controller Remote Connections, gives details of the commands, status and metering functions available at J1 and J11 on the rear of both System Controllers. It is recommended that J1 be used only for fail-safe/interlock and J11 be connected to a remote control (if used) for remote metering, status, and commands.

### 1.3.5 Interlock Considerations

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In a hybrid combiner system, if the reject presents an open interlock, both transmitters associated with that System Controller will be interlocked off. Once the interlock is closed, an ON command is required to restore normal operation. The interlocks are routed through the Reject Load interlock terminals. The 5kW load interlock is connected to the ZD32 System Controller. The 10kW load interlock is connected to the Z3-48 System Controller. Additional devices can be wired in series with the load interlocks if required.



### 1.3.6 Drive Functions

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Exciter muting and main/alternate functions are controlled by transmitter C of the Z3-48HD+. This is the cabinet on the left in a typical layout.

Exciter Main/Alternate control can be accessed through the transmitter C controller LCD display screen. From HOME, press STATUS/MORE/EXCITER/SWITCH. Observe status ON indicators for exciter 1 or exciter 2.

For exciter main/alternate operation, all exciters' AC should be on at all times regardless if a TX is shut down. This is accomplished by a separate AC feed for transmitters and exciter(s). Transmitter C contains a separate AC input for the exciters. The System Controller should also operate from a separate AC feed from the transmitters. The System Controllers are usually located in a separate rack with a separate AC feed.

When transmitter C is turned on, the power supply starts to ramp up and as soon as it is at full voltage, the mute line is pulled low by an open collector output and un-mutes the on air exciter as determined by transmitter C. The Auxiliary output of the Flexstar HDx-FM exciter is always ON (un-muted) and operating in the mode established within the exciter. This signal is routed through the transmitter C Exciter Switch Board to a splitter SP2 located in transmitter A (center cabinet). The outputs of this splitter go to the inputs of the Exciter Switch Boards in transmitter A and transmitter B. If two Boost Pro amplifiers are used in each transmitter A and transmitter B, the signal is switched between the two Boost Pro inputs by the Exciter Switch Boards. The Exciter Switch Board also controls the output of each Boost Pro by selecting the on air Boost Pro's output and routing it to the transmitter IPA stages. If only one Boost Pro is in each transmitter, the controller of that transmitter will be set for only one RF source through the LCD display screen and the Exciter Switch Board will not switch.

If during operation, the on air exciter fails, a ten second window exists to allow the exciter to retry and come back on line by itself. If after 10 seconds power still does not exist, a command from transmitter C Life Support Board switches the exciter outputs to the backup exciter, restoring RF drive to all transmitters.

If transmitter C is turned OFF and should a failure occur in the on air exciter, automatic switching of the exciter's auxiliary output will not occur but will continue to try to use the Auxiliary output from the exciter that was on air. When transmitter C is turned back ON, automatic switching will make the switch. If a long term OFF state is expected on transmitter C, the auxiliary outputs can be manually changed for RF drive to transmitters A and B. If power is removed from transmitter C, the Exciter Switch Board will switch back to exciter 1 outputs but still using the always on auxiliary output. Should the backup exciter's auxiliary output be needed to keep transmitter A and B operating, a manual change will be required as described earlier.



In this system, the HDx-FM Exciter's AUX output is used to drive the BoostPro boost amplifier(s) in the other TX cabinet. Phase of this drive will be shifted within the BoostPro and there are Phase adjustments in the BoostPro. If there is a phase delay beyond what these two adjustments can compensate for, some line length adjustment may be necessary for proper transmitter output phasing. See Z16 manual for more information. As discussed earlier, W901A and W901B length can be changed or BNC elbow adapters can be removed or added inline.

**CAUTION:**

*CARE SHOULD BE TAKEN NEVER TO REPLACE THESE CABLES WITH AN UNKNOWN CABLE, POSSIBLY CAUSING FULL COMBINED TRANSMITTER POWER OUTPUT TO GO TO A COMBINER REJECT LOAD ONLY DESIGNED TO CARRY QUARTER TOTAL POWER.*

### 1.3.7 HDx-FM Exciter/BoostPro Control

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The Forward Power sample of each RF source is routed directly to the transmitter controlling each RF source(s). The transmitter will use these samples to determine if there is an RF source failure. The sample(s) are also used to display power on the LCD display screen.

Mute and Active signals for the Flexstar exciter(s) are exclusively controlled by transmitter C and come from the Life Support Board. The active signal is used for the exciters to know which one should be the on air exciter and is determined from the display inputs, input signals, and internal logic. A high on the active line indicates exciter 1 should be the on air exciter. If the active line is pulled low, exciter 2 will now be the on air exciter. The mute signal routed to the exciter(s) turns off the main RF output only as dictated by the exciter setup for this Z3-48 system. The auxiliary output remains on at all times to provide drive to the other parts of the system, specifically transmitter A and B.





## 1.4 Alignments

### ⇒ NOTE:

All adjustments required have been made at the factory using calibrated test loads and power meters to verify operating power levels. The following alignments are to be performed only in the event of a field replacement involving any of these components.

Three RF to DC sample transducers, in conjunction with RF directional couplers, are used in each system, ZD32 and Z3-48, to monitor the RF power levels in that system. The DC samples are routed through coaxial cables to the input jacks on the back of the System Controllers.

The linearizer test point voltages are initially set using the tables below as determined by the type of system with adjustments made using the corresponding sample calibration pot (R37, R45 or R78). Variation of these voltages will exist depending on desired high power output and linearity of circuit.

**Table 1-3 ZD32 System Controller: FM+HD Mode**

TEST POINT	TARGET VOLTAGE	SET UP CONDITION	SAMPLE CAL
TP2	0.275 Volts	14kW of system forward power	R37
TP3	0.075 Volts	560 Watts of simulated reflected power	R45
TP4	0.275 Volts	100% of reject power; 3.5kW	R78

**Table 1-4 ZD32 System Controller: HD Only Mode**

TEST POINT	TARGET VOLTAGE	SET UP CONDITION	SAMPLE CAL
TP2	0.275 Volts	7kW of system forward power	R37
TP3	0.075 Volts	280 Watts of simulated reflected power	R45
TP4	0.275 Volts	100% of reject power; 1.75kW	R78



Table 1-5 ZD32 System Controller: FM Only Mode

TEST POINT	TARGET VOLTAGE	SET UP CONDITION	SAMPLE CAL
TP2	0.275 Volts	20kW of system forward power	R37
TP3	0.075 Volts	800 Watts of simulated reflected power	R45
TP4	0.275 Volts	100% of reject power; 5kW	R78

Table 1-6 Z3-48HD+ System Controller: FM+HD Mode

TEST POINT	TARGET VOLTAGE	SET UP CONDITION	SAMPLE CAL
TP2	0.275 Volts	21kW of system forward power	R37
TP3	0.075 Volts	840 Watts of simulated reflected power	R45
TP4	0.275 Volts	100% of reject power; 4.67kW	R78

Table 1-7 Z3-48HD+ System Controller: HD Only Mode

TEST POINT	TARGET VOLTAGE	SET UP CONDITION	SAMPLE CAL
TP2	0.275 Volts	10.5kW of system forward power	R37
TP3	0.075 Volts	420 Watts of simulated reflected power	R45
TP4	0.275 Volts	100% of reject power; 2.33kW	R78

Table 1-8 Z3-48HD+ System Controller: FM Only Mode

TEST POINT	TARGET VOLTAGE	SET UP CONDITION	SAMPLE CAL
TP2	0.275 Volts	30kW of system forward power	R37
TP3	0.075 Volts	1200 Watts of simulated reflected power	R45
TP4	0.275 Volts	100% of reject power; 6.67kW	R78



To set the forward power metering calibration, set the transmitters as follows (see Table 1-9 on page 1-15):

- Set transmitter system (only those controlled by that particular System Controller) to operate at 100% of normal operating power (not necessarily full power capability).
- Adjust R88, FWD PWR CAL, for 100% forward power reading on the front panel. Some fluctuation of power will be noticed due to this type of detection used for an IBOC signal and its peaks.
- Set transmitter power to zero and adjust R90, FWD PWR METER ZERO, for a reading of 0%.
- Repeat previous steps as needed.

**Table 1-9 System Controller RF Metering Inputs**

JACK	PURPOSE	LINEARIZER TEST POINT	SAMPLE CAL	METER CAL	METER ZERO
J6	System Forward Power	TP2	R37	R88	R90
J7	System Reflected Power	TP3	R45	N/A	R132
J8	System Reject Load Power	TP4	R78	R80	R70

To set the reject power metering calibration, set the transmitters as follows:

- For a particular System Controller, turn ON only the transmitters needed to run maximum power into the Reject Load. See table 1-2 for configuration of maximum Reject Load power.
- Adjust R80, REJ PWR CAL, for a 100% reject power reading.
- Turn the transmitter power output to zero and adjust R70, REJ PWR METER ZERO, for a reading of 0%. Repeat as needed until both conditions are met.

To set the reflected power meter calibration and overload:

- Adjust each transmitter (only those controlled by that particular System Controller) to operate at a forward power of half the stated reflected power in tables above so that the system combined power is the stated reflected power from the appropriate table. If total power output (100% forward power) is different than stated in table, set transmitter for 0.04 times total power out. Adjust target voltage proportionally.



- Reverse the reflected power coupler on the appropriate combiner output by loosening the hose clamps holding it to the transmission line and reattaching it to the line in its reverse position. This must be done without disassembling the coupler itself.
- Use R45, RFL PWR SAMPL CAL, to set test point TP3 voltage to the target voltage in tables above. Return the coupler to its original position.
- Adjust R132, VSWR ZERO, to read 1.01 reflected power on the front panel while the system is operating at full power and operating with no reflected power. Removing the sample cable from the System Controller input J7 will assure no reflected power reading.
- Verify the VSWR metering circuit by operating system at full power and forcing TP3 to read the target voltage from the tables with an external DC voltage source connected to J7.
- Verify that the VSWR reading is 1.50:1.
- Set the system controller VSWR trip threshold with R158, SWR TRIP SET, to trip at a VSWR of 1.30:1.
- Remove external DC voltage source and reconnect sample input cable to J7 of System Controller.

To set other overloads and set points:

- Turn the system output power (only that controlled by the particular System Controller) to 90% and adjust R197, LO RF TRIP SET, until the low power LED just turns on. Raise and lower the power above and below 90% and verify the LED comes on at the 90% point, adjust as needed.
- Using an external voltage source connected to J8 of the System Controller; force the reject power meter to read 90% and set R161, REJ PWR WARNING SET, until the reject warning LED comes on.
- Set the reject power meter to read 104% with an external voltage source and adjust R169, REJ PWR TRIP SET, until transmitters receive an OFF command. If back-up modes of operation are used, the REJ PWR TRIP SET can be set for up to the rating of the load. A ZD32 reject load typically has a rating 5KW but for example, the FM+HD mode, 3.5KW is the most power this load will absorb. If FM only was the backup mode, the trip set could be at 5KW divided by 3.5KW or 143%. See test data sheets for the set point as done in the factory.
- Remove external DC voltage source and reconnect sample input cable to J8 of System Controller.



Table 1-10 System Controller Remote Connections

Terminal Remote	Terminal Serial	Function	Remarks
J1-1	J11-1	TX ON LOW COMMAND	Momentary connection to ground sets the system to LOW POWER ON mode. Maximum open circuit voltage is approximately 15VDC
J1-2	J11-14	TX ON HIGH COMMAND	Momentary connection to ground sets the system to HIGH POWER ON mode. Maximum open circuit voltage is approximately 15 VDC.
J1-3	J11-2	TX OFF COMMAND	Momentary connection to ground sets the system to OFF mode. Maximum open circuit voltage is approximately 15 VDC.
J1-4	J11-15	SPARE COMMAND	Not used.
J1-5	N/A	MASTER FAIL-SAFE	Connection to +15 VDC source at J1-25 through a normally closed contact set, in customer equipment, allows transmitter operation. If not used, a jumper must be installed between this terminal and J1-25.
J1-6	N/A	MASTER INTERLOCK	Not available for use. This input is used for the combiner reject load in this configuration.
J1-7	J11-4	R/C STATUS	Provides a connection to ground through 200 Ohms when the REMOTE mode has been selected.
J1-8	J11-17	FWD PWR SAMPLE	Provides 0-4 VDC sample through 2k Ohms of the RF forward output power.
J1-9	J11-5	RFL PWR SAMPLE	Provides 0-4 VDC sample through 2k Ohms of the RF reflected output power.
J1-10	J11-18	REJ PWR SAMPLE	Provides 0-4 VDC sample through 2k Ohms of the RF reject load power.
J1-11	J11-6	IPA A PWR SAMPLE	Not used.
J1-12	J11-19	IPA B PWR SAMPLE	Not used.
J1-13	J11-7	SWR FAULT STATUS	Provides ground connection through 200 Ohms when the reflected output RF power level has exceeded the safe operating level, and the system controller has terminated transmitter operation. Can sink 25mA to ground and is suitable for use with circuits up to 15 VDC.



Table 1-10 System Controller Remote Connections

J1-14	J11-20	LOW RF STATUS	Provides ground connection through 200 Ohms when the forward RF output power level drops below a preset level.
J1-15	J11-8	REJ PWR WARNING	Provides ground connection through 200 Ohms when the forward RF output power to the combiner reject load exceeds a preset level.
J1-16	J11-21	REJ PWR FAULT	Provides ground connection through 200 Ohms when the forward RF output power to the combiner reject load exceeds the safe operating level and the system controller has terminated transmitter operation.
J1-17	J11-9	TX ON STATUS	Provides ground connection through 200 Ohms when either transmitter is in the ON mode.
J1-18	J11-22	TX LOW POWER STATUS	Provides ground connection through 200 Ohms when either transmitter is in LOW POWER ON mode. Can sink 25mA to ground and is suitable for use with circuits up to 15 VDC.
J1-19	J11-10	N/C	
J1-20	J11-23	N/C	
J1-21	J11-11	N/C	
J1-22	J11-24	N/C	
J1-23	J11-12	GROUND	Provides connection to circuit ground.
J1-24	J11-25	GROUND	Provides connection to circuit ground.
J1-25		+15 VDC	Provides connection to a current limited +15 VDC used for external interlock and fail-safe signaling.



# Section II

## Parts List

# 2

### 2.1 Parts List

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## Section II Parts List

**Table 2-1 XMTR, Z3-48HD+ HYB, FORMAT - 994 9712 005**

Harris PN	Description	Qty UM	Reference Designators
250 0129 000	CORD, 3C 16AWG TYPE SJ	0 FT	
250 0626 000	CORD, AC, IEC PLUG TO IEC RECP	2 EA	#SYS CNTRLS
358 3197 000	SLIDES 10" PAIR	0 PR	
384 0357 000	DIODE, RECT 1N4004	1 EA	
612 1291 000	PLUG, 3 WIRE FEMALE AC	0 EA	
620 0498 000	ADAPTOR 3-1/8	5 EA	
620 0544 000	CONN, ANCHOR INS 3-1/8; 50 OHM	1 EA	
620 0581 000	COUPLING, SLEEVE, 3-1/8	3 EA	
620 1563 000	SPLITTER, 2-WAY-0, BNC	1 EA	SP2
620 2275 000	ELBOW, EQUAL, 3-1/8, 90 DEG	3 EA	
700 1408 000	LOAD, 10KW 230VAC 50 OHM	1 EA	
901 0207 021	PWA, D/A FILTER	0 EA	
901 0207 271	PWA, CAN ADAPTER	1 EA	
917 2332 280	SPACER SYS CTLR MOUNTING	0 EA	
917 2332 878	CABLE PKG, EXTENDER CABLES SYS CTRL1	EA W4A,W5A	
917 2332 993	CABLE PKG, RF & CTLR, Z3-XX	1 EA	W4,W28,W30,W31,W32,W33,W35
917 2435 098	STRAP, SHIPPING	2 EA	
922 1346 015	CABLE, CONTROL, W4A	1 EA	
927 8096 010	ASSY, DIR COUPLER	1 EA	
927 8096 012	ASSY, DIR COUPLER	1 EA	
928 5652 003	ASSY, DETECTOR	3 EA	
939 8013 089	TUBE, COAX 3.125 X 26.5LG	1 EA	
939 8013 180	TUBE, COAX 3.125 X 49.25 LG	1 EA	
939 8014 089	TUBE,COAX 1.315 X 24.97LG	1 EA	
939 8014 180	TUBE, COAX 1.315 X 47.72 LG	1 EA	
971 0027 006	FLEXSTAR BOOST AMP	0 EA	
988 2621 001	DP, Z3-48HD+	1 EA	
992 8850 005	CONTROLLER, SYSTEM	1 EA	
992 9854 012	KIT, PLAT Z MOUNTING, HDX-FM	0 EA	
994 9712 003	XMTR, ZD24/32HD+HYB, FORMAT	0 EA	
995 0034 016	! XMTR, Z16HD+, FORMAT	0 EA	
DIE98694-4-77	DBCMBINER, IBOC 4.77DB 38KW	1 EA	

**Table 2-2 CABLE PKG, EXTENDER CABLES SYS CTRL - 917 2332 878 (A)**

Harris PN	Description	Qty UM	Reference Designators
922 1346 015	CABLE, CONTROL, W4A	1 EA	
922 1346 016	CABLE, CONTROL, W5A	1 EA	

**Table 2-3 CABLE PKG, RF & CTLR, Z3-XX - 917 2332 993 (A)**

Harris PN	Description	Qty UM	Reference Designators
922 1203 425	CABLE, COAX, W30	1 EA	
922 1203 426	CABLE, COAX, W31	1 EA	
922 1203 427	CABLE, COAX, W32	1 EA	
922 1203 432	CABLE, CONTROL W28	1 EA	
922 1203 908	CABLE, CONTROL, W4	1 EA	
952 9238 087	CABLE, CONTROL, W35/W33	1 EA	



**Table 2-4 ASSY, DIR COUPLER - 927 8096 010 (E)**

Harris PN	Description	Qty	UM	Reference Designators
358 0498 000	CLAMP, HOSE DIA 2.563 MIN 3.50 MAX	2	EA	
620 0581 000	COUPLING, SLEEVE, 3-1/8	1	EA	
827 8096 010	ASSY INSTR, DIR COUPLER	0	DWG	
839 7900 147	INNER COND. 3-1/8	1	EA	
939 8118 901	OUTER CONDUCTOR 2 HOLES,	1	EA	
992 9701 002	ASSY, DIRECTIONAL COUPLER,42DB	1	EA	
992 9701 005	ASSY, DIRECTIONAL COUPLER,49DB	2	EA	

**Table 2-5 ASSY, DIR COUPLER - 927 8096 012 (A)**

Harris PN	Description	Qty	UM	Reference Designators
358 0498 000	CLAMP, HOSE DIA 2.563 MIN 3.50 MAX	2	EA	
620 0581 000	COUPLING, SLEEVE, 3-1/8	1	EA	
827 8096 011	ASSY INSTR, DIR COUPLER	0	DWG	
839 7900 147	INNER COND. 3-1/8	1	EA	
939 8118 902	OUTER CONDUCTOR, 1 HOLE,	1	EA	
992 9701 002	ASSY, DIRECTIONAL COUPLER,42DB	1	EA	

**Table 2-6 ASSY, DETECTOR - 928 5652 003 (A)**

Harris PN	Description	Qty	UM	Reference Designators
516 0781 000	CAP 220PF 5% 100V C0G	1	EA	C3
548 2400 382	RES 6.98K OHM 1/2W 1%	1	EA	R5
817 2332 769	ASSY INSTR, DETECTOR ASSY	0	DWG	
817 2332 770	SCHEM, DETECTOR ASSY	0	DWG	
448 0875 000	BOX SHIELDED	1	EA	
516 0375 000	*CAP 0.010UF 20% 50V Z5U	1	EA	C1
508 0261 000	CAP .022UF 200V 10%	1	EA	C2
384 0321 000	*DIODE, SCHOTTKY, 5082-2800	1	EA	CR1
540 1600 208	RES 200 OHM 3W 5%	4	EA	R1,R2,R3,R4
254 0003 000	WIRE, BUS CU 18AWG	0.100	FT	

**Table 2-7 CONTROLLER, SYSTEM - 992 8850 005 (F)**

Harris PN	Description	Qty	UM	Reference Designators
250 0274 000	CORD, AC, 3C, NEMA/IEC PLUG	1	EA	
358 3223 000	FEMALE SCREWLOCK .56"4-40	1	EA	
398 0081 000	FUSE,SLO CART 2A 250V	1	EA	
472 1693 000	XFMR, PWR, DP241-6-28	1	EA	
484 0296 000	* FILTER RFI POWER LINE	1	EA	
813 4999 023	STDOFF 6-32X5/16 1/4 HEX	14	EA	
839 8118 218	SCHEM, OVERALL PTD SYS	0	DWG	
917 2435 050	HANDLE, CTRLR/DIGIT	2	EA	
922 1085 071	CABLE, PT CONTROLLER	1	EA	
922 1200 002	CABLE ASSY, RIBBON, 25C	1	EA	
922 1203 113	WINDOW, SYSTEM CONTROLLER	1	EA	
939 8118 180	COVER, SYSTEM CONTROLLER	1	EA	
943 5293 071	FRAME, FRONT PANEL MTG.	1	EA	
943 5293 072	REAR PNL, SYSTEM CONTROL	1	EA	
943 5293 075	CHASSIS, SYSTEM CONTROL	1	EA	
943 5293 646	FRONT PANEL, SYSTEM CONTROL,	1	EA	
992 8388 005	DISPLAY BD, DUAL TX CNTRL	1	EA	
992 8853 001	PWA, SYSTEM CONTROLLER	1	EA	

## Section II Parts List

**Table 2-8 DISPLAY BD, DUAL TX CNTRL - 992 8388 005 (E)**

Harris PN	Description	Qty UM	Reference Designators
000 0000 010	B/M NOTE:	0 DWG	
358 1928 000	JUMPER 1/4 LG 1/8H	7 EA	JP1,JP4,JP10,JP11,JP12,JP13,JP14
358 3383 000	JUMPER, 0.1" LG, 0.125" H	5 EA	JP015,JP016,JP17
380 0125 000	XSTR, NPN 2N4401 ESD	1 EA	Q003
380 0189 000	*XSTR, NPN, MMBT3904	1 EA	Q002
380 0190 000	*XSTR, PNP, MMBT3906	2 EA	Q001,Q005
382 0401 000	*IC, CD4028B	1 EA	U003
382 0523 000	*IC, CD4066	2 EA	U009,U010
382 1207 000	IC CD4076B ESD	1 EA	U002
382 1208 000	IC CD4070B ESD	4 EA	U005,U006,U007,U008
382 1209 000	IC CD4532B ESD	1 EA	U001
382 1210 000	IC CD4538B ESD	1 EA	U004
382 1211 000	IC ICL7136 ESD	1 EA	U011
384 0205 000	*DIODE, RECT 1N4148/914	30 EA	CR001,CR002,CR003,CR004,CR005,CR006,CR007,CR008,CR009,CR010,CR011,CR012,CR013,CR014,CR015,CR016,CR017,CR019,CR020,CR021,CR022,CR023,CR024,CR025,CR026,CR027,CR031,CR033,CR034,CR035
384 0826 000	LED LIGHT BAR, RED ESD	4 EA	DS004,DS005,DS006,DS011
384 0827 000	LED LIGHT BAR, GREEN ESD	2 EA	DS009,DS010
384 0849 000	LED LIGHT BAR, GREEN ESD	1 EA	DS007
384 0850 000	LED LIGHT BAR, RED ESD	2 EA	DS003,DS008
384 0858 000	LED LIGHT BAR, YELLOW ESD	1 EA	DS013
386 0135 000	*ZENER 1N4733A 5.1V 5% 1W	1 EA	CR032
404 0824 000	SOCKET, DIP14, LO PROFILE	6 EA	XU005,XU006,XU007,XU008,XU009,XU010
404 0825 000	SOCKET, DIP16, LO PROFILE	4 EA	XU001,XU002,XU003,XU004
404 0828 000	SOCKET, SIP18, STRAIGHT	4 EA	
406 0529 000	DISPLAY, LCD 3.5 DIGIT CUSTOM	1 EA	DS012
500 1274 000	CAP 51PF 100V 5%	1 EA	C003
506 0262 000	CAP, 0.047UF 100V 5%	1 EA	C006
516 0484 000	CAP 0.100UF 10% 100V X7R CK06	20 EA	C001,C004,C005,C007,C008,C009,C010,C011,C012,C013,C014,C015,C016,C017,C018,C019,C020,C021,C022,C023
522 0581 000	CAP 10UF 35V 20%	2 EA	C002,C026
540 1485 000	RES NETWORK 100K OHM 2%	2 EA	R001,R016
548 2400 234	RES 221 OHM 1/2W 1%	1 EA	R008
548 2400 242	RES 267 OHM 1/2W 1%	1 EA	R034
548 2400 301	RES 1K OHM 1/2W 1%	1 EA	R027
548 2400 312	RES 1.3K OHM 1/2W 1%	10 EA	R017,R018,R019,R020,R021,R022,R023,R024,R031,R032
548 2400 366	RES 4.75K OHM 1/2W 1%	1 EA	R033
548 2400 401	RES 10K OHM 1/2W 1%	10 EA	R006,R007,R010,R012,R013,R014,R015,R025,R026,R035
548 2400 466	RES 47.5K OHM 1/2W 1%	2 EA	R004,R011
548 2400 526	RES 182K OHM 1/2W 1%	1 EA	R003
548 2400 601	RES 1MEG OHM 1/2W 1%	1 EA	R002

548 2400 626	RES 1.82MEG OHM 1/2W 1%	1 EA	R009
550 0953 000	TRIMPOT 20K OHM 1/2W 10%	1 EA	R005
604 1111 000	SW PB GRAY MOM W/O LED	5 EA	S001,S003,S005,S009,S010
604 1119 000	SW PB RED MOM W/O LED	1 EA	S011
604 1261 000	SW PB GRAY ALT-ACTION W/O LED	1 EA	S008
610 0933 000	TEST POINT, OVAL-LOOP THRU	12 EA	TP001,TP002,TP003,TP004,TP005,TP006 ,TP007,TP008,TP009,TP010,TP011,TP012
610 1106 000	HDR, 8PIN, 1ROW, STRT,POL	1 EA	J014
610 1441 034	HDR, 34C 2ROW VERTICAL	1 EA	J001
839 8025 004	SCHEM, DISPLAY BD	0 DWG	
843 5215 004	PWB, DISPLAY	1 EA	

**Table 2-9 PWA, SYSTEM CONTROLLER - 992 8853 001 (M)**

Harris PN	Description	Qty UM	Reference Designators
000 0000 010	B/M NOTE:	0 DWG	
354 0309 000	TERM SOLDER	25 EA	TP001,TP002,TP003,TP004,TP005,TP006 ,TP007,TP008,TP009,TP010,TP011,TP012,TP013,TP014,TP015,TP016,TP017,TP018,TP019,TP020,TP021,TP022,TP023,TP024,TP025
358 1214 000	SCREWLOCK, M/F 4-40X3/16"	5 EA	
380 0189 000	*XSTR, NPN, MMBT3904	15 EA	Q001,Q002,Q003,Q004,Q005,Q006,Q007 ,Q009,Q010,Q011,Q014,Q015,Q016,Q017 ,Q018
380 0190 000	*XSTR, PNP, MMBT3906	7 EA	Q008,Q012,Q013,Q019,Q020,Q021,Q022
382 0184 000	IC, 340T-5/7805 +5V REG ESD	1 EA	U019
382 0359 000	IC, 7815 ESD	1 EA	U016
382 0360 000	IC, 7915 ESD	1 EA	U017
382 0465 000	IC, 74C74 ESD	1 EA	U012
382 0605 000	IC 7905C ESD	1 EA	U018
382 0711 000	*PRECISION IC MULTIPLIER ESD	1 EA	U009
382 0719 000	*IC, LM324A (DIP-14)	4 EA	U005,U006,U007,U008
382 1016 000	*IC, 74C240 (DIP-20)	2 EA	U004,U011
382 1017 000	*IC, 74C244 (DIP-20)	2 EA	U003,U013
382 1070 000	IC, ILQ1	1 EA	U001
382 1084 000	IC, LP339 (DIP-14)	1 EA	U010
384 0205 000	*DIODE, RECT 1N4148/914	38 EA	CR002,CR003,CR004,CR005,CR006,CR009,CR010,CR012,CR016,CR017,CR018,CR019,CR020,CR021,CR034,CR035,CR039,CR040,CR041,CR042,CR043,CR044,CR045,CR047,CR048,CR051,CR052,CR053,CR054,CR055,CR056,CR057,CR058,CR059,CR060,CR069,CR071,CR073
384 0321 000	*DIODE, SCHOTTKY, 5082-2800	15 EA	CR022,CR023,CR024,CR025,CR026,CR027,CR028,CR029,CR030,CR031,CR032,CR033,CR036,CR037,CR038
384 0357 000	DIODE, RECT 1N4004	14 EA	CR007,CR008,CR013,CR014,CR049,CR050,CR061,CR062,CR064,CR065,CR066,CR067,CR072,CR075
384 0610 000	LED, GRN T1-3/4 VERT	4 EA	DS001,DS002,DS003,DS004
384 0719 000	DIODE, TVS (UNIDIR), SA5.0A ESD	1 EA	CR063

## Section II Parts List

384 0720 000	DIODE, TVS (UNIDIR), 1.5KE15A	3 EA	CR068,CR074,CR077
384 0743 000	DIODE ARRAY DUAL 8 ESD	3 EA	U002,U014,U015
384 0838 000	DIODE, TVS (UNIDIR), 1.5KE36A	2 EA	CR070,CR078
384 0854 000	DIODE ARRAY, 8 ISOLATED ESD	2 EA	CR001,CR046
386 0085 000	*ZENER 1N4740A 10V 5% 1W	1 EA	CR015
404 0303 000	SOCKET IC 10 PIN	1 EA	XU009
404 0513 000	HEAT SINK PA1-1CB	4 EA	#U016,#U017,#U018,#U019
404 0674 000	SOCKET, DIP, 14 PIN (DL)	9 EA	XU002,XU005,XU006,XU007,XU008,X U010,XU012,XU014,XU015
404 0675 000	SOCKET, DIP, 16 PIN (DL)	3 EA	CR001,CR046,XU001
404 0767 000	SOCKET, DIP, 20 PIN (DL)	4 EA	XU003,XU004,XU011,XU013
494 0218 000	CHOKE, WIDE BAND 2.5 TURN	2 EA	
506 0230 000	CAP .001UF 100VAC 5%	36 EA	C001,C002,C003,C004,C005,C006,C007, C008,C010,C012,C013,C014,C015,C017, C018,C020,C021,C023,C030,C031,C032, C033,C034,C035,C036,C037,C038,C039, C040,C041,C043,C044,C045,C046,C047, C048
516 0453 000	CAP 0.100UF 10% 100V X7R	23 EA	C009,C011,C016,C019,C022,C025,C028, C051,C054,C056,C058,C059,C060,C061, C062,C063,C064,C065,C066,C067,C068, C072,C074
516 0511 000	CAP 0.47UF 100V 20%	1 EA	C075
522 0524 000	CAP 10 UF 100V 20% NON-POLAR	1 EA	C076
522 0548 000	CAP 10UF 50V 20% (5X11)	6 EA	C026,C029,C049,C053,C070,C071
522 0586 000	CAP 3300UF 50V 20%	2 EA	C050,C069
526 0109 000	CAP 22UF 25V 20%	2 EA	C024,C027
526 0349 000	CAP 2.2UF 50V 20%	4 EA	C052,C055,C057,C073
540 0618 000	*RES 2K OHM 2W 10%	2 EA	R216,R217
540 1357 000	RES NETWORK 1000 OHM 2%	4 EA	R001,R004,R005,R006
540 1366 000	RES NETWORK 100 OHM 2%	6 EA	R002,R003,R007,R008,R009,R010
548 2051 000	RES ZERO OHM	5 EA	R038,R048,R076,R099,R140
548 2400 201	RES 100 OHM 1/2W 1%	2 EA	R020,R163
548 2400 209	RES 121 OHM 1/2W 1%	2 EA	R207,R208
548 2400 268	RES 499 OHM 1/2W 1%	1 EA	
548 2400 273	RES 562 OHM 1/2W 1%	2 EA	R220,R221
548 2400 281	RES 681 OHM 1/2W 1%	4 EA	R016,R017,R226,R227
548 2400 301	RES 1K OHM 1/2W 1%	13 EA	R012,R015,R018,R022,R023,R025,R027, R029,R121,R122,R129,R159,R170
548 2400 318	RES 1.5K OHM 1/2W 1%	3 EA	R058,R218,R219
548 2400 327	RES 1.87K OHM 1/2W 1%	5 EA	R044,R064,R079,R096,R144
548 2400 330	RES 2K OHM 1/2W 1%	5 EA	R154,R164,R166,R174,R176
548 2400 335	RES 2.26K OHM 1/2W 1%	5 EA	R036,R054,R069,R106,R117
548 2400 336	RES 2.32K OHM 1/2W 1%	1 EA	R130
548 2400 338	RES 2.43K OHM 1/2W 1%	1 EA	R057
548 2400 358	RES 3.92K OHM 1/2W 1%	4 EA	R071,R089,R104,R135
548 2400 366	RES 4.75K OHM 1/2W 1%	7 EA	R019,R034,R056,R067,R108,R111,R187
548 2400 368	RES 4.99K OHM 1/2W 1%	12 EA	R035,R049,R055,R066,R068,R075,R086, R087,R107,R110,R114,R133
548 2400 385	RES 7.5K OHM 1/2W 1%	2 EA	R160,R171
548 2400 393	RES 9.09K OHM 1/2W 1%	2 EA	R128,R131

548 2400 401	RES 10K OHM 1/2W 1%	45 EA	R013,R014,R030,R043,R046,R050,R053, R059,R065,R074,R077,R098,R100,R101, R109,R118,R138,R139,R141,R142,R153, R155,R156,R157,R167,R168,R177,R179, R182,R185,R188,R193,R195,R196,R198, R200,R203,R204,R206,R209,R210,R211, R213,R215,R222
548 2400 430	RES 20K OHM 1/2W 1%	1 EA	R152
548 2400 439	RES 24.9K OHM 1/2W 1%	5 EA	R051,R061,R073,R102,R137
548 2400 447	RES 30.1K OHM 1/2W 1%	5 EA	R031,R041,R082,R093,R147
548 2400 466	RES 47.5K OHM 1/2W 1%	22 EA	R165,R173,R175,R178,R181,R183,R184, R186,R189,R190,R191,R192,R199,R201, R202,R205,R212,R214,R223,R224,R225, R228
548 2400 468	RES 49.9K OHM 1/2W 1%	5 EA	R042,R062,R081,R094,R146
548 2400 493	RES 90.9K OHM 1/2W 1%	5 EA	R032,R040,R083,R092,R148
548 2400 501	RES 100K OHM 1/2W 1%	27 EA	R011,R021,R024,R026,R028,R047,R052, R060,R063,R072,R085,R103,R112,R113, R115,R116,R119,R120,R123,R124,R125, R126,R127,R136,R150,R151,R180
548 2400 526	RES 182K OHM 1/2W 1%	5 EA	R033,R039,R084,R091,R149
548 2400 566	RES 475K OHM 1/2W 1%	2 EA	R162,R172
548 2400 601	RES 1MEG OHM 1/2W 1%	1 EA	R194
550 0858 000	TRIMPOT 5K OHM 1/2W 10%	6 EA	R080,R088,R095,R145,R158,R197
550 0947 000	TRIMPOT 1K OHM 1/2W 10%	1 EA	R132
550 0956 000	TRIMPOT 2K OHM 1/2W 10%	5 EA	R037,R045,R078,R097,R143
550 0958 000	TRIMPOT 10K OHM 1/2W 10%	2 EA	R161,R169
550 0981 000	TRIMPOT 50 OHM 1/2W 10%	4 EA	R070,R090,R105,R134
560 0060 000	MOV, 40WVAC, 3J, 7MM DISC	1 EA	RV001
574 0366 000	RELAY, DPDT 12VDC 2A	4 EA	K001,K002,K003,K004
610 0828 000	*HEADER, 26C TWO ROW VERTICAL	1 EA	J011
610 0900 000	HDR, 3C VERT 1ROW UNSHR	9 EA	JP001,JP002,JP003,JP004,JP005,JP006,JP 007,JP008,JP009
610 1106 000	HDR, 8PIN, 1ROW, STRT,POL	1 EA	J012
610 1441 034	HDR, 34C 2ROW VERTICAL	1 EA	J013
612 1180 000	*D RECP 15C RT ANGLE	4 EA	J002,J003,J004,J005
612 1181 000	*D RECP 25C RT ANGLE	1 EA	J001
612 1184 000	SHUNT JUMPER 0.1" CENTERS	9 EA	#JP001,#JP002,#JP003,#JP004,#JP005,#J P006,#JP007,#JP008,#JP009
612 1268 000	RECEPTACLE RT ANG BNC	5 EA	J006,J007,J008,J009,J010
839 8118 181	SCHEM, PTD SYS CONTROLLER	0 DWG	
843 5293 076	PWB, PTD SYS CONTROLLER	1 EA	

**Table 2-10 XMTR, ZD24/32HD+HYB, FORMAT - 994 9712 003 (A)**

Harris PN	Description	Qty UM	Reference Designators
2520003000A	*WIRE, MIL, 20AWG 1000V WHITE	0.3 FT	#J2,#J3
354 0384 000	CONTACT, PIN	4 EA	J2,J3
358 2635 000	CABLE TIE, PUSH MOUNT SNAP IN	7 EA	
358 3197 000	SLIDES 10" PAIR	1 PR	
384 0357 000	DIODE, RECT 1N4004	2 EA	
408 0212 000	BACKSHELL, D-SUB 15C NO-SHIELD	2 EA	#J2,#J3
606 0866 000	BREAKER, CIRCUIT 10A	1 EA	A1CB2

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610 0538 000	PLUG, DSUB 15PIN CRIMP-POKE	2 EA	J2,J3
614 0048 000	TERM BLK, 2ROW 4-TERM 20A	1 EA	A1TB7
620 0498 000	ADAPTOR 3-1/8	6 EA	
620 0544 000	CONN, ANCHOR INS 3-1/8; 50 OHM	2 EA	
620 0581 000	COUPLING, SLEEVE, 3-1/8	11 EA	
620 0675 000	COUPLER, PI/2 HYBRID	1 EA	
620 2275 000	ELBOW, EQUAL, 3-1/8, 90 DEG	10 EA	
646 0972 000	*LABEL 117V	0 EA	#A1TB7
646 0973 000	*LABEL, 230V	0 EA	#A1TB7
700 1414 000	LOAD, 8898-315, 115VAC	0 EA	
700 1415 000	LOAD, 5KW 230VAC 3-1/8	0 EA	
822 1346 014	XMTR LAYOUT, ZD24/32HD+, HYBRID, W/FLEXSTAR0 DWG		
822 1346 073	XMTR LAYOUT, ZD-HYB 1PH	0 DWG	
901 0207 271	PWA, CAN ADAPTER	2 EA	
917 2332 280	SPACER SYS CTLR MOUNTING	8 EA	
917 2332 741	CABLE PKG, RF & CTLR	1 EA	W4,W5,W28,W30,W31,W32
917 2332 879	CABLE PKG, COAX, ZDHD+	1 EA	W147,W902,W903,W901A,W901B
917 2435 098	STRAP, SHIPPING	2 EA	
922 1203 406	SHIELD 4POS TERM BLK,	1 EA	#A1TB7
922 1260 239	CABLE, RIBBON W211B	0 EA	
922 1260 240	CABLE, RIBBON W212B	0 EA	
927 8096 010	ASSY, DIR COUPLER	1 EA	
927 8096 012	ASSY, DIR COUPLER	1 EA	
928 5652 003	ASSY, DETECTOR	3 EA	
939 8013 022	TUBING COAX	1 EA	
939 8013 120	TUBE, COAX 3.125 X 34.25 LG	1 EA	
939 8013 254	TUBE, COAX 3.125 X 67.75 LG	1 EA	
939 8014 022	TUBE, COAX 1.315 X 8.22LG	1 EA	
939 8014 120	TUBE, COAX 1.315 X 32.72 LG	1 EA	
939 8014 254	TUBE, COAX 1.315 X 66.22 LG	1 EA	
971 0027 006	FLEXSTAR BOOST AMP	1 EA	
988 2514 003	DWG PKG, ZD24/32HD+, HYBRID	1 EA	
988 2515 001	DP, SYSTEM ZDHD	1 EA	
992 8850 005	CONTROLLER, SYSTEM	1 EA	
992 9854 012	KIT, PLAT Z MOUNTING, HDX-FM	1 EA	
995 0034 012	! XMTR, Z12HD+, FORMAT	0 EA	
995 0034 016	! XMTR, Z16HD+, FORMAT	0 EA	