Contents

SAFETY INFORMATION

1. Parts that have special safety characteristics are identified by the  symbol on schematics or by special notes on the parts list. Use only replacement parts that have critical characteristics recommended by the manufacturer.

2. Make leakage current or resistance measurements to determine that exposed parts are acceptably insulated from the supply circuit before returning the unit to the customer.
Use the following checks to perform these measurements:

A. Leakage Current Hot Check-With the unit completely reassembled, plug the AC line cord directly into a 120V AC outlet. (Do not use an isolation transformer during this test.) Use a leakage current tester or a metering system that complies with American National Standards Institute (ANSI) C101.1 "Leakage Current for Appliances" and Underwriters Laboratories (UL) 6500 / IEC 60056 paragraph 9.1.1. With the unit AC switch first in the ON position and then in OFF position, measure from a known earth ground (metal waterpipe, conduit, etc.) to all exposed metal parts of the unit (antennas, handle bracket, metal cabinet, screwheads, metallic overlays, control shafts, etc.), especially any exposed metal parts that offer an electrical return path to the chassis. Any current measured must not exceed 0.5 milliamp. Reverse the unit power cord plug in the outlet and repeat test. ANY MEASUREMENTS NOT WITHIN THE LIMITS SPECIFIED HEREIN INDICATE A POTENTIAL SHOCK HAZARD THAT MUST BE ELIMINATED BEFORE RETURNING THE UNIT TO THE CUSTOMER.

B. Insulation Resistance Test Cold Check-(1) Unplug the power supply and connect a jumper wire between the two prongs of the plug. (2) Turn on the power switch of the unit. (3) Measure the resistance with an ohmmeter between the jumpered AC plug and each exposed metallic cabinet part on the unit. When testing 3 wire products, the resistance measured to the product enclosure should be between 2 and infinite MOhms. Also, the resistance measured to exposed input/output connectors should be between 4 and infinite MOhms. When testing 2 wire products, the resistance measured to exposed input/output connectors should be between 4 and infinite M Ohms. When testing 2 wire products, the resistance measured to exposed input/output connectors should be between 4 and infinite M Ohms.
If it is not within the limits specified, there is the possibility of a shock hazard, and the unit must be repaired and rechecked before it is returned to the customer.

ELECTROSTATIC DISCHARGE SENSITIVE (ESDS) DEVICE HANDLING

This unit contains ESDS devices. We recommend the following precautions when repairing, replacing, or transporting ESDS devices:

• Perform work at an electrically grounded work station.

• Wear wrist straps that connect to the station or heel straps that connect to conductive floor mats.

• Avoid touching the leads or contacts of ESDS devices or PC boards even if properly grounded. Handle boards by the edges only.

• Transport or store ESDS devices in ESD protective bags, bins, or totes. Do not insert unprotected devices into materials such as plastic, polystyrene foam, clear plastic bags, bubble wrap or plastic trays.

CAUTION: THE BOSE® PERSONAL® MUSIC CENTER AND MULTI-ROOM INTERFACE CONTAINS NO USER-SERVICEABLE PARTS. TO PREVENT WARRANTY INFRACTIONS, REFER SERVICING TO WARRANTY SERVICE STATIONS OR FACTORY SERVICE.

Warranty Information

The Bose® Lifestyle® 40 and 50 system is covered by a transferable 1-year limited warranty.

SPECIFICATIONS

Personal® Music Center

Dimensions:	8.8" W x 4.1" D x 1.4" H (22.4 cm x 10.5 cm x 3.6 cm)
Weight:	.8 lb. (0.3629 kg)
Finish:	Painted, polymer
Power:	6 Vdc (4 AAA batteries)
Operating frequency:	2.4 GHz, RF
Viewing angle:	Top to bottom, ± 45° Left to right, ±15°
Battery life:	Medium to heavy use, 6 months (alkaline batteries)

Multi-Room Interface

Dimensions:	7.4" W x 4.0" D x 2.1" H (18.8 cm x 10.1 cm x 5.3 cm)
Weight:	3 lb. (1.36 kg)
Line level inputs:	Video 1, Video 2, Aux, Tape
Line level outputs:	Four room outputs (A, B, C, D), Tape
Powered speaker connections:	4, Video 1, Video 2, Aux and Tape
Serial communication connections:	1, 3.5 mm stereo jack (data out, data in, ground)
Communication frequency:	2.4 GHz, RF
Power connector:	1, 2 mm barrel-type power jack
Power supply:	120 VAC, 1.6 Amps
CD control:	mini din 8 pins

SPECIFICATIONS

Tuner Specifications

FM antenna: 75 Ohm external antenna connection, line cord functions as an FM antenna

Tuning range:
US: 87.7 MHz to 107.9 MHz
Euro: 87.5 MHz to 108.0 MHz
Japan: 76.0 MHz to 90.0 MHz

De-emphasis:
US: 75 μsec
Euro: 50 μsec
Japan: 50 μsec

Frequency steps:
US: 200 kHz
Euro: 50 kHz
Japan: 100 kHz

FM specifications per IHF-T-200, unless otherwise noted. Measurement conditions, otherwise noted: RF input frequency 98.1 MHz, audio frequency 1 kHz, RF input level 65 dBf, deviation: mono 75 kHz. Stereo 67.5 kHz, 7.5 kHz pilot. The performance specifications listed below apply across the entire FM band.

Specification Parameter	Nominal	Limit(Ambient/ Environmenal)
Sensitivity mono usable US:	13 dBf	17/23 dBf
Euro:	14 dBf	19/25 dBf
Japan:	13 dBf	17/23 dBf
Stereo (50 dB quieting) US:	38 dBf	42 dBf
Euro:	40 dBf	45 dBf
Japan:	38 dBf	42 dBf
Signal to noise ratio @65 dBf Mono:	74 dB	69/60 dB
Stereo:	70 dB	65/55 dB
Signal to hum ratio @ 65 dBf Mono:	85 dB	80 dB
Stereo:	85 dB	80 dB
Harmonic distortion (1 kHz) @ 65 dBf		
Mono:	0.3%	0.6/2.0%
Stereo:	0.4%	0.8/2.0%
Capture ratio @45 dBf	2.0 dB	3.0 dB
AM rejection @ 45 dBf	60 dB	50 dB
Adjacent channel selectivity @ 45 dBf		
US:	13 dB	10 dB
Euro:	13 dB	10 dB
Alternate channel selectivity @ 45 dBf		
US:	70 dB	65 dB
Euro:	70 dB	65 dB
Image rejection	45 dB	40 dB
RF intermodulation	65 dB	55 dB
Subcarrier product rejection @ 65 dBf	55 dB	45 dB
Frequency response 30 Hz to 15 kHz	± 1.0 dB	± 2.0 dB
Stereo channel separation @ 1 kHz	35 dB	25 dB
Auto stop level (seek)	30 dBf	± 5 dBf
Mono/stereo threshold	40 dB	± 5 dB

SPECIFICATIONS

Tuner Specifications (continued)

AM antenna: 2.5 mm mono phone jack

Channel spacing: US: 10 kHz
Euro: 9 kHz
Japan: 9 kHz

Tuning range: US: 530 kHz to 1710 kHz
Euro: 522 kHz to 1611 kHz
Japan: 522 kHz to 1629 kHz

Test Parameter	530-550 kHz	560-590 kHz	600-700 kHz	710-950 kHz	960-1400 kHz	1410-1610 kHz	1620-1710 kHz
Usable sensitivity, dB μV/m, 200 Hz HPF	55/61/67 nominal/limit/ environmental	52/57/63 nominal/limit/ environmental	50/55/61 nominal/limit/ environmental	49/53/59 nominal/limit/ environmental	48/53/59 nominal/limit/ environmental	47/52/58 nominal/limit/ environmental	47/52/58 nominal/limit/ environmental
Adjacent channel selectivity, dB	26/21 nominal/limit	26/21 nominal/limit	27/22 nominal/limit	23/18 nominal/limit	23/18 nominal/limit	25/20 nominal/limit	22/17 nominal/limit
Alternate channel selectivity, dB	30/25 nominal/limit	30/25 nominal/limit	30/25 nominal/limit	30/25 nominal/limit	30/25 nominal/limit	29/24 nominal/limit	27/22 nominal/limit
Image rejection ratio, dB	35/30 nominal/limit	37/32 nominal/limit	40/35 nominal/limit	40/35 nominal/limit	40/35 nominal/limit	40/35 nominal/limit	40/35 nominal/limit
Signal to noise, dB at 100 dB μV/m	50/45/40 nominal/limit/ environmental	50/45/40 nominal/limit/ environmental	50/45/40 nominal/limit/ environmental	50/45/40 nominal/limit/ environmental	50/45/40 nominal/limit/ environmental	50/45/40 nominal/limit/ environmental	50/45/40 nominal/limit/ environmental
Distortion, %, at 100 dB μV/m	.6/1.4/2.0 nominal/limit/ environmental	.6/1.4/2.0 nominal/limit/ environmental	.6/1.4/2.0 nominal/limit/ environmental	.6/1.4/2.0 nominal/limit/ environmental	.6/1.4/2.0 nominal/limit/ environmental	.6/1.4/2.0 nominal/limit/ environmental	.6/1.4/2.0 nominal/limit/ environmental
Frequency response, dB, at 50 Hz, 1.8 kHz at 100 dB μV/m	-3/-6 nominal/limit	-3/-6 nominal/limit	-3/-6 nominal/limit	-3/-6 nominal/limit	-3/-6 nominal/limit	-3/-6 nominal/limit	-3/-6 nominal/limit
Auto stop level, dB μV/m	70 ± 7	65 ± 7	63 ± 7	60 ± 7	54 ± 7	48 ± 7	48 ± 7

THEORY OF OPERATION

1. Personal® Music Center (PMC)

Refer to the schematic diagram 188903. The Bose® Personal® Music Center (PMC) is a hand held wireless remote control/display product used to communicate with the Multi-Room Interface in the Lifestyle® 40 and 50 products. The PMC uses a 2-way 2.4 GHz RF transceiver called the RDL (Radio Data Link) to transfer information, and displays information on a black and white LCD backlit by a green/white EL panel. Information is entered via a resistive touchscreen positioned above the LCD display.

1.1 Power Supply

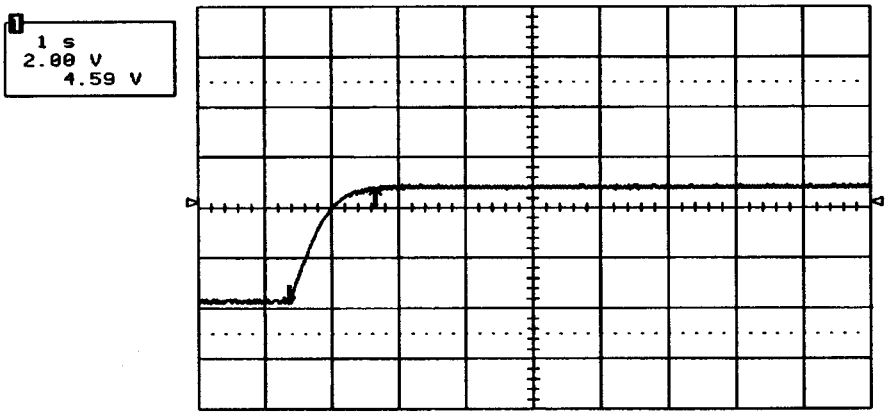
The PMC is powered by four AAA alkaline batteries, which are connected in series and wired directly to the +VBATT and DGROUND nodes on the PCB. Depending on the freshness of the batteries, the PMC's power supply could therefore range from about 6.2 volts down to about 3.8 volts. Q8, R38 and R37 form a high-side switch used to disconnect power from U4 when the PMC goes to sleep, saving battery life. Other subcircuits are powered up/down by the +VB_SW net, through high-side switch Q1, and will be discussed later. The following is a description of low battery thresholds: 4.123 volts: LOW BATTERY icon turns on for the first time. 3.919 volts: LOW BATTERY icon begins to flash. 3.779 volts: LOW BATTERY icon flashes faster. 3.691 volts: LOW BATTERY icon flashes even faster. 3.567 volts: below this level, the EL backlight is not turned on. 3.273 volts: PMC is disabled altogether (put into sleep mode).

1.2 Microcontroller and Related Circuitry

U1 is the microcontroller IC for the Personal® Music Center, Toshiba part number TMP87xx23F. The micro is responsible for managing all subcircuits: controlling the LCD display, supervising the touchscreen, generating drive waveforms for the EL backlight, transferring information to and from the 2.4 GHz RDL transceiver PCB, monitoring battery voltage, reading and writing the EEPROM, sounding the beeper, and communicating with outside equipment via the TAP port. Details of the micro's interaction with each of these separate subcircuits are provided in following sections. The micro's internal clock oscillator frequency is set by x1, a 5 MHz ceramic resonator with built-in load capacitors.

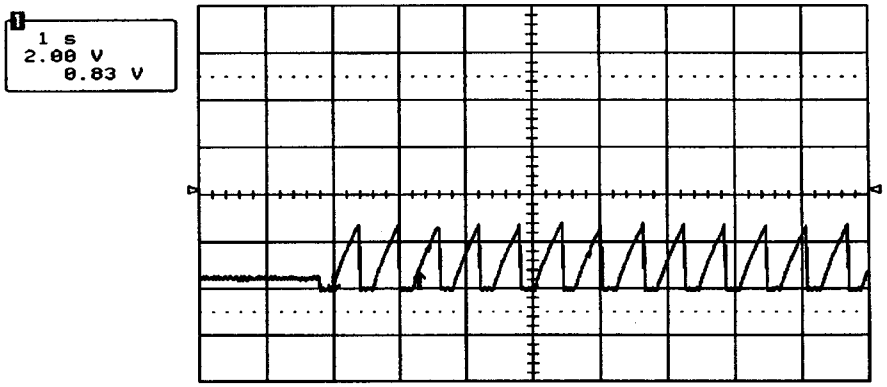
Reset management is provided by U3, a Motorola MC33464, which outputs a logic LOW to the micro's RESET/ line, holding it in reset, whenever the power supply voltage (+VBATT) is below 3.0 volts. C2 ensures that the RESET/ line stays low for the proper amount of time at power-up, and C1 helps to keep the RESET/ line clean in the event of ESD (preventing undesired microprocessor resets).

Normal Micro RESET Waveform at Power-Up (Pin 1 of U3, pin 4 of Micro U1)



THEORY OF OPERATION

RESET Waveform for PMC with Damaged or Unprogrammed Micro



1.2 Microcontroller and Related Circuitry (continued)

C3 and C4 keep the micro's power supply clean: keeping externally generated noise from getting into the micro, and also making sure that the micro's internal clock and switching noise doesn't get out onto the +VBATT supply.

D1 is a Texas Instruments TLV431A, 1.25V, 1% precision voltage reference, used by the micro to measure the PMC's battery voltage as follows: when the micro forces port P34 (pin 37) to ground, current flows through D1, and the micro can read the anode voltage of D1 with its onboard A/D converter (port P57, pin 47). Since the voltage across D1 is always 1.25V, and since the micro's A/D converter range is always equal to the battery voltage (note that +VBATT is tied to pin 48 of U1, VAREF, which is the supply pin for the onboard A/D converter), the micro can compute the PMC's present battery voltage. C11 is used to keep the A/D converter supply voltage clean.

1.3 EEPROM

U2 is a CMOS 24C02A serial EEPROM (Electrically Erasable Programmable Read-Only Memory) IC, made by SGS Thompson and Microchip, among others. An EEPROM is nonvolatile, meaning it can retain its memory if its power supply is removed. The PMC uses U2 to store important setup information such as touchscreen calibration data, user preferences, and RDL network frequencies and registration information. Without U2, this information would be lost whenever the user changed the batteries in the PMC, and loss of RDL registration information would destroy the PMC's ability to communicate with the Multi-Room Interface.

Information is exchanged with U2 using the EE_DATA and EE_CLK lines, where EE_DATA is the serial data being sent to/from U2, and EL_CLK is the clock signal generated by the micro to shift this data in or out. Data is exchanged in the I^2C protocol format. R2 is a pullup resistor required when U2 is driving the data line. Note that U2 and R2 are connected to the +VB_SW supply, which is a switched power supply rail controlled by the micro. This allows the micro to power U2 completely down when the PMC goes to sleep, eliminating unnecessary current draw and helping to prolong battery life. C8 is simply a filter cap for U2's power supply.

1.4 LCD Interface

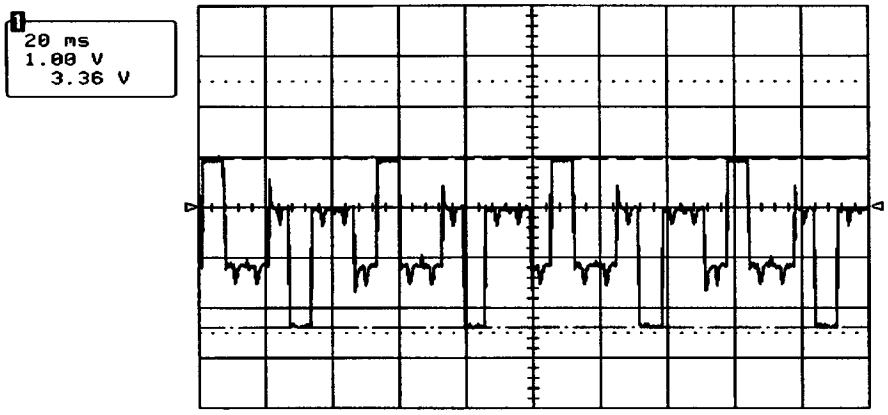
The display on the PMC is a positive image black and white LCD (Liquid Crystal Display) with 160 separately-lightable icons arranged in a matrix of 4 groups of 40. Using the 4 "common" lines, the micro selects each of the 4 groups of 40 segments to control individually, in sequence. Any icon being shown on the display is therefore only lit 1/4 of the time, and is actually flickering faster than the eye can see.

THEORY OF OPERATION

1.4 LCD Interface (continued)

The AC control waveforms for the display are generated by LCD driver hardware built into the micro (pins 92-95 are the common lines, and pins 52-91 are the segment lines), created by switching each line alternately between the LCD supply voltage (VLC, pin 96 of U1), ground, and resistor divider within the micro. Each icon on the display is connected to only one segment and one common line. When the phase/amplitude relationship between a segment and a common line creates a large AC signal across an icon, it turns on.

Typical LCD Common-Line Drive Waveform (Shape Varies with Icons Displayed)



U4 is a CMOS TS3V914 op amp used to buffer the common signals. U4 is needed because the capacitance of such a large LCD would otherwise load the LCD driver in the micro and cause "ghost" images to appear on the display.

The micro drives a pulsewidth-modulated (PWM) square wave out pin 10 (P41) while the LCD is turned on. R40, R1, R29 and C5 divide-down and filter this square wave into a DC voltage used to supply power to the LCD driver section of the micro (VLC, pin 96). In this way, the micro will adjust the PWM duty cycle, for example, to try to maintain appropriate contrast as the battery voltage changes.

1.5 EL Backlight Driver Circuitry

The LCD display in the PMC is transflective, meaning it can reflect ambient light as well as pass light through it. In this way, the LCD will be readable as long as either ambient light is shining on it (daylight viewing) or a backlight is lit behind it (night viewing). A backlight, which is always on whenever the PMC is awake, is provided in the PMC to allow users to walk from well-lit areas to darker areas without losing readability.

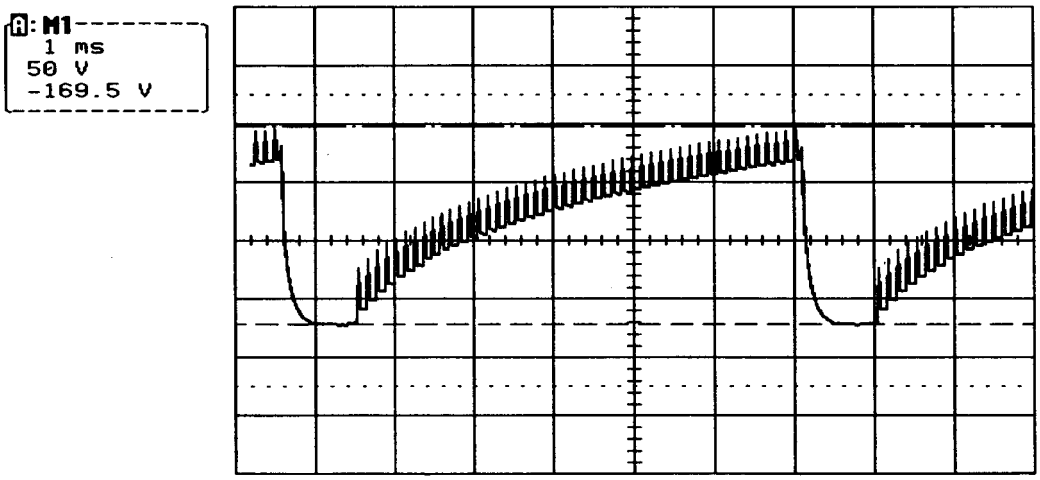
The backlight in the PMC is an electroluminescent (EL) panel, which looks pink when off, but glows green when a large AC voltage is applied across its terminals. The EL driver circuit in the PMC converts the battery voltage (3.6 - 6.0 volts DC) to approximately 175 volts peak-to-peak AC to light the panel. An EL panel looks electrically like a capacitor, and the driver circuit creates a large AC voltage by gradually charging the EL panel up to 175 volts and then discharging it, over and over.

THEORY OF OPERATION

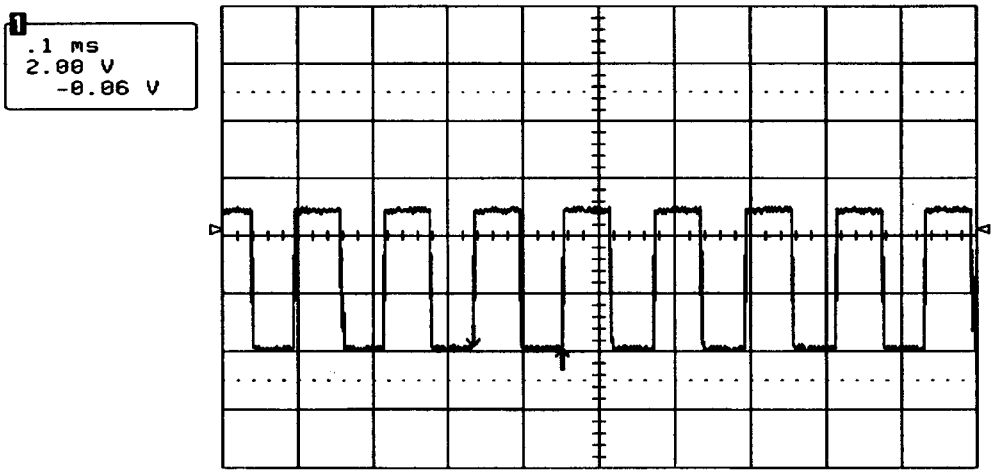
1.5 EL Backlight Driver Circuitry (continued)

Q2 is an STD4NB25 power FET configured as a flyback converter switch, which uses L1 to deliver the packets of energy to the backlight which charge it gradually up to 175 volts. Q2 shorts L1 to ground long enough to store the desired amount of energy in the inductor, then releases (open-circuits) it. The sudden release causes a flyback voltage spike across the inductor, which charges the backlight through diode D3. L3 is a small inductor used to reduce interference with the RDL (D3's charging impedance when switching in and out of conduction caused L.O. loading variations which translated to noise on the transmit waveform). Once the backlight is fully charged-up, transistor Q6 discharges it through R8, and the cycle is repeated. A shield is placed over L1 to keep it from interfering with the AM tuner in the Multi-Room Interface.

EL Backlight Driver Waveform (Measured Across EL Panel Terminals



Backlight Charge Waveform (Pin 29 of U1, Driving Q2)



THEORY OF OPERATION

1.5 EL Backlight Driver Circuitry (continued)

The microcontroller creates the waveforms needed to turn Q2 and Q6 on and off at the proper times. At low battery voltages however, the signal at P14 (pin 29) BL_CNTRL1, does not go high enough to ensure that Q2 will turn on. The set of components between the micro and the gate of Q2 boosts the gate drive signal to overcome this problem. C12 and D2 form a voltage doubler which provides the boosted gate voltage through R7 when BL_CNTRL1 is high (when BL_CNTRL1 is low C12 charges through D2, so when BL_CNTRL1 goes high the cathode of D2 rises to twice the battery voltage). Q9 turns on when the micro is reset. R41, R42 and L4 help eliminate noise from the RDL.

1.6 Touchscreen Interface

The PMC uses an analog resistive touchscreen with a 4-wire interface. “Analog”, here, refers to the fact that the touchscreen is not divided into individual (“discrete”) button areas, but is instead one large, continuous touch surface. “Resistive” refers to the fact that the touchscreen changes in resistance depending on where the user presses his finger (some other touchscreens change in capacitance).

The touchscreen is formed from a sandwich of two conductive sheets, one on top and one on bottom. When not being pressed, the top sheet does not come in contact with the bottom sheet, they’re held apart by a layer of small, evenly-spaced “micro dot” insulators. When a user presses the touchscreen, the area between these “spacer dots” is compressed and the two sheets short together.

The top conductive sheet has electrodes internally connected along its top and bottom edges (nets SCREENY0 and SCREENY1 of J3). The resistance between these electrodes is normally about 200 Ohms. The bottom conductive sheet has electrodes along its left and right edges (nets SCREENX0 and SCREENX1 of J3), with a resistance of about 2.1 K Ohms. While the PMC is asleep, the top sheet is connected to +VBATT by the micro, and the bottom sheet is pulled-down to ground by R5. When the user presses the touchscreen, the two sheets short together and SCREENX0 becomes +VBATT also, which wakes up the micro (pin 8 going high interrupts the micro’s stop mode).

To determine which touchscreen “key” the user is pressing, the micro uses Q3 and Q4 to apply a voltage across the top sheet, and reads the resulting voltage from the bottom sheet (SCREENX1) using its onboard A/D converter. The closer the user’s finger to the top of the touchscreen, the more positive the voltage read from the bottom sheet would be. This indicates the vertical (Y) position of the keypress. The micro then repeats the procedure by applying a voltage across the bottom sheet, and reading a voltage from the top sheet (SCREENY1) which represents the horizontal (X) position of the keypress. (R6 is used here to keep the top sheet from floating, with respect to ground, when the user abruptly lifts his finger, which would cause erroneous reading). From this X/Y information, the micro can determine which of the displayed keys is being pressed.

1.7 “Find Me” Wake up Circuit

About every 60 seconds, the PMC needs to wake up to determine if a user has pressed the “Locate Music Center” button on the back of the Multi-Room Interface. (If so, the PMC needs to begin beeping so the user can find it). Q5, along with D9, R10, C14, D4 and C15, create the two 60 second time delay and wake the processor up, as follows: Whenever the PMC is awake, the micro holds the negative side of C15 to ground, which charges C15 to the battery voltage through D4. Just before the PMC goes to sleep, the micro drives the same nets high, so the positive side of C15 goes to about twice the battery voltage and begins to discharge slowly through D4 and R10. After about 60 seconds, R10 has discharged enough to turn Q5 on through D9. Q5 then wakes the micro up the same way that a keypress would, by asserting SCREENX0. Once the micro is awake, the FIND_EN line goes low, which allows the touchscreen to operate normally.

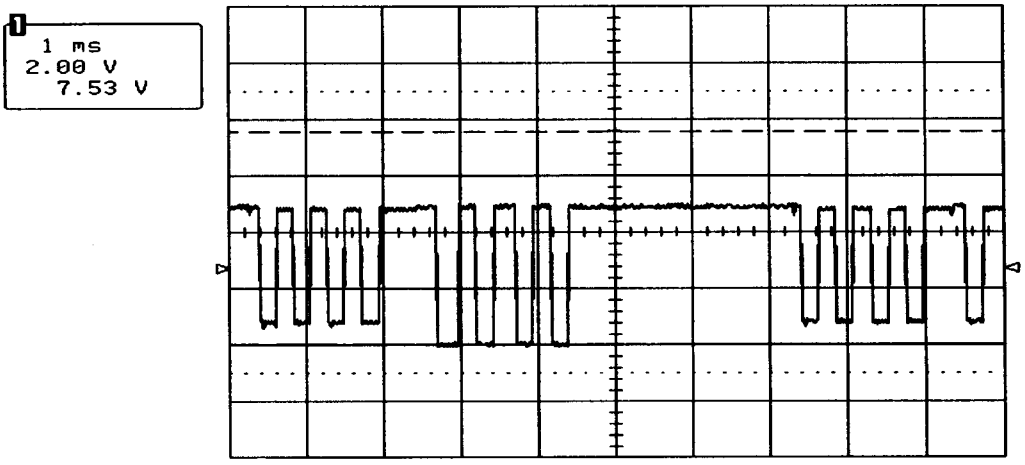
THEORY OF OPERATION

1.8 RDL Interface

The micro transfers information to and from the RDL RF transceiver via an eleven (11) pin parallel bus (RDLBUS). Eight (8) of the pins are used to pass (RDLBUS+0 through RDLBUS_7), and the other three (3) lines are for handshaking (REQUEST/, GRANT/ and STROBE/).

REQUEST/ is normally high, and is driven low by the PMC micro or by the micro in the RDL when data needs to be sent across the bus. It is held low for the duration of the exchange (7 bytes get passed at a time). The micro receiving this data asserts GRANT/ low and holds it low until it received the first byte. The STROBE/ line is asserted low to indicate that the sending micro is passing the first byte. The remaining data is passed the same way: when GRANT/ signals that the receiving micro is ready, the sending micro puts a byte on the bus, then asserts STROBE/ and holds it until the receiving micro de-asserts GRANT/.

RDL Interface, GRANT Line Waveform When Transferring Data (Pin 26 of U1)
Note: Large Pulses are from U1, Smaller Pulses are from RDL



Q1 is a high-side transistor switch used by U1 to disable the RDL when the PMC is asleep, which saves battery life. When the PMC wakes up, the micro drives RDL_ENBL/ low, which turns-on Q1 through R36, which powers up the RDL board. C9 and C10 keep the PMC's digital noise off the RDL, and R35 makes sure that Q1 stays off while U1 resets.

1.9 Sound Circuitry

The sounder in the PMC beeps whenever a user presses the touchscreen, giving audible feedback that the keypress has been acted on. This sounder is also used to signal the completion of certain tasks (the successful storage of a new tuner preset, for example). LS1 is the piezoelectric sounder, and is driven by square waves generated by the micro (the micro determines the pitch and duration of the sounder's beep).

The micro is able to drive both pins of the sounder, allowing it to create tones of two different amplitudes. When a quieter tone is required, only one side of the sounder is driven (with the other side held to ground by the micro). When a louder tone is required, the two sides of the sounder are driven 180 degrees out of phase, effectively producing a drive waveform across the sounder with twice the amplitude. R13, R14, C18 and C19 filter the micro drive waveforms to reduce the harshness of the sounder's tone, as well as to limit the loudness and reduce current draw.

THEORY OF OPERATION

1.10 test Access Port (TAP) Interface

The microcontroller in the PMC is capable of communicating with outside equipment through an RS-232 like serial port, SERIAL_IN and SERIAL_OUT. This interface is used during manufacturing to put the PMC into various test modes. There is no external serial data port jack available for service use.

R30, R31, C16, C17, D7 and D8 protect the microcontroller from ESD transients which might enter through the TAP interface in production. The resistors and capacitors slow down the transient, reduce its amplitude and limit its current. The diodes clamp its voltage to a safe level to prevent damage to the microcontroller ports.

1.11 Description of Hidden Diagnostic Features

The PMC has 11 hidden diagnostic modes included to assist in product development and troubleshooting. These modes are NOT intended to be disclosed or used by the end user (customer). The hidden diagnostics are accessed by pressing and holding the digits of the Upper Numeric Display field for 10 seconds. The Upper Numeric Display field is the set of LCD digits used to display the volume when the system is off, or the radio station frequency when in AM/FM mode. The diagnostic modes are exited by pressing the ON/OFF button on the touchscreen. A description of each mode follows.

For all diagnostic modes, the Lower Numeric Display field (normally used to display AM/FM preset number or CD track number) shows the number of the mode presently running. Diagnostic modes are numbered d0 through da. The left/right arrows keys beside this field are used to scroll between modes. The descriptions below use the following abbreviations:

UNDL: Upper Numeric Display field, Left. Refers to the left pair of display digits in this field.
UNDR: Same, but refers to the right pair of digits.
MND: Middle Numeric Display field. Refers to the two digits normally used to display CD disc.
MNDL: The left digit in this field.
UAL: The left arrow button beside the Upper Numeric Display field.
UAR: The right arrow button beside the Upper Numeric Display field.
MAL: The left arrow beside the Middle Numeric Display field.
MAR: The right arrow beside the Middle Numeric Display field.
PLAY: The play button normally used for CD.
PAUSE: The pause button.

Names below in italics indicate actual register names in code.

Note: For all diagnostic modes, the STOP button toggle on/off the Slave's ability to automatically hop between its 5 subfreqencies. "CHANGING" icon is lit when hopping is enabled. This feature may not be useful in all modes.

1.11.0 Mode d0

UNDL: *MasterSN*. Serial number of the RDL in the MRI to which this PMC is regestered.
UNDR: *SlaveSN*: Unique serial number of this PMC, assigned by the MRI Master.

1.11 Description of Hidden Diagnostic Features (continued)

1.11.0 Mode d0 (continued)

MND: *BaseFrequency*. Hex number from 00 to 4b describing which of the 76 sets of frequencies the RDL is operating on (chosen by the MRI at initial setup).

PAUSE: Forces the Slave to attempt to be registered to the Master (the RDL in the MRI).

MAL and MAR: Changes the base frequency used by the Slave. Does not effect the Master.

1.11.1 Mode d1

UNDL: *RcvBufferFullCount*. Count shows incidents of RDL received message loss due to receiver buffer being full.

MNDL: Always zero.

MNDL: *SlaveID*: a, b, c, or d. Slave ID assigned to this Slave by the Master.

MNDR: *SubFrequency*. A number from 0 to 4 indicating which of the 5 subfrequency groups is presently being occupied by this Slave.

MAR: Forces this Slave to hop to the next available subfrequency group.

1.11.2 Mode d2

UNDL: *WPACKCount*, Count of Wake up Polls successfully received. Zeroed at mode entry.

UNDR: *DPACKCount*. Same, but dedicated Polls. Also zeroed at mode entry.

MNDL: *RetriesCount*. Indicates incidents of this Slave needing to resend data.

MNDR: *BadDAtaCount*: Count of data packets clocked in but rejected for bad checksum.

MAL: *ZerosRetriesCount.*

MAR: *ZerosBadDataCounts.*

1.11.3 Mode d3

UNDL: *MaxAttemps* (1 digit) and *AttchAttempts* (1 digit). For debugging hop algorithum.

UNDR: *UnstablesCount* (1 digit) and *TimeOutsCount* (1 digit). for debugging hopping.

MND: *SubFrequency*. See 1.11.1.

UAL: and UAR: Scroll *MaxAttempts* value.

MAR: Forces this Slave to hop to the next available subfrequency group.

1.11.4 Mode d4

UNDL: MessageRssi. Indicates relative RF signal strength of valid polls received.

UNDR: Always zero.

MND: Always zero.

1.11.5 Mode d5 Transmit Continuously Mode

UNDL and UNDR: Displays the frequency to be transmitted, in MHz.

UAL and UAR: Selects desired frequency: 2400, 2410, 2420, 2430, 2440, 2450, 2460, 2470, 2480 MHz.

PLAY: Begins transmission on this frequency. Stops all normal polling, etc.

PAUSE: Toggles modulation on/off.

1.11 Description of Hidden Diagnostic Features (continued)

1.11.6 Mode d6 Receive Continuously Mode

UNDL and UNDR: Displays the frequency to receive, in MHz.
UAL and UAR: Selects the desired frequency: 2400, 2410, 2420, 2430, 2440, 2450, 2460, 2470, 2480 MHz.
PLAY: Begins reception on this frequency. Stop all normal polling, etc.

1.11.7 Mode d7

UNDL: ReceivedMessage1. First data byte of next-to-last received RDL message.
UNDR: ReceivedMessage2. First data byte of the last-received RDL message.
MND: SentMessage. First data byte of last message this Slave sent over the RDL.

1.11.8 Mode d8

UNDL: Always zero.
UNDR: Always zero.
MND: Testkey. Identifier byte of touchscreen key being pressed.

1.11.9 Mode d9

UNDL: Always zero.
UNDR: Always zero.
MND: iconNumber. Identifier byte for icon being displayed.
MAL and MAR: Selects an icon to be displayed.

1.11.10 Mode da

UNDL: Always zero.
UNDR: Always zero.
MND: TestBaseFrequency. New base frequency to force system to temporarily operate on.
MAL and MAR: Selects the desired base frequency, hex value from 0 to 4b.
PLAY: Forces MRI and PMC to temporarily operate on the selected base frequency. Returns to previous base frequency after resetting each unit (new frequency not sorted to EEPROM in the MRI or the PMC)>

THEORY OF OPERATION

2.0 Multi-Room Interface (MRI)

2.1 Power Supply

The MRI is powered by an external 12 VAC power supply capable of delivering 1.6 Amps RMS.

D7 - D10, and C13 form a full-wave bridge rectifier that supplies voltage to the +5V and +10V regulator circuit, CD connector, room enable circuitry, and power fail circuitry. The nominal voltage at the output of the bridge rectifier is 14.5VDC.

U1 is a +5V low dropout voltage regulator, which uses R5 and R6 to dissipate power and thereby maintain allowable regulator junction temperature over all operating conditions. D1 steers the +10V regulator's output to the +5V regulator's input to prevent +5V regulator dropout under low AC input level conditions. The 5.6V zener D2 protects U1's output terminal which cannot sink current. Diode D1 will switch between conduction and off states at a 120 Hz rate with nominal AC line level biasing. These switching transients couple to the Radio Data Link (RDL) board and cause interference. Capacitor C17 limits the rate of turn-on/turn off of D1, which reduces the interference from this circuitry to the RDL. L1 provides series decoupling of the regulator's output from its load circuits.

U2 is a +10V low dropout voltage regulator, which uses R3 to dissipate power and maintain allowable junction temperatures for the regulator.

R1, R2, Q1, Q2, and R4 form a power fail detection circuit. When the bridge rectifier output voltage drops below approximately 7.0 volts, Q1 turns on which turns on Q2 causing PFAIL to become active low.

2.2 FM Tuner Circuitry

The FM signal is provided by the F connector, J301, and goes to the FM front-end module. The front-end contains a tuned RF amplifier, FM local oscillator and mixer. The 10.7 MHz IF output signal (pin 7 of the module) passes through a 10.7 MHz ceramic filter, CF302, to an FM IF amplifier. Transistor Q301 and related circuitry form the FM IF amplifier which produces about 15 dB of voltage gain and provides the proper impedance matching for ceramic filters CF302 and CF301. These FM IF filter stages reject unwanted FM stations and noise.

The output signal from CF301 is fed to the AM/FM detector IC, U300. This device contains the FM detector, FM stereo MPX decoder, S-meter circuitry which is for seek processing, and most of the AM circuitry. The FM IF input signal to U300 goes through several gain/limiter stages and then to a single-tuned, coil-based discriminator circuit. The discriminator coil, T302, is adjusted for minimum audio distortion. The recovered FM composite signal appears on pin 24 of U300.

The composite audio signal is filtered by C334 and fed into U300 on pin 22. The value of C334 affects FM stereo separation performance. Q304 is off in FM mode so that C321 does not affect circuit operation. The stereo MPX decoding is performed by U300, and the decoded left and right output signals are produced on pins 16 and 17. The MPX decoder uses the 456 kHz ceramic resonator, CR300, to set the free-running frequency of the MPX VCO. The MPX VCO output is divided by 12 to produce the 38 kHz signal used for sub-channel demodulation, and is divided by 24 to produce the 19 kHz signal which phaselocks to the pilot tone. C315, R318, and C316 on pin 14 form the pilot PLL loop filter.

THEORY OF OPERATION

2.2 FM Tuner Circuitry (continued)

Capacitors C330 and C332, and the internal resistance of U300 set the FM de-emphasis. For a U.S. unit the capacitor values are set to produce 75 uSec de-emphasis, and for Europe/Japan they are set to produce 50 uSec de-emphasis. MPX filters, T303 and T304, reject the residual 19 kHz pilot tone and 38 kHz sub-channel demodulation components.

The S-meter signal, which is at pin 12 of U300, is an analog voltage which is proportional to IF/RF input signal level in both FM and AM modes. It is used to control the FE stop level, FM force-mono level, and AM stop level.

FM stop: 30 dBf @ 98.1 MHz
FM force-mono: 40 dBf @ 98.1 MHz

The S-meter signal is connected to an 8-bit analog to digital converter in the microprocessor, pin 50 of U400. During factory tuner alignment the appropriate test levels are injected to the UUT and the resulting ACD values for stop and force-mono levels are stored in EEPROM.

Supply voltage biasing to U300 is provided from +10V, through two voltage dropping diodes, D301 and voltage dropping resistor R325. This circuit is used to maintain the proper supply voltage to U300 over allowable tolerances of +10V supply voltage and U300 supply current.

2.2 AM Tuner Circuitry

The signal from the AM loop antenna enters through the 2.5 mm jack J300, and is fed to the AM front-end module, T300. This module contains the varactor-tuned RF and local oscillator (LO) tracking circuit. This part is pre-tuned by the manufacturer for proper alignment in this circuit and is further adjusted during factory alignment, if necessary. The RF tuned output appears on pin 12 and is fed to the AM buffer FET Q300. The buffered output is sent to pin 27 of U300 which contains the AM RF amplifier, mixer, IF amplifier, AM detector, and AM S-meter circuitry. The 450 kHz AM IF output signal is demodulated by U300 and the audio output is sent to pins 16 and 17, which are the left and right outputs. At low AM RF input levels the AM audio bandwidth is narrowed to reduce the noise and improve sensitivity. This is accomplished by turning on Q304 which shunts C321 and narrows the detection bandwidth at pin 24 of U300.

The AM seek stop processing and factory alignment is performed in a similar fashion to FM mode processing. The S-meter voltage which corresponds to the desired AM stop level is stored during factory tuner alignment in the EEPROM. The nominal AM stop level is 53 dBuV/m @ 1080 kHz.

2.4 Phase-Locked Loop Tuning

The AM and FM local oscillators are controlled by the PLL IC, U302. The microprocessor selects the AM or FM band and the particular frequency. The 7.2 MHz crystal, Y300, is connected across an inverting amplifier inside U302 to form an accurate and stable crystal oscillator. The 7.2 MHz oscillator is divided down to produce a 12.5 kHz reference frequency in FM and 10 kHz reference frequency in AM mode. U302 divides down the AM or FM LO and compares it to the appropriate reference frequency. An error signal from the comparison is produced on U302 pin 16. This error signal is integrated by Q310, Q311 and associated components, producing the tuning voltage at the collector of Q310.

2.4 Phase-Locked Loop Tuning (continued)

C350, C345, R312 and R347 control the gain and pole-zero locations of this active lead-lag filter.

The 2.4 GHz RF transmission from the Radio Data Link (RDL) board couples to the PLL circuitry and is detected by nonlinear circuit elements. This results in unwanted modulation sidebands being produced on the FM local oscillator at the rate which the RDL RF transmission turns on and off. Several RF bypass caps, C365-C368, are used to reduce the level of the 2.4 GHz coupled RF signal and thereby suppress unwanted FM LO sidebands.

The AM tuning voltage is further filtered by R300 and C300 and is fed to pin 14 of the AM front end, T300. The tuning voltage varies the capacitance of the varactor diodes, which in turn tunes the AM antenna and the AM LO. Similarly, in FM mode, the tuning voltage is filtered by R311 and C322 and fed to the FM front-end. As in the AM case, the tuning voltage is fed to varactors which tune the LO frequency and RF filters.

2.5 Audio Path

The MRI accommodates six (6) audio sources: the internal AM/FM tuner, the Bose® Model C1 CD changer, the Video 1 and 2 inputs, the AUX input, and the Tape input. The MRI can control five (5) fully independent audio outputs: Room A, B, C, D and Tape output.

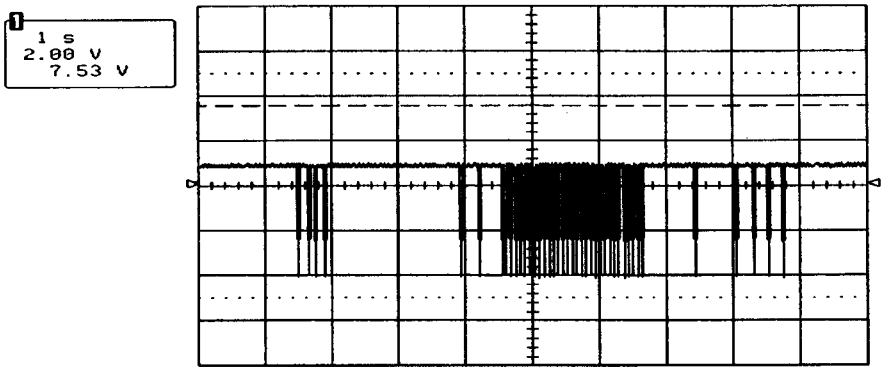
Stereo multiplexer (MUX) ICs U100 and U101 are used to select the desired audio source. The MUX's are TEA6422 made by SGS Thompson, and include output buffers and output muting capability. U100 selects the audio input source to be played out Room A, B and Tape output. U101 selects the audio input source to be played out Room C and D. U101's output feeds a peak detector formed by D101, R128 and R411, which is sampled by the micro's A/D converter when it measures the amplitude if any of the audio input sources.

Volume control ICs U102, U103, U104, and U105 are SGS Thompson TDA7309D used by the micro to set the attenuation level of each of the four (4) Room audio outputs. The Tape output is fixed (line) level only. The volume control ICs also include built-in mute cells at their outputs. The loudness functions of the ICs are not used. 100K resistors (R111, R210, R115, R214, R119, R218, R133, R222) are added to all volume IC outputs to eliminate power up/down pops. Capacitors C126, C128, C130 and C132 are connected to the volume ICs to provide the time constant for the ICs "soft mute" functions (built-in functions to ramp the volume up/down smoothly and quickly).

The micro (U400) controls the MUX and volume control ICs by sending serial I^2C commands using clocks and data lines. U100, U102 and U103 share the ICA_CLK clock line. U101, U104 and U105 share the ICB_CLK clock line. Note that U102 and U103 can be uniquely identified by the micro because U102 has its address line grounded, whereas U103 has its address line internally pulled high. The same holds true for the manufacturer, which makes the MUX IC commands distinguishable from those meant for the volume ICs. Note that all MUX and volume ICs share the same data line (IC_DATA).

THEORY OF OPERATION

Typical ICx_CLK Waveform When Writing Volume/MUX ICs



2.5 Audio Path (continued)

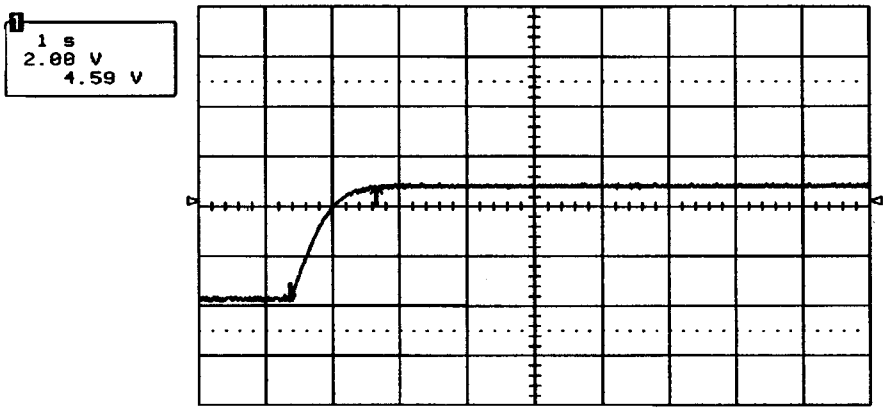
The entire audio path in the MRI is “single-ended” (biased above ground), and runs off a single +10 volt power supply (AUD_10V). D102 and C133 isolate this power supply and filter it, preventing pops in the event of sudden AC power failure. The 5V pseudo-ground used to bias the audio path is called CREF, and is formed by resistive voltage dividers inside each MUX and volume IC. To prevent pops when different sources are selected, all CREF lines are connected together. C120 filters the CREF net and prevents pops by slowing the rate at which it rises at power-up and fails after power-down. Resistors and capacitors on the inputs of the MUX ICs and the outputs of the volume control ICs provide ESD protection, and block DC so that ground-referenced audio can be shifted up to our pseudo-ground.

2.6 Microcontroller and Related Circuitry

U400 is the Toshiba TMP87C40F microcontroller, responsible for controlling the AM/FM tuner, external CD changer, audio path, managing information in the EEPROM, and exchanging system information with PMC’s via the RDL built into the MRI.

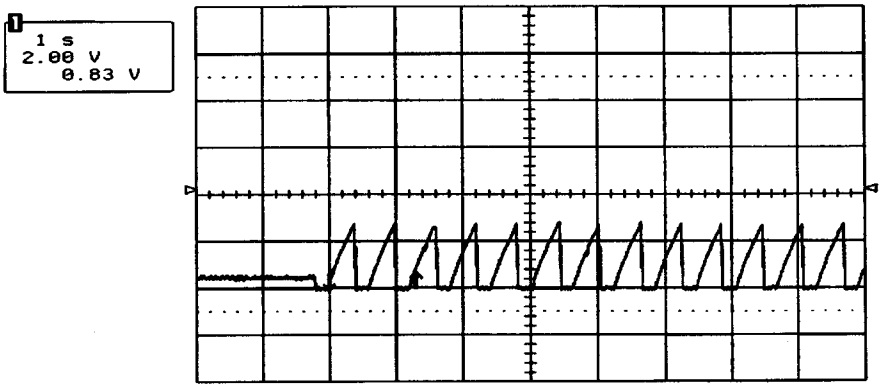
U400 is the power supply supervisor IC (or “reset” IC). If the +5V supply drops below its internal threshold, U402 generates a reset pulse for the micro.

Normal Micro RESET Waveform at Power-Up
(Pin 2 of U402, Pin 23 of the Micro)



THEORY OF OPERATION

RESET Waveform for MRI with Damaged or Unprogrammed Micro



2.6 Microcontroller and Related Circuitry (continued)

Resistor R436 determines the power-up default character of the MRI. If the resistor is not loaded, the MRI powers-up initially with its AM/FM tuner set to U.S. channel spacings (200 kHz between stations). If R436 is populated with a 10k Ohm resistor, the MRI initially defaults to European channel spacing (50 kHz between stations). If R436 is populated with a 12 Ohm resistor the MRI initially defaults to the Japan band edges and channel spacing required for proper operation (note: a special FM front-end is required here, as well).

U401 is the EEPROM used to save information which the MRI needs to maintain in the event of power failure. This information includes AM/FM tuner presets, as well as information that the RDL system requires (such as RDL operating frequency, and the numbers of regestered PMC's). See section 1.3.

Quad op-amp U403 is used to buffer the enable lines which turn on/off the powered speakers plugged into the MRI's four (4) room connectors. Resistors R437 and R441 configure each amp to have a DC gain of two, which convert the micro's 5V logic to signals which are +10V in the high (enable) state.

RM_SENSE is a line monitored by U400 to identify which of the audio output room connectors have speaker cables plugged in. Built into all LS40/50 compatible speaker cables is a short-circuit between pin 5 and the ground shell of its plug. R103-133 form a binary-weighted resistor divider network which establishes a unique voltage on RM_SENSE determined by the plugged-in cables. U400 measures the voltage of RM_SENSE with its A/D converter.

Resistor array R406, the 470K Ohm pullup resistors on the speaker data lines, is used by U400 to identify the type of powered speaker attached to each room connector. When a change in RM_SENSE alerts U400 that a new speaker has been plugged in, the voltage on the associated speaker data line is measured by the micro's A/D converter. If a "smart" speaker (one of Bose's powered speakers with built in micros, such as the AM-9P, AM-25P and digital surround sound systems) is plugged in, it will load down the dataline, creating (along with the 470K pullups) a voltage divider which U400 can measure.

2.6 Microcontroller and Related Circuitry (continued)

VOL_LEVEL is a signal from the MUX ICs proportional to amplitude of the summed left + right audio signals from any input source which U400 wishes to examine with its A/D converter. The micro measures VOL_LEVEL, for example, to determine if the FM radio is tuned to a station where noise is creating unacceptably load signal levels. D101 sums the left and right signals of interest.

Push-button switch SW400 initiates the “Locate Music Center” feature of the MRI. When a user presses SW400, the MRI will instruct each PMC to begin to beep its piezo sounder and flash its backlight. Beeping and flashing will begin as soon as each PMC performs its periodic wake-up and establishes communication with the MRI, which could take 60 seconds. Beeping and flashing will continue until the user finds a PMC and presses its touchscreen.

J401 is the Serial Data In/Out connector. U400 communicates with external devices (including Manufacturing Test equipment and Marketing/Sales demo equipment) through this interface using an RS-232TTL protocol. R421 and R422 keep the lines biased normally-high, per the protocol. D402, D403 and the remaining resistors and capacitors in this circuit are for ESD protection.

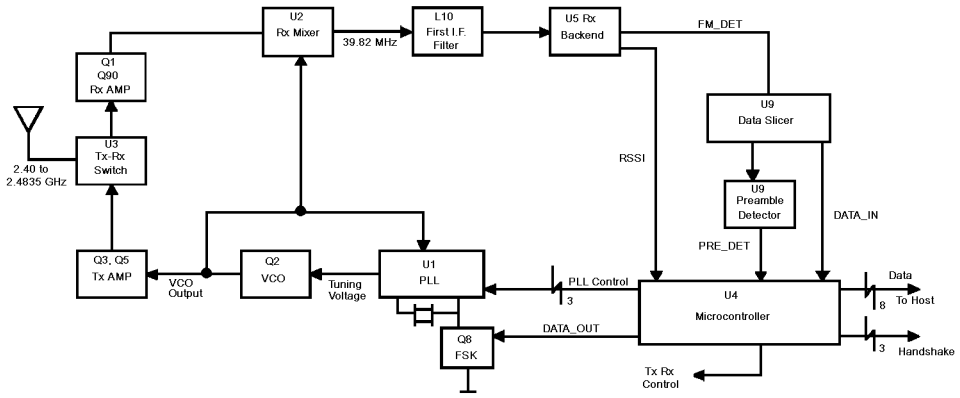
2.7 RDL Interface

The MRI’s RDL interface is identical to the PMC’s. See section 1.8.

3.0 Radio Data Link (RDL)

Refer to the schematic diagram number 188904 included with this service manual. In addition, IC layouts and diagrams (located in the back pages of this manual) of Signetics SA626 (U5) and Fujitsu MB15E07 (U1) provide useful information.

RDL Block Diagram



3.1 RDL Introduction

The Radio Data Link (RDL) transmits and receives data back and forth between the MRI and the PMC. One RDL board is used in each MRI and PMC. RDL boards are interchangeable between the MRI and PMC application. The RDL operates on the 2400 to 2483.5 MHz frequency band. No FCC license is required to operate a low power radio transmitter such as the RDL in this frequency band. The RDL transmitter output power is approximately one milliwatt. The receiver sensitivity is approximately two microvolts. The modulation is FSK, frequency shift keying, and the frequency deviation is 40 kHz peak-to-peak. The data rate is 22.5 kbps.

These specifications apply to the U.S. version of the RDL, other countries may have somewhat differing standards.

THEORY OF OPERATION

3.2 Description of Antenna

The antenna is a quarter-wave monopole, shaped to fit the available space. A GaAsFET SPDT switch, U3, switches the antenna to the receiver or transmitter as required.

3.3 Description of Receiver

The receiver is a double-conversion superheterodyne design. Signal from the antenna switch U3 is amplified in Q1. The signal passes through a bandpass filter constructed of PCB traces and strong out-of-band signals are rejected. The signal is further amplified in Q90 and passes to receive mixer U2. Using LO (local oscillator) injection from VCO (voltage controlled oscillator) Q2, the receiver mixer converts the incoming frequency band to a fixed first IF (intermediate frequency) of 39.82 MHz. After first IF bandpass filter L10, the signal passes to receive back end IC U5. This IC comprises a second mixer which converts the signal frequency from 39.28 to 10.7 MHz using crystal resonator Y2 of 29.12 MHz; a 10.7 MHz IF amplifier and limiter with bandpass filters Y3 and Y4 providing a 10.7 MHz IF bandwidth of about 100 kHz. U5 also provides a quadrature detector using coil L9 and RSSI output (Received Signal Strength Indication).

The analog data output from U5 is passed through de-emphasis filters R80, C85, R4 and C58, to the first section of comparator U9 which is called the Data Slicer. The analog output level is about 1.0 VDC corresponding to a zero and 1.3 VDC corresponding to a one. The Data Slicer decides whether the analog input stands for logic 0 or logic 1 and provides the corresponding logical output signal.

The second section of U9 generates the command for the uC U4 to start reading data from the Data Slicer. Each packet of data starts with a string of 12 (twelve) ones followed by a zero. The one-to-zero edge is used to sychronize the data reading clock. The string of 12 ones before the message starts is called a Preamble and so this U9 circuit is called the Preamble Detector.

3.4 Description of Transmitter

The transmit frequency is entered directly by VCO Q2. The signal is amplified by Q3 and Q5. L-C circuits associated with Q3 and Q5 reduce harmonic output. The signal passes to the antenna switch U3.

3.5 Description of PLL Frequency Synthesizer

The VCO Q2 operates in the 2400-2483.5 MHz frequency band. PLL (Phase Locked Loop) IC U1 is provided, It consists primarily of two programmable frequency dividers and a phase detector. The main programmable frequency divider counts the VCO down to 200 kHz. The second programmable divider, called the reference divider, counts the 21.8 MHz reference frequency down to 200 kHz also. The phase detector compares the phase of these two signals and produces the VCO frequency by loading a new value for the main counter ratio. The reference counter value is always the same.

For receive operation, the VCO is set to 39.8 MHz above or below the desired receive frequency. The above or below choice is made so that the VCO will always be inside the 2400-2483.5 MHz frequency band.

During transmit, the VCO is set to the desired frequency. In addition, the 21.8 MHz reference oscillator is shifted downward a small amount, about 360 Hz, by keyer transistor Q8, to transmit the data. When multiplied by the PLL, this shift amounts to 40 kHz at the output frequency.

3.6 Description of Microcontroller

The uC IC U4 interfaces the RDL to its host, either the MRI or PMC. It acquires the channel frequency and serves as the data modem. It sets the PLL frequency and issues transmit and receive commands.

4.0 CD Changer

4.1 Introduction

This theory of operation describes the circuitry related to the CD changer used in the LS40/50. It mostly covers the circuit found on the schematic diagram 190705, but also discusses half of the schematic diagram 188905 (Multi-Room Interface).

The CD changer board used in the LS40/50 system includes a power regulating circuit and simple interface circuits. Unregulated power from the Multi-Room Interface is regulated to 12.0 volts for consumption by the CD changer mechanism. The changer board provides a means of turning the power on or off, enabling or disabling the CD mechanism and powering the LED. Audio signals from the CD mechanism are passed to the Multi-Room Interface where a differential amp helps reduce the level of hum present in the audio.

4.2 Power Regulator

The power regulator takes unregulated power delivered from the Multi-Room Interface (RAWPOWER) and regulates it to 12.0 volts. RAWPOWER is a DC voltage with a 120 Hz ripple component. The DC level of RAWPOWER can vary from 19.5 volts at very high AC conditions, to less than 12.0 volts for very low AC line, heavy load conditions.

The core of the regulator is composed of six (6) components: R1, D5, Q4, Q3, D6 and R4. R1 feeds current from RAWPOWER to D5 which maintains 5.1 volts at the node, +VREF. +VREF serves as the reference voltage for a feedback loop involving Q4, Q3, D6 and R4. Q4 compares the voltage at its base (+VREF) and the voltage at its emitter and creates a collector current that is proportional to the difference (in the small-signal sense). That current is pulled from the base of Q3, and gets multiplied by Beta to produce the Q3 collector current. This current drives the load to create CD_VCC, the regulated supply voltage, D6 drops 7.5 volts from CD_VCC to set the voltage at the emitter of Q4. R4 supplies the bias current necessary to keep the components linear.

Several extra components are used to turn the regulator on or off. The CD_ENABLE signal is sent from the Multi-Room Interface. It is filtered by R5 and C16 to drive Q2, which is used as a digital switch. When Q2 is on, the base of Q1 is pulled low, which turns Q1 off and allows the regulator to function normally. Otherwise, R17 turns Q1 on, which forces +VREF to ground, turning the regulator off. Q6 is included to softly clamp CD_VCC to ground. R2 limits the base current to Q6, and R3 limits the power dissipation when the regulator is turned off.

A few other components are used for robustness and performance considerations. C7, C8, C9, and C26 are filtering components. C27 is used to guarantee high frequency stability of the feedback loop. R27 keeps Q3 from being turned on by stray fields when the regulator is off.

THEORY OF OPERATION

4.3 Audio Path

The audio path on the CD changer board is very simple, but it has some important features. It is important to understand that the series impedance from the output of the audio sources in the CD mechanism to the diff-amp must be well matched between the audio lines and the reference line. C14 and R20 compensate for the output impedance of the CD mechanism and match the reference line to the signal lines.

The filtering components, C10, C11, C12, C2 and C3 help provide immunity from RF interference. They also help protect against ESD.

4.4 LED

Like CD_ENABLE, the LED_ENABLE signal is driven by the Multi-Room Interface. It has two functions. first, it directly drives the enable line to the CD mechanism. Second, it drives Q5 through R15 which turns on the LED (as long as the regulator is on). R6 limits the LED current.

4.5 Differential Amplifier

The differential amplifier is located in the Multi-Room Interface (MRI). Its purpose is to attenuate the hum that exists on the audio signal due to ground currents between the MRI and the CD mechanism. It also amplifies the audio signal by about 10 dB.

The MRI side audio reference is CREF which is generated by the volume control ICs. The audio and reference signals enter the board through J107 and all encounter identical impedances necessary to provide good common mode rejection. C141, C241 and C142 AC couple the differential amplifier to the outside world. R127, R226 and R145 loosely bias the lines to avoid popping when the CD mechanism mutes. C124 and C221 are ESD protection devices. The amplifiers themselves are used in a standard differential amplifier configuration, and use high tolerance in order to maximize common-mode rejection.

4.6 CD Cable

The cable itself (part number 191491) is an important part of the design. Its characteristics help minimize the amount of hum that is present on the audio signals. Important features are the gauge of the wire used, shielding, and the relative orientation of the individual wires.

PMC DISASSEMBLY/ASSEMBLY PROCEDURES

Personal® Music center (PMC)

Note: Refer to figures 1 and 2 for the following procedures.

1. Bottom cover Removal

1.1 Place the Personal® Music Center upside down on a clean soft surface.

1.2 Remove the battery cover (6) and the batteries from the rear of the unit.

1.3 Remove the nine screws (7) from the bottom cover (8). Two of the nine screws are in the battery area.

1.4 Lift the bottom cover (8) starting from the front and working towards the back.

1.5 Unplug the two cables (4) and (5) from the PCB (12) and place the cover to one side.

2. Bottom Cover Replacement

2.1 Align the bottom cover (8) on the top of the unit and plug the cables (4) and (5) into the connectors on the main PCB (12).

2.2 Place the bottom cover (8) on to the unit and secure it using nine screws (7).

2.3 Replace the batteries and battery cover (6).

3. Radio Data Link PCB Removal

3.1 Perform procedure 1.

3.2 Remove the screw (11) securing the RDL PCB (10) to the bottom cover (8).

3.3 Unclip the RDL PCB from the two small clips and slide the PCB out of the slots.

4. Radio data Link PCB Replacement

4.1 Place the RDL PCB (component side down) into the slots on the bottom cover (8) and secure it into place with the clips. Replace the screw (11).

4.2 Align the RDL PCB cable (4) so that it sits flat and is secured in its slot.

4.3 Perform procedure 2.

5. Main PCB Removal

5.1 Perform procedure 1.

5.2 Unplug the small connector on the side of the main PCB (12).

5.3 Lift the main PCB (12) out of the front display cover (2).

Note: Take care not to drop or scratch the display mounted on the other side of the main PCB.

6. Main PCB Replacement

6.1 Place the main PCB (12) onto the front cover (2) and connect the small cable from the touchscreen (3).

6.2 Perform procedure 2.

7. Display Removal

7.1 Perform procedure 5.

7.2 Place the main PCB (12) display side down onto a clean soft surface.

7.3 Straighten the 12 clips holding the display frame (13) to the main PCB.

7.4 Lift the main PCB (12) up and away from the display (13).

PMC DISASSEMBLY/ASSEMBLY PROCEDURES

8. Display Replacement

81 Place the main PCB (12) onto the display assembly (13).

Note: There are two very small bumps on one side of the display. This would be the right side of the display as the main PCB is being placed on top, with the BOSE® logo right side up.

8.2 Secure the main PCB (12) to the display by bending the 12 clips from the display frame.

8.3 Perform procedure 6.

9. Touchscreen Removal

9.1 Perform procedure

9.2 Remove the touchscreen (3) from the front cover (2).

10. Touchscreen Replacement

10.1 Place the touchscreen (3) onto the front cover (2).

Note: There is a cutout for the cable of the touchscreen in the top cover.

10.2 Perform procedure 6.

MRI DISASSEMBLY/ASSEMBLY PROCEDURES

Multi-Room Interface (MRI)

Note: Refer to figure 3 for the following procedures.

1. Top Cover Removal

1.1 Place the unit upside down and remove the two screws (1) securing the top cover to the unit.

1.2 Turn the unit over and remove the top cover (5).

Note: The wire dressing of the RDL harness is very critical for transmitting the Radio Data to the PMC controller.

2. Top Cover Replacement

2.1 Place the top cover (5) onto the unit. Make sure the cable is folded neatly and not pinched.

2.2 Secure the top cover (5) to the unit using the two screws (1).

3. Tuner and Control PCB Removal

3.1 Perform procedure 1.

3.2 Lift the Tuner PCB (7) (top PCB) up slightly and remove from the unit.

3.3 Release the control PCB (7) (bottom PCB) from the two clips that secure it in place.

3.4 Slide the PCB assembly out of the bottom cover.

4. Tuner and Control PCB Replacement

4.1 Place the control PCB (7) into the bottom cover (2) and clip it into place.

4.2 Place the tuner PCB (7) into the bottom cover (2) and align it onto the location pins.

4.3 Perform procedure 2.

5. Radio Data Link (RDL) PCB Removal

5.1 Perform procedure 1.

5.2 Remove the one screw (3) securing the RDL PCB (4) to the top cover (5).

5.3 Remove the cable (6) from the PCB.

6. Radio Data Link PCB Replacement

6.1 Connect the cable (6) to the RDL PCB (4).

6.2 Secure the RDL PCB (4) to the top cover (5).

6.3 Perform procedure 2.

DISASSEMBLY/ASSEMBLY PROCEDURES

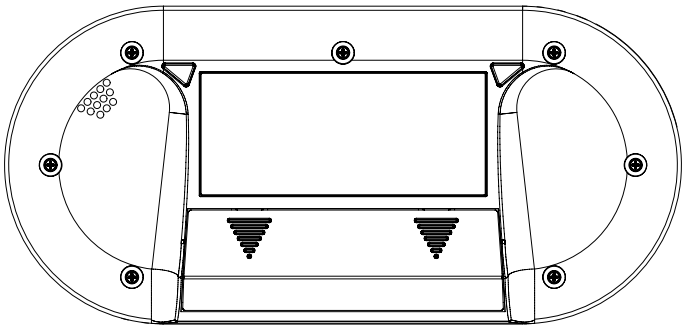


Figure 1. Screw Location

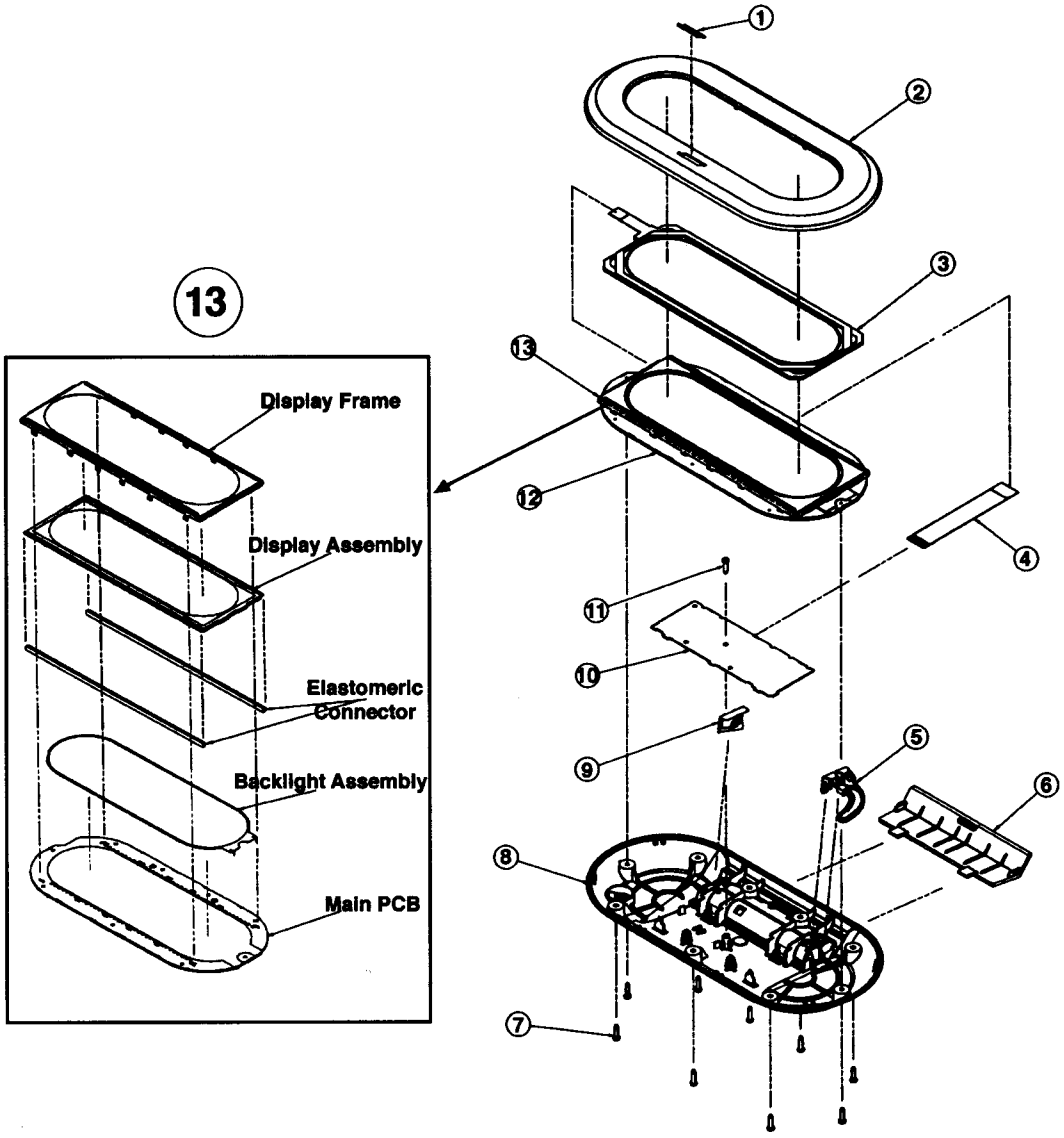


Figure 2. Personal® Music Center Assembly

DISASSEMBLY/ASSEMBLY PROCEDURES

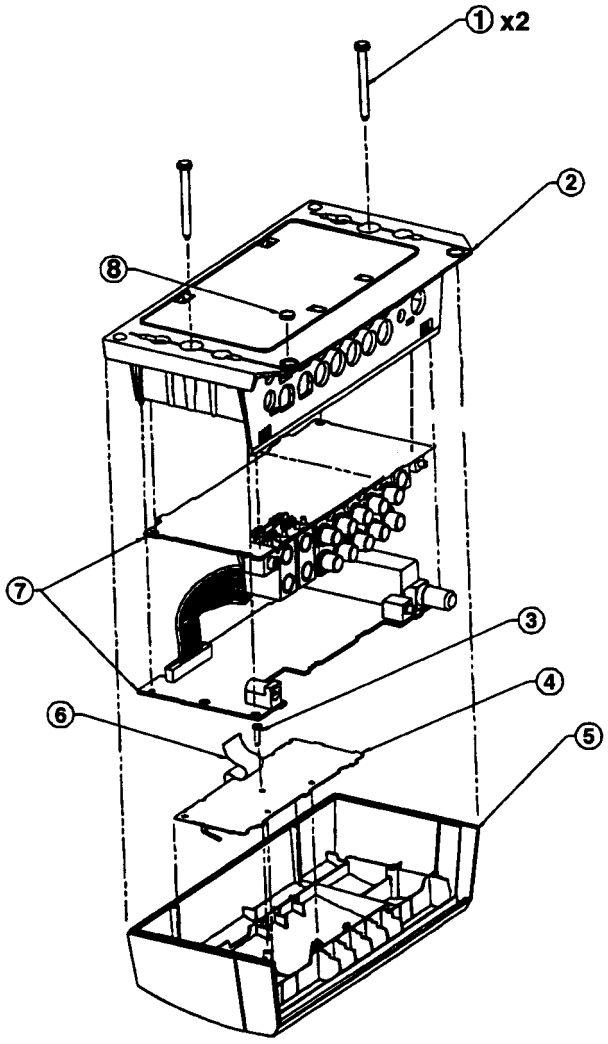


Figure 3. Multi-Room Interface Assembly

TEST PROCEDURE SET-UP

AM/FM Test Procedure Set-Up

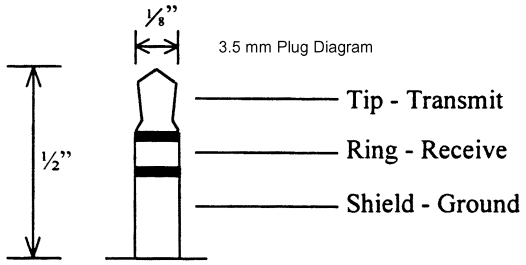
It will be necessary to use the serial data jack located on the back of the Multi-Room Interface for some of the AM and FM tests listed in the test procedures.

The serial data port is located on the back of the multi-Room Interface. It is designed to offer control of the Lifestyle® system, for test purposes and for third-party add-ons. The serial protocol is standard asynchronous with start and stop bits. Standard ASCII is used to convey information. The technical specifications are as follows:

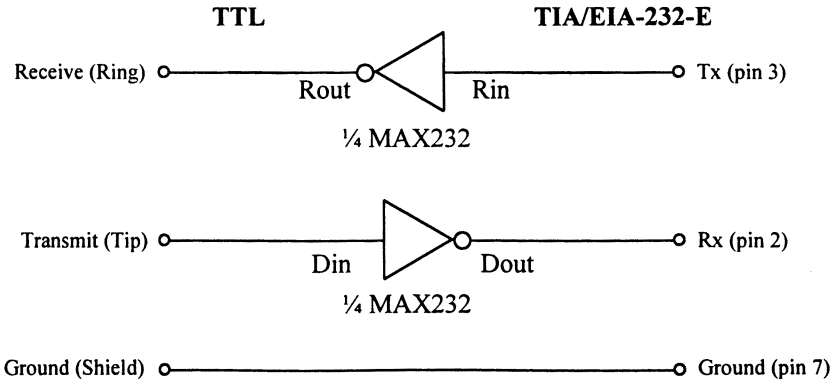
Protocol:	Standard Asynchronous Serial
Directionality:	Half Duplex
Bit Rate (Baud):	4800
Data Bits:	8
Stop Bits:	1
Parity:	None
Logic Levels:	TTL
Logic 1 (Mark):	3.75 V min.,5 V max.
Logic 0 (Space):	0 V min., 0.8 V max.

It is not possible to communicate directly with the Multi-Room Interface using TIA/EIA-232-E (RS232) levels. You will need to purchase or build a circuit that converts between TTL and RS232. One such product is the RS232-to-TTL converter (Model 232TTL) by B&B Electronics. A chip that performs this function is the MAX232 or equivalent, available from numerous chip makers.

The serial connector accommodates a male three-conductor 1/8" phone plug. The arrangement of the plug is as follows:



The transmit signal is for data originating at the Multi-Room Interface, to be received by the connected device. The receive signal is for data originating at the connected device, to be received by the Multi-Room Interface. The circuit for connection to a standard TIA/EIA-232-E connector is as follows:



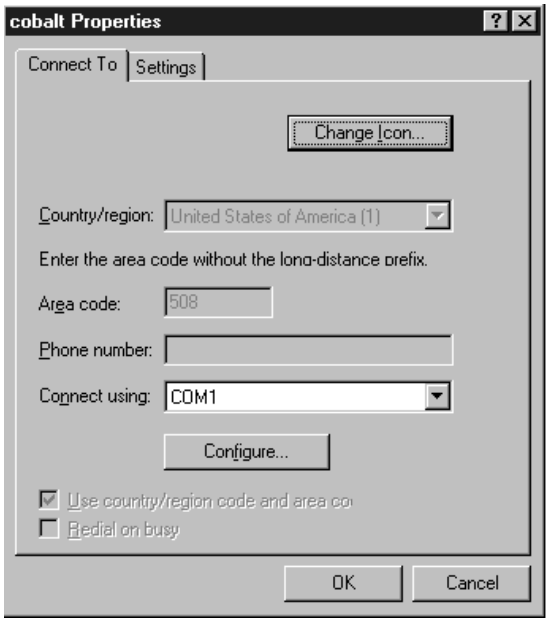
TEST PROCEDURE SET-UP

Computer Setup Procedure

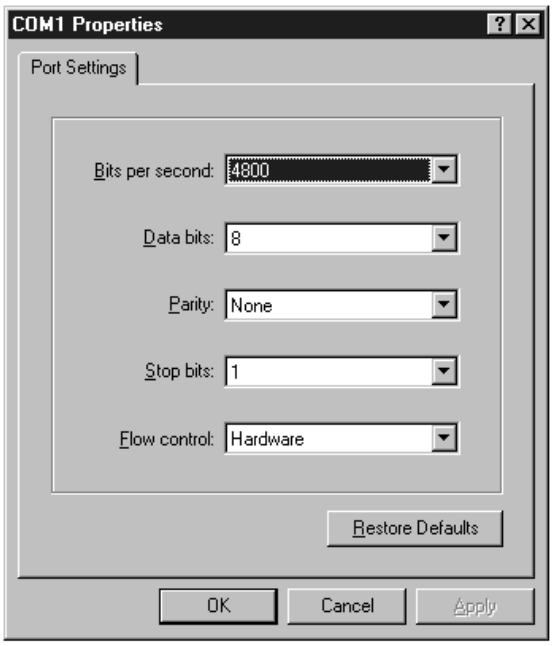
Use this procedure to configure your IBM compatible PC for communication with the Multi-Room Interface.

1. Open a terminal window, as shown at right, in either Terminal or Hyperterm, as applicable for the version of Microsoft® Windows® you are using on your PC.

2. In the terminal window, click on the file, then Properties. Set the Test Properties in the dialog box as shown at right.



3. In the Test Properties dialog box shown in step 2, click on Configure to see the COM1 Properties as shown at right. Click OK to return to the Test Properties dialog box.

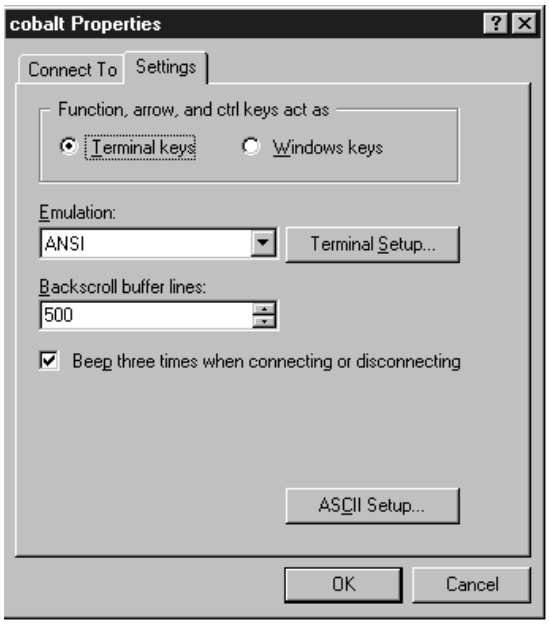


See the next page for conclusion of this procedure.

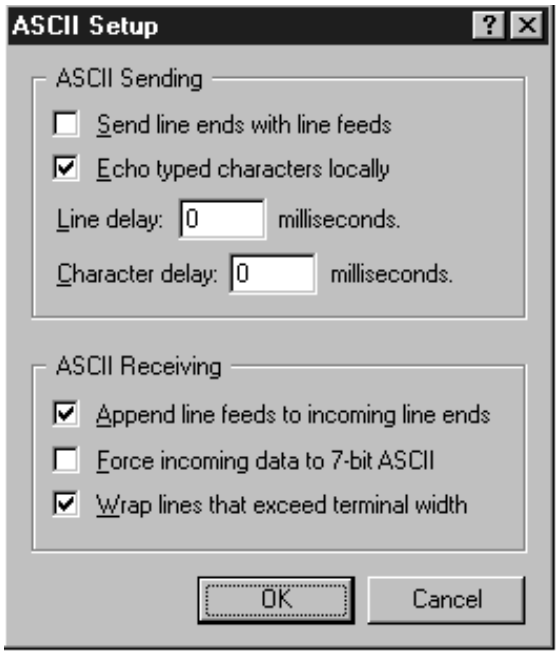
TEST PROCEDURE SET-UP

Computer Setup Procedure (continued)

4. In the Test Properties dialog box, click on the Settings tab and set the controls as shown in the example at right.
Note: Be sure to check “Beep three times when connected or disconnected”.



5. In the Test Properties dialog box under the Settings tab, click on ASCII Setup button and set the controls to look like the dialog box at right. Click OK to return to the Test Properties dialog box.

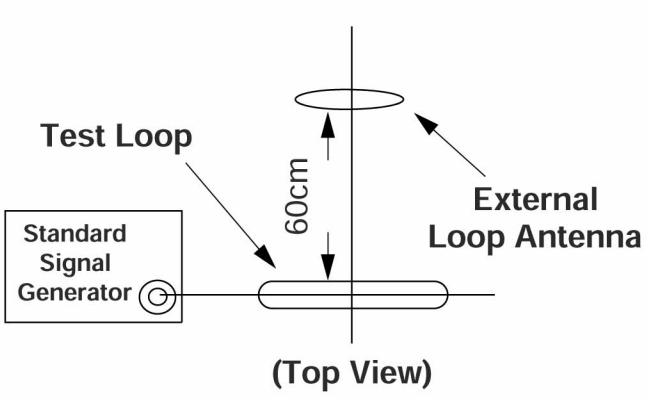


6. Once you have made all of the settings in the test properties dialog box, click OK to close it. You have now configured your PC to communicate with the Multi-Room Interface. To connect to the Multi-Room Interface under test, in the terminal window, click on Call, then Connect, and listen for 3 beeps. This will tell you that the PC is connected to communicate with the MRI.

TEST PROCEDURE SET-UP

General Test Setup for AM Testing

The figure below is a diagram of the AM antenna setup. The antenna that plugs into the MRI is a Bose® antenna, part number 199837-002, and must be used. This should be placed approximately 18 inches from the MRI and the AM loop antenna should be placed approximately 60cm (23.6 in) from the AM antenna.



AM Loop Antenna Setup

Required Equipment for the Preferred Test Setup for AM and FM Testing

The following items are needed for testing the AM and FM sections to factory specifications.

1. A computer with a serial data port access and a terminal emulator program such as hyperterm or kermit running on Windows 3.2, 95, or 98.

2. An RS232/TTL converter (with power supply) available from B+B Electronics.

3. A connection cable, Bose part number 254858, for the RS232 to the serial data port connection.

4. A cable with a 25 pin d-sub connector to a 3.5mm mini jack for the serial data on the back of the MRI.

5. AM/FM signal generator, dB meter, AC meter, and Oscilloscope.

MRI TEST PROCEDURES

Multi-Room Interface

Note: Use cable part number 198677 for testing the room outputs A through D. Room A must have a cable connected for the B through D outputs to function. At least two cables are required for the following tests.

1. Source Select Test

1.1 Apply a 1 kHz, 1 Vrms signal to the Video 1 inputs.

1.2 Set the volume level at the controller to maximum (100 on the display). Reference a dB meter to the input level.

1.3 Connect a dB meter to the room A, B, C, D and tape outputs. The reading should be between -1.5 dB to +1.0 dB.

1.4 Change the input to each of the following; Video 2, Aux and Tape. Perform procedure 1.3.

1.5 Apply a .331 Vrms, 1 kHz signal to the CD input. Reference a dB meter to the input level.

1.6 Perform procedures 1.2 to 1.3.

2. Volume Control Test

2.1 Apply a 1 kHz, 1 Vrms signal to the Tape inputs.

2.2 Set the volume level at the controller to maximum (100 on the display). Reference a dB meter to the output of room A.

2.3 Set the volume level to -47 dB (53 on the controller's display).

2.4 Measure the output level at room A and C. The reading should be <-44.4 dB and >-50.3 dB.

2.5 Repeat procedures 2.1 through 2.4 for the other room outputs (B-D). Switch the input between the Tape and Aux for each of the outputs being tested.

3. Volume Mute Test

3.1 Apply a 1 kHz, 1 Vrms signal to the Tape inputs.

3.2 Set the volume level at the controller to maximum (100 on the display). Reference a dB meter to the inputs.

3.3 Select the mute button on the controller.

3.4 Measure the output level at room A. The reading should be <90 dB.

3.5 Repeat procedures 3.1 though 3.4 for the other room outputs (B-D). Switch the input between the tape and Aux for each of the outputs being tested.

4. Distortion test

4.1 Apply a 1 kHz, 1 Vrms signal to the Video 1 inputs.

4.2 Set the volume level at the controller to maximum (100 on the display).

4.3 Measure the distortion at room A through D. The reading should be $\leq$ 0.05% THD+N.

5. Noise Test

5.1 Short all inputs to ground.

5.2 Measure the unweighted RMS noise level at each output. The reading should be $\leq$ 40 uVrms.

MRI TEST PROCEDURES

Multi-Room Interface

Note: The following tests can be performed without the use of a computer. For the complete AM and FM alignment tests, with the use of an IBM compatible computer, refer to the Computer Assisted Test Procedures.

Note: For all AM alignment and tests, plug the AM antenna, part number 199837-002, into the Multi-Room Interface and position it at least 18 inches away from the MRI. Configure a standard AM test antenna and RF signal source to create the specified field strength for each test. Set the AM modulation to 30% with a 1 kHz signal. Refer to the AM Setup procedure on page 31.

Note: The following tests are performed using the Personal™ Music center to tune the Multi-Room Interface.

6. AM RF Tracking

6.1 Inject an RF signal set to 1500 kHz, at a level of 74 dBuVemf.

6.2 Connect an AC meter to the tape output jacks.

6.3 Tune the MRI to 1500 kHz and adjust the red slug (T300) for maximum level. Verify that the level is greater than 108 mVrms.

6.4 Tune the generator and the MRI to 600 kHz. Adjust the black slug (T300) for maximum level. Verify that the level is greater than 108 mVrms.

6.5 Repeat steps 6.3 and 6.4 until maximum output is obtained.

7. AM Sensitivity

7.1 Inject an RF signal set to 1080 kHz, at a level of 79 dBuVemf.

7.2 Tune the MRI to 1080 kHz.

7.3 Connect a dB meter to the tape output jacks and reference it to this point.

7.4 Remove the AM modulation and measure the tape output. The reading should be ≤ 20 dB.

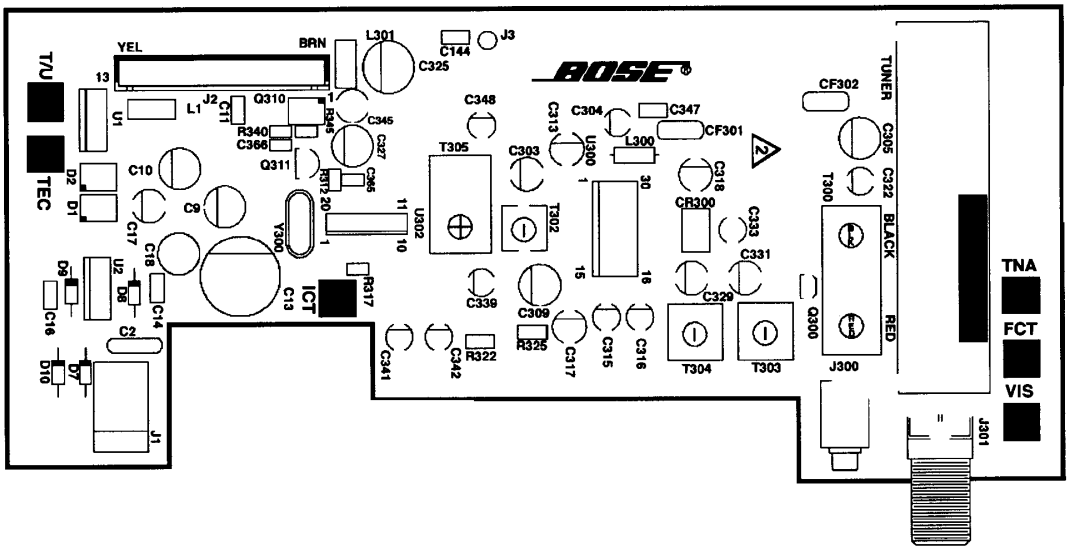


Figure 4. Tuner Adjustment Location

Note: Unless otherwise noted, set the RF generator for 1 kHz, mono modulation, pilot off and 75 kHz deviation.

9. FM Distortion Adjustment

9.1 Inject an RF signal set to 98.1 MHz, 1 kHz tone, at a level of 46 dBuV emf.

9.2 Tune the Personal® Music center to 98.1 MHz.

9.3 Measure the distortion plus noise (THD+N) at the room A output. If it is less than or equal to 0.50%, verify that the audio level is greater the 580 mV. If these are not the measurements you have, proceed to step 9.4.

9.4 If the THD+N is greater than 0.55%, or the audio level is less than 580mV, adjust T302 for minimum distortion. Verify that the level is greater than 580 mV and the distortion is less than 0.55%.

10. FM Sensitivity

10.1 Inject an RF signal set to 98.1 MHz, 1 kHz tone, at a level of 11 dBuVemf (19 dBuVemf for Euro and Japan).

10.2 Measure the THD+N. It should be less than or equal to 3%.

11. FM Stereo Separation

11.1 Inject an RF signal set to 98.1 MHz, 1 kHz tone, at a level of 59 dBuVemf into the left channel only.

11.2 Reference a dB meter to the output.

11.3 Switch the RF signal input to the right channel.

11.4 Measure the left channel output. It should read $\leq$-25 dB.

MRI TEST PROCEDURES

Multi-Room Interface Computer Test Procedures

Note: Refer to the computer setup instructions on pages 30 through 32 for proper connection to an IBM compatible computer. Also refer to the AM antenna setup procedure on page 33 to achieve the proper field strength.

Note: Some of the commands will automatically set the calibration, requiring only an external RF signal at the input of the tuner. Other commands require the technician to make measurements and adjustments.

1. AM Alignment

1.1 Inject an RF signal set to 600 kHz, at a level of 73 dBuVemf.

1.2 Enter the command T0 into the computer. This will tune the Multi-Room Interface to 600 kHz regardless of the tuner's current state.

1.3 You should receive an OK response on the computer's screen.

Note: If you receive an error response on the computer screen, enter the TF command. This will enable the calibration mode.

1.4 Adjust the black slug of T300 for maximum output. Verify that the level is greater than 108 mVrms.

1.5 Inject an RF signal set to 1500 kHz, at a level of 73 dBuVemf.

1.6 Enter the command T1 into the computer. This will tune the Multi-Room Interface to 1500 kHz regardless of the tuner's current state.

1.7 You should receive an OK response on the computer's screen.

1.8 Adjust the red slug of T300 for maximum output. Verify that the level is greater than 108 mVrms.

1.9 Repeat the AM alignment test until maximum level is obtained.

2. AM Stop Level

2.1 Inject an RF signal set to 1080 kHz, at a level of 75 dBuVemf.

2.2 Enter the command T2 into the computer. This will tune the Multi-Room Interface to 1080 kHz regardless of the tuner's current state. The tuner then averages four signal readings to determine the AM stop level, and store it in the EEPROM.

2.3 You should have a stored level response on the computer screen similar to the following: Stored Level xx (where xx is the stored level).

3. FM Stop Level (U.S. and Euro)

3.1 Inject an RF signal set to 98.1 MHz, at a level of 24 dBuVemf.

3.2 Enter the command T3 into the computer. This will tune the Multi-Room Interface to 98.1 MHz regardless of the tuner's current state. The tuner then averages four signal readings to determine the FM stop level, and stores it in EEPROM.

3.3 You should have a stored level response on the computer screen similar to the following: Stored Level xx (where xx is the stored level).

4. FM Stop Level (Japan)

4.1 Inject an RF signal set to 83.0 MHz, at a level of 24 dBuVemf.

4.2 Enter the command T4 into the computer. This will tune the Multi-Room Interface to 83.0 MHz regardless of the tuner's current state. The tuner then averages four signal readings to determine the FM stop level, and stores it in the EEPROM.

4.3 You should have a stored level response on the computer screen similar to the following: Stored Level xx (where xx is the stored level).

5. FM Stereo Threshold (U.S. and Euro)

5.1 Inject an RF signal set to 98.1 MHz, at a level of 34 dBuVemf.

5.2 Enter the command T5 into the computer. This will tune the Multi-Room Interface to 98.1 MHz regardless of the tuner's current state. The tuner then averages four signal readings to determine the FM stereo threshold level, and stores it in the EEPROM.

5.3 You should have a stored level response on the computer screen similar to the following: Stored Level xx (where xx is the stored level).

6. FM Stereo Threshold (Japan)

6.1 Inject an RF signal set to 83.0 MHz, at a level of 34 dBuVemf.

6.2 Enter the command T6 into the computer. This will tune the Multi-Room Interface to 83.0 MHz regardless of the tuner's current state. The tuner then averages four signal readings to determine the FM stereo threshold level, and stores it in the EEPROM.

7. FM IF Centering (U.S. and Euro)

7.1 Inject an RF signal set to 98.1 MHz, at a level of 44 dBuVemf.

7.2 Enter the command T7 into the computer. This will tune the Multi-Room Interface to 98.1 MHz regardless of the tuner's current state. The tuner then performs an algorithum that determines the optimum offset for the IF strip to account for filter variances. This offset is then stored in the EEPROM.

7.3 You should have an offset response on the computer screen similar to the following: Offset xx (where xx is the offset).

8. FM IF Centering (Japan)

8.1 Inject an RF signal set to 83.0 MHz, at a level of 44 dBuVemf.

8.2 Enter the command T8 into the computer. This will tune the Multi-Room Interface to 83.0 MHz regardless of the tuner's current state. The tuner then performs an algorithm that determines the optimum offset for the IF strip to account for filter variances. This offset is then stored in the EEPROM.

8.3 You should have an offset response on the computer screen similar to the following: Offset xx (where xx is the offset).

PMC TEST PROCEDURES

Personal® Music center

Note: Refer to figures 5, 6 and 7 for the following procedures. The following calibration tests can be performed with or without the Multi-Room Interface.

1. Touchscreen Calibration Procedure

1.1 Press the top center region of the display for approximately 5 seconds. The word “CAL” will be displayed in the center of the upper left section of the display.

1.2 Press the source button, displayed in the upper left section of the display,as close to the center of the word “source” as possible. The word “KEYPAD” will be displayed in the upper right section of the display.

1.3 Press the “KEYPAD” button displayed in the upper right section of the display as close to the center as possible. A circle will be displayed in the lower right section of the display.

1.4 Press the circle, displayed in the lower right section of the display as close to the center as possible. This completes the touchscreen calibration procedure.

2. Backlight Test Procedure

2.1 Place the Personal® Music Center into a dimly lit room or box.

2.2 Press anywhere on the display to turn the screen on.

2.3 Verify that the display has good contrast, is free of cosmetic defects and has no regions that are significantly brighter or dimmer than other regions.

3. Buzzer Test Procedure

3.1 Press anywhere on the display to turn the Personal® Music Center on.

3.2 Press the buttons that are displayed and verify that a buzzer can be heard.

4. Communication Test Procedure

Note: The following tests are to be performed with a Multi-Room Interface for communication with the Personal® Music Center.

4.1 Connect the power to the Multi-Room Interface unit.

4.2 Connect a cable to the Room A output. A Bose® cable, part number 198677, or 198678 can be used for this connection.

4.3 Press the display on the Personal® Music Center. Verify that the display turns on with the source buttons displayed on the left hand side of the display. If no response is displayed go to procedure 4.4.

4.4 If no response is displayed, verify that the Multi-Room Interface has power connected to it.

4.5 Hold the Personal® Music Center as close to the Multi-Room Interface as possible.

4.6 Press the display on the Personal® Music Center and hold the mute button down until you hear a beep. The communication should be re-established with in approximately 10 seconds.

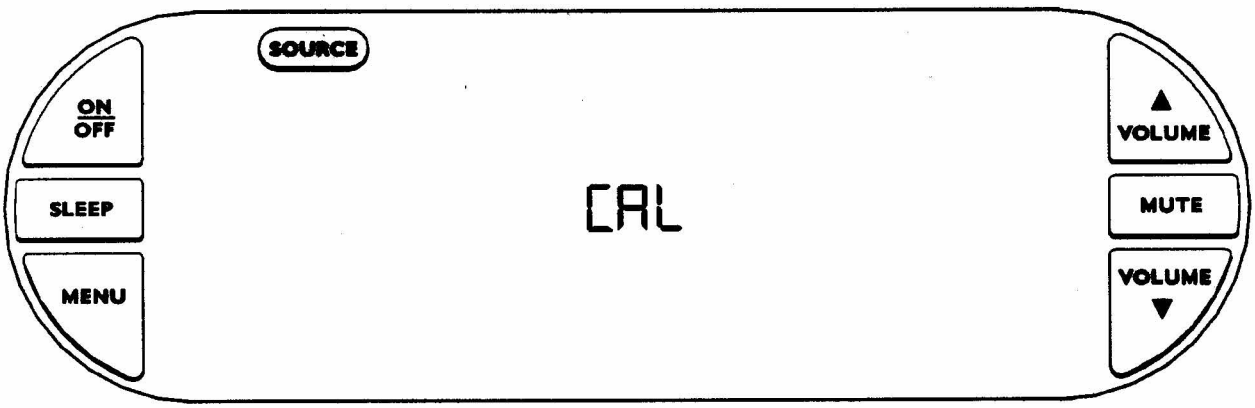


Figure 5. First Calibration Screen

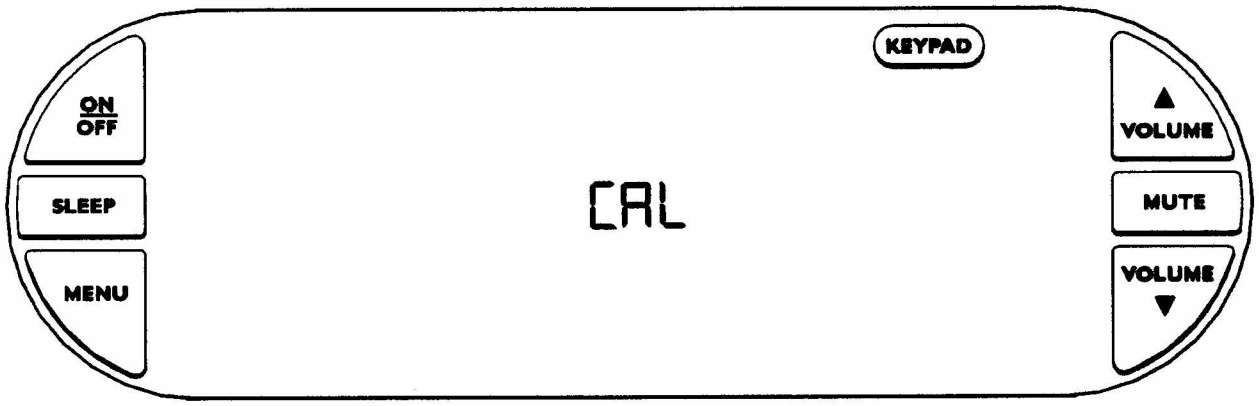


Figure 6. Second Calibration Screen

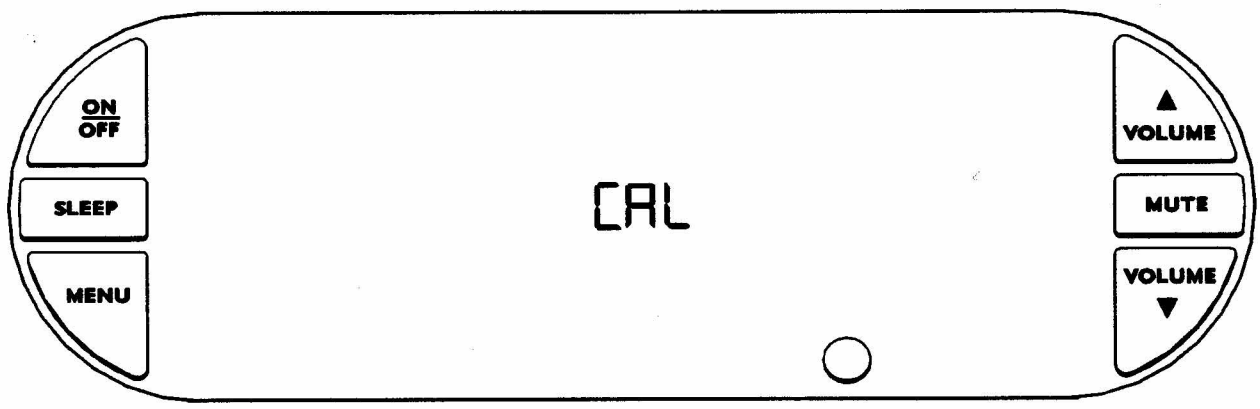


Figure 7. Third Calibration Screen

PMC TEST PROCEDURES

Personal® Music center

5. Beep Level Adjustment Test

5.1 Press and hold the source button on the display until the word “Lcd” appears.

5.2 Using the upper arrows (on the left or right of the word Lcd) press one of the arrows until the word “Beep” appears.

5.3 Using the lower arrows, press one of the arrows and verify that Lo, Hi and -- (off) is displayed between the arrows and the volume level of the beeping changes.

5.4 Press the done button to exit the test.

6. Backlight Adjustment Test

6.1 Press and hold the source button on the display until the word “Lcd” appears.

6.2 Using the lower arrows on the display, adjust the contrast level from -19 to 19. Zero would be the center or default setting.

6.3 Verify the contrast does visually change. Use a dimly lit room or hold the Personal Music Center inside a box while performing this test.

7. Display Stay Test

7.1 Press and hold the source button on the display until the word ”Lcd” appears.

7.2 Press the upper arrows (on the left and right of the word “Lcd”) until the word “Stay” appears.

7.3 Press the lower arrows to change the setting from “y” to “n” while the word “source” is displayed in the upper left section of the display.

7.4 Press the upper arrows to change the source button to the keypad button which is displayed on the upper right section of the display.

7.5 Press the lower arrows to change the setting from “y” to “n” while the word source is displayed in the upper left section of the display.

7.6 Press the done button to exit the test.

PART LIST NOTES

1. This part is not normally available from Customer Service. Approval from the Field Service Manager is required before ordering.

2. The individual parts located on the PCBs are listed in the Electrical Parts List.

3.  This part is critical for safety purposes. Failure to use a substitute replacement with the same safety characteristics as the recommended replacement part might create shock, fire and or other hazards.

PERSONAL® MUSIC CENTER MAIN PART LIST

Item Number	Description	Part Number	Qty.	Note
1	NAME PLATE	195353	1	
2	COVER, CONTROLLER, BLACK	188913-001	1	
3	TOUCHSCREEN ASSY MUSIC CENTER	188902	1	
4	CABLE, FLEX, 14 COND, 85MM	189979-085	1	
5	CABLE ASSY, BATTERY, CNTRLR	188918-001	1	
6	DOOR, BATTERY, BLACK	189972-002	1	
7	SCREW, PLT, #2-28 x 3/8, PAN, XREC	191444-06	9	
8	BASE, CONTROLLER	188912-002	1	
9	CONTACT, BATTERY, DOUBLE	188917	1	
10	PCB ASSY, RDL, U.S. PCB ASSY, RDL, EURO PCB ASSY, RDL, AUS.	189951-001 189951-002 189951-005	1	1
11	SCREW, PLT, #2-28 x 3/8, PAN, XREC	191444-06	1	
12	PCB ASSY, CONTROLLER, U.S. PCB ASSY, CONTROLLER, EURO	188908-001 260289-002	1	1
13	FRAME, DISPLAY, CONTROLLER	188914	1	
14	LIQUID CRYSTAL DISPLAY, MUSIC CENTER LIQUID CRYSTAL DISPLAY, MEDIA CENTER	188901-001 258619	1	
15	CONN, ELASTOMERIC CONTROLLER	188910	2	
16	BACKLIGHT, DISPLAY	191500	1	
---	SOUNDER, PIEZOELECTRIC	189973	1	
---	FOOT, RUBBER	191445	2	

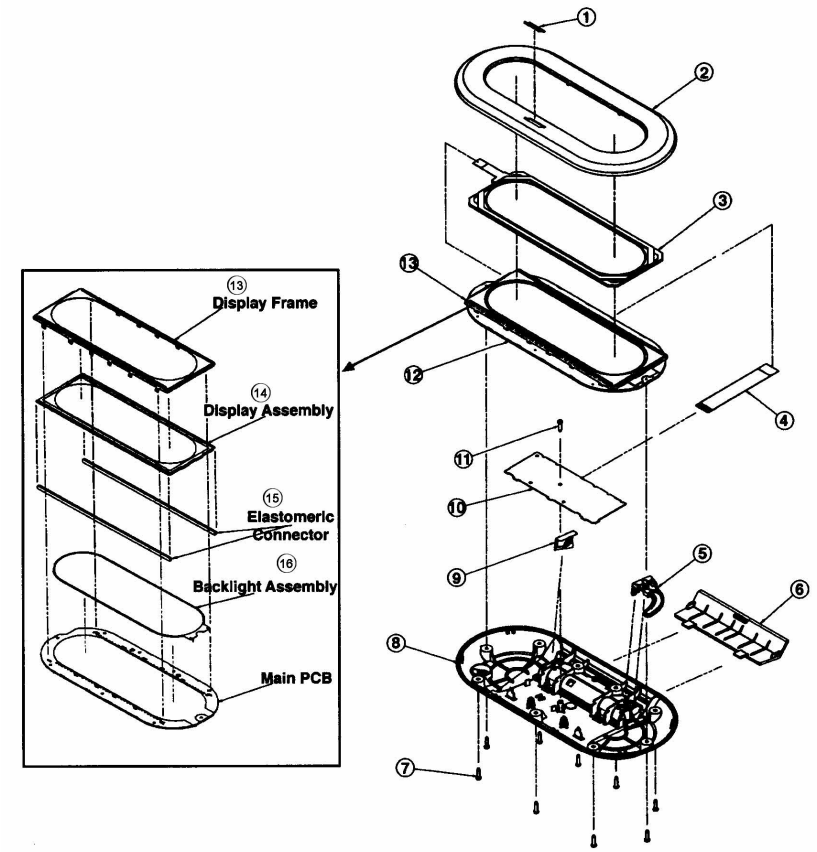


Figure 8. Personal® Music Center Exploded View

MULTI-ROOM INTERFACE MAIN PART LIST

Item Number	Description	Part Number	Qty.	Note
1	SCREW, TAPP, 6-13 x 1.5, PAN, XRCSQ	172783-24	2	
2	BASE, TUNER	189952-001	1	
3	SCREW, PLT, #2-28 x 3/8, PAN, XREC	191444-06	1	
4	PCB ASSY, RDL, RANGE EXT, AUS PCB ASSY, RDL, RANGE EXT, EUR	189951-005 189951-002	1	1
5	COVER, MRI COVER, MRI, EXT RANGE	189953-001 259813-001	1	
6	CABLE, FLEX, 14 COND, SHIELDED	199405-140	1	
7	PCB ASSY, MRI, U.S. PCB ASSY, MRI, EURO	188928-001 260298-002	1	1
8	FOOT, RUBBER	188462-001	2	
---	LABEL, I/O, MRI	190703-001	1	

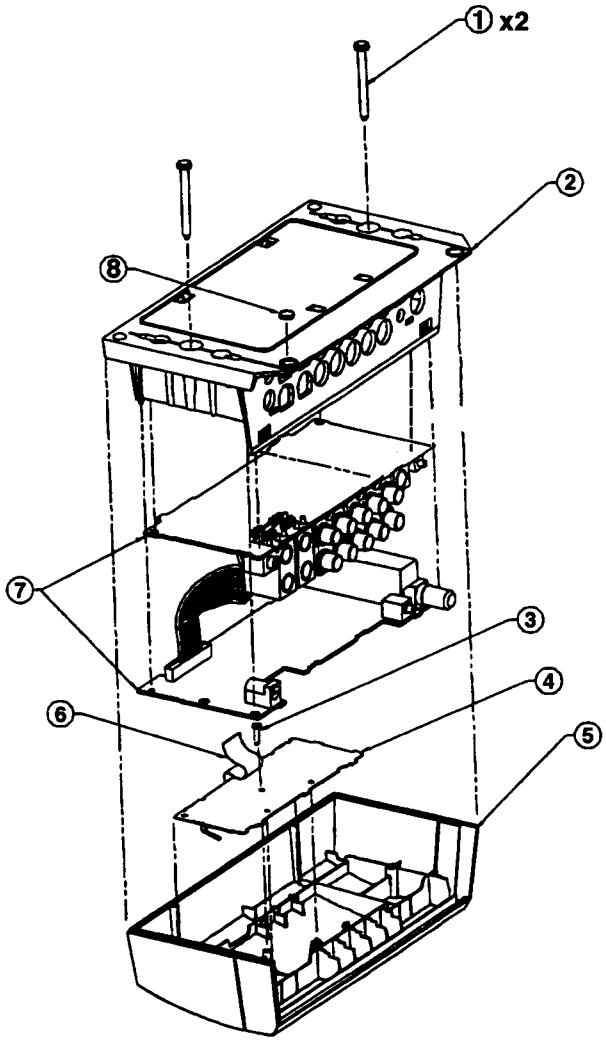


Figure 9. Multi Room Interface Exploded View

ELECTRICAL PART LIST

Personal® Music Center

Resistors

Reference Designator	Description	Part Number	Note
R1	14K CHIP, 0603, 1/10W, 1%	191465-1402	
R2	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R3	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R5	470K, CHIP, 0805, 1/10W, 5%	133626-4745	
R6	470K, CHIP, 0805, 1/10W, 5%	133626-4745	
R7	4.7K, CHIP, 0805, 1/10W, 5%	133626-4725	
R8	2.0K, 2512, 1W, 5%	181895-2001	
R9	2.00K, CHIP, 0805, 1/10W, 5%	133626-2025	
R10	5.1MEG, CHIP, 0805, 1/10W, 5%	133626-5155	
R11	4.7K, CHIP, 0805, 1/10W, 5%	133626-4725	
R12	4.7K, CHIP, 0805, 1/10W, 5%	133626-4725	
R13	470 OHM, CHIP, 0805, 1/10W, 5%	133626-4715	
R14	470 OHM, CHIP, 0805, 1/10W, 5%	133626-4715	
R15	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R16	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R17	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R29	14K, CHIP, 0603, 1/10W, 1%	191465-1402	
R30	470 OHM, CHIP, 0805, 1/10W, 5%	133626-4715	
R31	470 OHM, CHIP, 0805, 1/10W, 5%	133626-4715	
R32	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R33	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R34	470K, CHIP, 0805, 1/10W, 5%	133626-4745	
R35	470K, CHIP, 0805, 1/10W, 5%	133626-4745	
R36	1.00K, CHIP, 0805, 1/10W, 1%	133625-1001	
R37	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R38	470K, CHIP, 0805, 1/10W, 5%	133626-4745	
R39	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R40	4.7K, CHIP, 0603, .1W, 5%	199403-472	

Capacitors

Reference Designator	Description	Part Number	Note
C1	.047uF, 0603,X7R, 16V, 5%	258498-473	
C2	2.2uF, MONO, 1206, 16V, 80%	178212-225	
C3	.047uF, 0805, Z5U, 20%	148779-473	
C4	2.2uF, MONO, 1206, 16V,.80%	178212-225	
C5	1uF, 1206, Y5V, 16V, 80%	173383-105	
C8	.047uF, 0805, Z5U, 20%	148779-473	
C9	.047uF, 0805, Z5U, 20%	148779-473	
C10	4.7uF, TANT, 10V, 10%, A SIZE	196981-A475A1	
C12	.047uF, 0805, Z5U, 20%	148779-473	
C14	.047uF, 0805, Z5U, 20%	148779-473	
C15	.1uF-330uF, TANT, 2.5-50V	196981-E156C1	
C16	1000pF, 0805, COG, 50V, 5%	133622-102	
C17	1000pF, 0805, COG, 50V, 5%	133622-102	
C18	1000pF, 0805, COG, 50V, 5%	133622-102	
C19	1000pF, 0805, COG, 50V, 5%	133622-102	
C20	.047uF, 0805, Z5U, 20%	148779-473	

ELECTRICAL PART LIST

Personal® Music Center

Diodes

Reference Designator	Description	Part Number	Note
D1	VOLT REG, SHUNT, SOT-23	196982-C002	
D2	SHOTTKY, BAT42W, SOD-123	196984-002	
D3	BAV21W-7, FAST RECOVERY	191454-251	
D4	BAV99, SOT23	147239	
D7	BAV99, SOT23	147239	
D8	BAV99, SOT23	147239	
D9	SHOTTKY, BAT42W, SOD-123	196984-002	

Transistors

Reference Designator	Description	Part Number	Note
Q1	MMBT3906, PNP, SOT	148596	
Q2	POWER, MOSFET, SMT	191453	
Q3	MMBT3906, PNP,SOT,	148596	
Q4	MMBT3904, NPN,SOT,	146819	
Q5	MMBT3906, PNP,SOT,	148596	
Q6	BPLR, N, SMT, DPAK, 400V	196807-002	
Q8	MMBT3906, PNP, SOT	148596	
Q9	MMBT3904, NPN, SOT	146819	

Integrated Circuits

Reference Designator	Description	Part Number	Note
U1	uC, OTP, PROGRAMD, MUSIC CEN uC, OTP, PROGRAMD, MEDIA CEN	189966-004 260283-003	
U2	EEPROM , DIP-8/SO-8, 24CO2A	177982-2	
U3	ET, 3.0V, SOT23, CASE 1212	196983-23R0	
U4	OP AMP, CMOS, QUAD, 3V, SO14	199543	

Inductors

Reference Designator	Description	Part Number	Note
L2	2.2mH, SMT, HI-CURRENT	195343-222	
L3	15 nH, 1608, SMT	191488-150J	
L4	15 nH, 1608, SMT	191488-150J	
L5	15 nH, 1608, SMT	191488-150J	
L6	15 nH, 1608, SMT	191488-150J	

Crystals

Reference Designator	Description	Part Number	Note
X1	CER, W, INTGRTD, 5MHZ	191446-5R00	

Miscellaneous

Reference Designator	Description	Part Number	Note
J1	SMT, PCB, MALE, 2 POS.	188920-002	
J2	ZIF, 1MM, 14 POS, SMT	191479-14	
J3	ZIF, 1MM, 8 POS, SMT	191479-08	
SH1	SHIELD, EMI	195360	

ELECTRICAL PART LIST

Multi-Room Interface

Resistors

Reference Designator	Description	Part Number	Note
R1	5.36K, CHIP, 0805, 1/10W, 1%	133625-5361	
R2	8.45K OHM, 0805, 1/10W, 1%	133625-8451	
R3	130 OHM, 2512, 1/10W, 5%	181895-1300	
R4	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R5	100 OHM, 2512, 1W, 5%	181895-1000	
R6	470 OHM, 2010, 1/2W, 5%	187608-4715	
R100	1.00K, CHIP, 0805, 1/10W, 1%	133625-1001	
R101	1.00K, CHIP, 0805, 1/10W, 1%	133625-1001	
R102	1.00K, CHIP, 0805, 1/10W, 1%	133625-1001	
R103	1.00K, CHIP, 0805, 1/10W, 1%	133625-1001	
R104	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R105	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R106	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R108	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R109	150 OHM, CHIP, 0805, 1/10W, 1%	133625-1500	
R110	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R111	100K, CHIP, 0805, 1/10W, 5%	133626-1045	
R112	332 OHM, CHIP, 0805, 1/10W, 1%	133625-3320	
R113	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R114	2.00K, CHIP, 0805, 1/10W, 5%	133626-2025	
R115	100K, CHIP, 0805, 1/10W, 5%	133626-1045	
R116	332 OHM, CHIP, 0805, 1/10W, 1%	133625-3320	
R117	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R118	2.00K, CHIP, 0805, 1/10W, 5%	133626-2025	
R119	100K, CHIP, 0805, 1/10W, 5%	133626-1045	
R120	332 OHM, CHIP, 0805, 1/10W, 1%	133625-3320	
R121	100K, CHIP ,0805, 1/10W, 1%	133625-1003	
R122	2.00K, CHIP, 0805, 1/10W, 5%	133626-2025	
R123	100K, CHIP, 0805, 1/10W, 5%	133626-1045	
R124	332 OHM, CHIP, 0805, 1/10W, 1%	133625-3320	
R125	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R126	2.00K, CHIP, 0805, 1/10W, 5%	133626-2025	
R127	10 MEG, CHIP, 0805, 1/10W, 5%	133626-1065	
R128	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R130	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R131	200K, CHIP, 0805, 1/10W, 1%	133625-2003	
R132	402K, CHIP, 0805, 1/10W, 1%	133625-4023	
R133	806K, CHIP, 0805, 1/10W, 1%	133625-8063	
R134	33 OHM, CHIP, 0805, 1/10W, 5%	133626-3305	
R135	33 OHM, CHIP, 0805, 1/10W, 5%	133626-3305	
R136	33 OHM, CHIP, 0805, 1/10W, 5%	133626-3305	
R137	33 OHM, CHIP, 0805, 1/10W, 5%	133626-3305	
R139	1K, CHIP, 0805, 1/10W, 5%	133626-1025	
R140	16.9K, CHIP, 0805, 1/10W, 1%	181896-1692	
R141	51.1K, CHIP, 0805, 1/10W, 1%	181896-5112	
R142	16.9K, CHIP, 0805, 1/10W, 1%	181896-1692	

ELECTRICAL PART LIST

Multi-Room Interface

Resistors (continued)

Reference Designator	Description	Part Number	Note
R143	51.1K, CHIP, 0805, 1/10W, .1%	181896-5112	
R144	10K, ARRAY, SMT, 4 POS, 5%	186433-1034	
R145	10 MEG, CHIP, 0805, 1/10W, 5%	133626-1065	
R150	12 OHM, CHIP, 0805, 1/10W, 5%	133626-1205	
R151	12 OHM, CHIP, 0805, 1/10W, 5%	133626-1205	
R152	12 OHM, CHIP, 0805, 1/10W, 5%	133626-1205	
R153	12 OHM, CHIP, 0805, 1/10W, 5%	133626-1205	
R200	1.00K, CHIP, 0805, 1/10W, 1%	133625-1001	
R201	1.00K, CHIP, 0805, 1/10W, 1%	133625-1001	
R202	1.00K, CHIP, 0805, 1/10W, 1%	133625-1001	
R203	1.00K, CHIP, 0805, 1/10W, 1%	133625-1001	
R204	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R205	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R206	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R207	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R208	150 OHM, CHIP, 0805, 1/10W, 1%	133625-1500	
R209	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R210	100K, CHIP, 0805, 1/10W, 1%	133626-1045	
R214	100K, CHIP, 0805, 1/10W, 1%	133626-1045	
R211	332 OHM, CHIP, 0805, 1/10W, 1%	133625-3320	
R213	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R215	332 OHM, CHIP, 0805, 1/10W, 1%	133625-3320	
R217	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R218	100K, CHIP, 0805, 1/10W, 1%	133626-1045	
R219	332 OHM, CHIP, 0805, 1%	133625-3320	
R221	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R222	100K, CHIP, 0805, 1/10W, 1%	133626-1045	
R223	332 OHM, CHIP, 0805, 1%	133625-3320	
R225	100K, CHIP, 0805, 1/10W, 1%	133625-1003	
R226	10 MEG, CHIP, 0805, 1/10W, 5%	133626-1065	
R240	16.9K, CHIP, 0805, 1/10W, 1%	181896-1692	
R241	51.1K, CHIP, 0805, 1/10W, 0.1%	181896-5112	
R300	3.01K, CHIP, 0805, 1/10W, 1%	133625-3011	
R301	22 OHM, CHIP, 0805, 1/10W, 5%	133626-2205	
R302	47.0K, CHIP, 0805, 1/10W, 5%	133626-4735	
R303	1.2K, CHIP, 0805, 1/10W, 5%	133626-1225	
R304	4.75K, CHIP, 0805, 1%	133625-4751	
R305	100 OHM, CHIP, 0805, 1/10W, 5%	133626-1015	
R306	499 OHM, CHIP, 0805, 1/10W, 1%	133625-4990	
R307	2.26K, CHIP, 0805, 1/10W, 1%	133625-2261	
R308	332 OHM, CHIP, 0805, 1%	133625-3320	
R311	499 OHM, CHIP, 0805, 1/10W, 1%	133625-4990	
R312	2.26K, CHIP, 0603, 1/10W, 1%	191465-2261	
R313	2.26K, CHIP, 0805, 1/10W, 1%	133625-2261	
R314	100 OHM, CHIP, 0805, 1/10W, 5%	133626-1015	
R315	10K, CHIP, 0805, 1/10W, 5%	133626-1035	

ELECTRICAL PART LIST

Multi-Room Interface

Resistors (continued)

Reference Designator	Description	Part Number	Note
R316	499 OHM, CHIP, 0805, 1/10W, 1%	133625-4990	
R317	499 OHM, CHIP, 0603, 1/10W, 1%	191465-4990	
R318	3.01K, CHIP, 0805, 1/10W, 1%	133625-3011	
R319	20 OHM, CHIP, 0805, 1/10W, 5%	133626-2005	
R320	20K, CHIP, 0805, 1/10W, 5%	133626-2035	
R321	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R322	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R323	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R324	1K, CHIP, 0805, 1/10W, 5%	133626-1025	
R325	30.1 OHM, CHIP, 0805, 1/10W, 1%	133625-30R1	
R326	1K, CHIP, 0805, 1/10W, 5%	133626-1025	
R327	2.26K, CHIP, 0805, 1/10W, 1%	133625-2261	
R328	100K, CHIP, 0805, 1/10W, 5%	133626-1045	
R329	3.92K, CHIP, 0805, 1/10W, 1%	133625-3921	
R330	49.9, OHM, CHIP, 0805, 1/10W, 1%	133625-49R9	
R332	8.87K, CHIP, 0805, 1/10W, 1%	133625-8871	
R333	1K, CHIP, 0805, 1/10W, 5%	133626-1025	
R334	22.1K, CHIP, FILM, 0805, 1/10W, 1%	133625-2212	
R335	100K, CHIP, 0805, 1/10W, 5%	133626-1045	
R336	100K, CHIP, 0805, 1/10W, 5%	133626-1045	
R340	620 OHM, CHIP, 0603, 1/10W, 1%	191465-6190	
R341	5.62K, CHIP, 0805, 1/10W, 1%	133625-5621	
R342	5.62K, CHIP, 0805, 1/10W, 1%	133625-5621	
R343	2.21K, CHIP, 0805, 1/10W, 1%	133625-2211	
R344	2.21K, CHIP, 0805, 1/10W, 1%	133625-2211	
R345	1.5K, CHIP, 0603, 1/10W, 1%	191465-1501	
R346	1K, CHIP, 0805, 1/10W, 5%	133626-1025	
R347	1.74K, CHIP, 0805, 1/10W, 1%	133625-1741	
R400	1.0K, ARRAY, SMT, 8 POS, 5%	186433-1028	
R401	1.0K, ARRAY, SMT, 8 POS, 5%	186433-1028	
R402	1.0K, ARRAY, SMT, 4 POS, 5%	186433-1024	
R404	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R405	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R406	470K, ARRAY, SMT, 4 POS, 5%	186433-4744	
R407	1.0K, ARRAY, SMT, 4 POS, 5%	186433-1024	
R408	1.0K, ARRAY, SMT, 4 POS, 5%	186433-1024	
R411	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R417	100 OHM, CHIP, 0805, 1/10W, 5%	133626-1015	
R419	4.7K, CHIP, 0805, 1/10W, 5%	133626-4725	
R420	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R421	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R422	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R423	1K, CHIP, 0805, 1/10W, 5%	133626-1025	
R424	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R425	332 OHM, CHIP, 0805, 1/10W, 1%	133625-3320	
R426	332 OHM, CHIP, 0805, 1/10W, 1%	133625-3320	

ELECTRICAL PART LIST

Multi-Room Interface

Resistors (continued)

Reference Designator	Description	Part Number	Note
R428	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R429	1K, CHIP, 0805, 1/10W, 5%	133626-1025	
R430	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R431	100K, CHIP, 0805, 1/10W, 5%	133626-1045	
R432	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R433	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R434	1K, CHIP, 0805, 1/10W, 5%	133626-1025	
R435	1K, CHIP, 0805, 1/10W, 5%	133626-1025	
R436	10.0K, CHIP, 0805, 1/10W, 1%	133625-1002	
R437	100K, ARRAY, SMT, 4 POS, 5%	186433-1044	
R438	100K, ARRAY, SMT, 4 POS, 5%	186433-1044	
R439	10K, CHIP, 0805, 1/10W, 5%	133626-1035	
R440	47.0K, CHIP, 0805, 1/10W, 5%	133626-4735	
R441	100K, ARRAY, SMT, 4 POS, 5%	186433-1044	
R442	1K, CHIP, 0805, 1/10W, 5%	133626-1025	
R450	4.7K, CHIP, 0805, 1/10W, 5%	133626-4725	

Capacitors

Reference Designator	Description	Part Number	Note
C2	1000pF, MONO, 100V, 20%	180630-103	
C7	.01uF, 0805, X7R, 50V, 10%	133623-103	
C9	47uF, 7MM, EL, 105°C, 16V, 20%	196990-470C	
C10	47uF, 7MM, EL, 105°C, 16V, 20%	196990-470C	
C11	.047uF, 0805, Z5U, 20%	148779-473	
C12	.01uF, 0805, X7R, 50V, 10%	133623-103	
C13	1000uF, EL, 105°C, 25V, 20%	196991-102E	
C14	.01uF, 0805, X7R, 50V, 10%	133623-103	
C15	01uF, 0805, X7R, 50V, 10%	133623-103	
C16	.01uF, 0805, X7R, 50V, 10%	133623-103	
C17	10uF, 7MM, EL, 105°C, 25V, 20%	196990-100E	
C18	10uF, EL, 105°C, 35V, 20%	196991-100V	
C100	180pF, 0805, COG, 50V, 5%	133622-181	
C101	180pF, 0805, COG, 50V, 5%	133622-181	
C102	180pF, 0805, COG, 50V, 5%	133622-181	
C103	180pF, 0805, COG, 50V, 5%	133622-181	
C104	2.2uF, EL, 105°C, 50V, 20%	137126-2R2	
C105	2.2uF, EL, 105°C, 50V, 20%	137126-2R2	
C106	2.2uF, EL, 105°C, 50V, 20%	137126-2R2	
C107	2.2uF, EL, 105°C, 50V, 20%	137126-2R2	
C108	22uF, EL, 105°C, 16V, 20%	137126-220	
C109	1000pF, 0805, COG, 50V, 5%	133622-102	
C110	22uF, EL, 105°C, 16V, 20%	137126-220	
C111	1000pF, 0805, COG, 50V, 5%	133622-102	
C112	22uF, EL, 105°C, 16V, 20%	137126-220	
C113	1000pF, 0805, COG, 50V, 5%	133622-102	
C114	22uF, EL, 105°C, 16V, 20%	137126-220	
C115	1000pF, 0805, COG, 50V, 5%	133622-102	

ELECTRICAL PART LIST

Multi-Room Interface

Capacitors (continued)

Reference Designator	Description	Part Number	Note
C116	22uF, EL, 105°C, 16V, 20%	137126-220	
C117	1000pF, 0805, COG, 50V, 5%	133622-102	
C120	1000uF, EL, 105°C, 16V, 20%	199558	
C121	.047uF, 0805, Z5U, 20%	148779-473	
C123	2.2uF, MONO, 1206, Y5V, 16V, 80%	178212-225	
C124	1000pF, 0805, COG, 50V, 5%	133622-102	
C125	.047uF, 0805, Z5U, 20%	148779-473	
C126	.047uF, 0805, Z5U, 20%	148779-473	
C127	.047uF, 0805, Z5U, 20%	148779-473	
C128	.047uF, 0805, Z5U, 20%	148779-473	
C129	.047uF, 0805, Z5U, 20%	148779-473	
C130	.047uF, 0805, Z5U, 20%	148779-473	
C131	.047uF, 0805, Z5U, 20%	148779-473	
C132	.047uF, 0805, Z5U, 20%	148779-473	
C133	470uF, EL, 105°C, 20%, 25V	198458-471E	
C134	.047uF, 0805, X7R, 25V, 5%	196995-473	
C135	.047uF, 0805, X7R, 25V, 5%	196995-473	
C136	.047uF, 0805, X7R, 25V, 5%	196995-473	
C137	.047uF, 0805, X7R, 25V, 5%	196995-473	
C138	1000pF, 0805, COG, 50V, 5%	133622-102	
C139	1000pF, 0805, COG, 50V, 5%	133622-102	
C140	1000pF, 0805, COG, 50V, 5%	133622-102	
C141	4.7uF, TANT, 10V, 10%, A SIZE	196981-A475A1	
C142	4.7uF, TANT, 10V, 10%, A SIZE	196981-A475A1	
C143	.047uF, 0805, Z5U, 20%	148779-473	
C144	470pF, 0805, X7R, 50V, 10%	133623-471	
C200	180pF, 0805, COG, 50V, 5%	133622-181	
C202	180pF, 0805, COG, 50V, 5%	133622-181	
C203	180pF, 0805, COG, 50V, 5%	133622-181	
C204	180pF, 0805, COG, 50V, 5%	133622-181	
C205	2.2uF, EL, 105°C, 50V, 20%	137126-2R2	
C206	2.2uF, EL, 105°C, 50V, 20%	137126-2R2	
C207	2.2uF, EL, 105°C, 50V, 20%	137126-2R2	
C208	2.2uF, EL, 105°C, 50V, 20%	137126-2R2	
C209	22uF, EL, 105°C, 50V, 20%	137126-220	
C210	1000pF, 0805, COG, 50V, 5%	133622-102	
C211	22uF, EL, 105°C, 16V, 20%	137126-220	
C212	1000pF, 0805, COG, 50V, 5%	133622-102	
C213	22uF, EL, 105°C, 16V, 20%	137126-220	
C214	1000pF, 0805, COG, 50V, 5%	133622-102	
C215	22uF, EL, 105°C, 16V, 20%	137126-220	
C216	1000pF, 0805, COG, 50V, 5%	133622-102	
C217	22uF, EL, 105°C, 16V, 20%	137126-220	
C218	1000pF, 0805, COG, 50V, 5%	133622-102	
C220	2.2uF, MONO, 1206, Y5V, 16V, 80%	178212-225	
C221	1000pF, 0805, COG, 50V, 5%	133622-102	

ELECTRICAL PART LIST

Multi-Room Interface

Capacitors (continued)

Reference Designator	Description	Part Number	Note
C241	4.7uF, TANT, 10V, 10%, A SIZE	196981-A475A1	
C300	.047uF, 0805, Z5U, 20%	148779-473	
C301	9.1pF, 0805, 50V, 5%	133622-9R1	
C302	.047uF, 0805, Z5U, 20%	148779-473	
C303	22uF, EL, 105°C, 16V, 20%	137126-220	
C304	3.3uF, EL, 105°C, 50V, 20%	137126-3R3	
C305	47uF, EL, 85°C, 16V, 20%	149947-470C	
C306	.047uF, 0805, Z5U, 20%	148779-473	
C307	1000pF, 0805, COG, 50V, 5%	133622-102	
C308	.047uF, 0805, Z5U, 20%	148779-473	
C309	47uF, EL, 85°C, 16V, 20%	149947-470C	
C310	.047uF, 0805, Z5U, 20%	148779-473	
C311	180pF, 0805, COG, 50V, 5%	133622-181	
C312	.047uF, 0805, Z5U, 20%	148779-473	
C313	22uF, EL, 105°C, 16V, 20%	137126-220	
C314	.047uF, 0805, Z5U, 20%	148779-473	
C315	.47uF, 7MM, EL, 105°C ,50V, 20%	196990-R47H	
C316	1.0uF, 7MM, EL, 105°C, 20%	196990-1R0H	
C317	4.7uF, EL, 85°C, 50V, 20%	149947-4R7H	
C318	10uF, 7MM, EL, 105°C, 25V, 20%	196990-100E	
C319	4700pF, 0805, X7R, 50V, 10%	133623-472	
C320	1000pF, 0805, COG, 50V, 5%	133622-102	
C321	.015uF, 0805, X7R, 50V, 10%	133623-153	
C322	.33uF, EL, 105°C, 50V, 20%	196990-R33H	
C324	.047uF, 0805, Z5U, 20%	148779-473	
C325	100uF, EL, 85°C, 16V, 20%	149947-101C	
C326	.047uF, 0805, Z5U, 20%	148779-473	
C327	47uF, EL, 85°C, 16V, 20%	149947-470C	
C328	01uF, 0805, X7R, 50V, 10%	133623-103	
C329	22uF, EL, 105°C, 16V, 20%	137126-220	
C330	.033uF, 0805, X7R, 25V, 5%	196995-333	
C331	22uF, EL, 105°C, 16V, 20%	137126-220	
C332	.033uF, 0805, X7R, 25V, 5%	196995-333	
C333	2.2uF, EL, BP, 85°C, 50V, 20%	147522-2R2	
C334	1000pF, 0805, COG, 50V, 5%	133622-102	
C335	1000pF, 0805, COG, 50V, 5%	133622-102	
C336	1000pF, 0805, COG, 50V, 5%	133622-102	
C337	33pF, 0805, COG, 50V, 5%	133622-330	
C338	27pF, 0805, COG, 50V, 5%	133622-270	
C339	2.2uF, EL, 105°C, 16V, 20%	137126-2R2	
C340	.047uF, 0805, Z5U, 20%	148779-473	
C341	2.2uF, EL, 105°C, 50V, 20%	137126-2R2	
C342	2.2uF, EL, 105°C, 50V, 20%	137126-2R2	
C343	33pF, 0805, COG, 50V, 5%	133622-330	
C345	4.7uF, NP, EL, 105°C, 35V, 20%	196992-4R7V	
C346	.047uF, 0805, Z5U, 20%	148779-473	

ELECTRICAL PART LIST

Multi-Room Interface

Capacitors (continued)

Reference Designator	Description	Part Number	Note
C347	.047uF, 0805, Z5U, 20%	148779-473	
C348	2.2uF, EL, 105°C, 50V, 20%	137126-2R2	
C350	.022uF, 0805, X7R, 50V, 10%	133623-223	
C355	10pF, 0805, COG, 50V, 5%	133622-100	
C365	3pF, 0603, COG, 50V, 5%	188454-3R0	
C366	5pF, 0603, COG, 50V, 5%	188454-0R5	
C367	2.0pF, 0805, 50V, 5%	133622-2R0	
C368	2.0pF, 0805, 50V, 5%	133622-2R0	
C400	.047uF, 0805, Z5U, 20%	148779-473	
C402	.047uF, 0805, Z5U, 20%	148779-473	
C403	.047uF, 0805, Z5U, 20%	148779-473	
C404	2.2uF, MONO, 1206, Y5V, 16V, 80%	178212-225	
C407	.047uF, 0805, Z5U, 20%	148779-473	
C408	2.2uF, MONO, 1206, Y5V, 16V, 80%	178212-225	
C410	01uF, 0805, X7R, 50V, 10%	133623-103	
C411	1000pF, 0805, COG, 50V, 5%	133622-102	
C412	1000pF, 0805, COG, 50V, 5%	133622-102	
C416	1000pF, 0805, COG, 50V, 5%	133622-102	
C417	2200pF, 0805, X7R, 50V, 10%	133623-222	
C418	2200pF, 0805, X7R, 50V, 10%	133623-222	
C419	2200pF, 0805, X7R, 50V, 10%	133623-222	
C420	2200pF, 0805, X7R, 50V, 10%	133623-222	
C421	1000pF, 0805, COG, 50V, 5%	133622-102	

Diodes

Reference Designator	Description	Part Number	Note
D1	BAV99, SOT23	147239	
D2	1N5232, ZENER,5.6V,225MW	135247-5232	
D7	1N4004, RECTIFIER, 400V, 1A	116996-4	3 
D8	1N4004, RECTIFIER, 400V, 1A	116996-4	3 
D9	1N4004, RECTIFIER, 400V, 1A	116996-4	3 
D10	1N4004, RECTIFIER, 400V, 1A	116996-4	3 
D100	MMBD914LT1, SOT	148582	
D101	SOT-23, BAV 70	147249	
D102	SHOTTKY, BAT42W, SOD-123	196984-002	
D301	BAV99, SOT23	147239	
D302	MMBD914LT1, SOT	148582	
D402	BAV99, SOT23	147239	
D403	BAV99, SOT23	147239	

ELECTRICAL PART LIST

Multi-Room Interface

Transistors

Reference Designator	Description	Part Number	Note
Q1	2SA1179, SOT23	134743	
Q2	NPN, SOT, 47K	258024	
Q300	JFET, N, 20V, 20mA, TO-92	148590-E	
Q301	BPLR, N, 25V, 30MA, SOT-23	187601-001	
Q302	PNP, SOT, 47K	258025	
Q303	NPN, SOT, 47K	258024	
Q304	NPN, SOT, 47K	258024	
Q310	MMBT3904, NPN, SOT	146819	
Q311	JFET, N, 40V, 10mA, TO-92	147561-3	
Q400	2SA1179, SOT23	134743	
Q401	MMBT3904, NPN, SOT	146819	

Integrated Circuits

Reference Designator	Description	Part Number	Note
U1	REG, VLDO	172942-L5	
U2	REG, 10V, TO-220	172942-10	
U100	AUDIO MATRIX, SO28	177984-2	
U101	AUDIO MATRIX, SO28	177984-2	
U102	TDA7309D, VOL CNTRL, SO 20	188941-001	
U103	TDA7309D, VOL CNTRL, SO 20	188941-001	
U104	TDA7309D, VOL CNTRL, SO 20	188941-001	
U105	TDA7309D, VOL CNTRL, SO 20	188941-001	
U106	NJN3404AM, OP AMP	181080	
U300	LA1836, AM/FM TUNER, SO-20	187600-001	
U302	LC72131, PLL FREQ SNTH, MFP20	187733-001	
U400	TMP87PM40F, PROG, U.S. TMP87PM40F, PROG, EURO	189955-005 260301-003	
U401	EEPROM, DIP-8/SO-8, 24CO2A	177982-2	
U402	MAX809, SOT23, 4.65V	191158-01	
U403	OP AMP, QUAD, SO, 14PIN	191464-001	

Filters, Inductors and Coils

Reference Designator	Description	Part Number	Note
CF301	FILTER, CER, BANDPASS, FGD	253037-001	
CF302	FILTER, CER, BANDPASS, FGD	253037-002	
L1	10uH, IND,SMT,LEM4532	178370-100	
L300	1000uH, 40A, 796Hz, AX	147563-102	
L301	100uH, IND,SMT,LEM4532	178370-101	
L400	470nH, INDUCTOR, 0805	191469-471J	
T302	DETECTOR, FM, SINGLE TUNED	187602-001	
T303	FILTER, STEREO MPX, SINGLE TUNED	147236	
T304	FILTER, STEREO MPX, SINGLE TUNED	147236	
T305	FILTER, CER, AM IF	189609	

ELECTRICAL PART LIST

Multi-Room Interface

Crystals

Reference Designator	Description	Part Number	Note
CR300	RESONATOR, CERAMIC, 456KHz	187604-001	
X400	CER, W/INTGRTD S, 8 MHz	191446-8R00	
Y300	QUARTZ, 7.2 MHz, 50PPM	147223 or 197680	11/02

Connectors

Reference Designator	Description	Part Number	Note
J1	CONN, DC POWER JACK	147540	
J2	CABLE, 24AWG, RIBBON, 2.5M, 110MM	178365-13110	
J3	CABLE, 18 AWG, BOARD TO BOARD	199544-001	
J101	CONN, HOUSING, PHONO, 6 POS, FEM	148766	
J102	CONN, HOUSING, PCB MNT, PHONO, QD	149959	
J103	CONN, DUAL, DIN	199553	
J104	CONN, DUAL, DIN	199553	
J107	CONN, MINI DIN, 8 PIN, REV.KEY	191490	
J300	CONN, AM ANTENNA, 2.5MM	179266	
J301	CONN, FM ANTENNA, EURO	179271	
J400	CONN, 1.00MM, 14 PIN, TOP TAPED	190718-T14	
J401	CONN, SERIAL	178356	
J402	CABLE, 24AWG, RIBBON, 2.5M, 110MM	178365-13110	
J403	CABLE, 18 AWG, BOARD TO BOARD	199544-001	

Miscellaneous

Reference Designator	Description	Part Number	Note
SW400	TACT, HORIZ, SPST, SKHHLV	190719-002	
T300	MODULE, TUNING, AM FRONT END	195359	
TUNER	TUNER, FM, 4 GANG, 7V	184589	

ELECTRICAL PART LIST

Radio Data Link

Resistors

Reference Designator	Description	Part Number	Note
R1	140 OHM, CHIP, 0603, 1/10W, 1%	191465-1400	
R2	3.32K OHM, CHIP, 0603, 1/10W, 1%	191465-3321	
R3	3.09K, CHIP, 0603, 1/10W, 1%	191465-3091	
R5	4.75K, CHIP, 0603, 1/10W, 1%	191465-4751	
R6	1.5K, CHIP, 0603, 1/10W, 1%	191465-1501	
R7	3.01K, CHIP, 0603, 1/10W, 1%	191465-3011	
R8	10 OHM, CHIP, 0603, 1/10W, 1%	191465-10R0	
R9	2.61K, CHIP, 0603, 1/10W, 1%	191465-2611	
R10	243 OHM, CHIP, 0603, 1/10W, 1%	191465-2430	
R11	24.9 OHM, CHIP, 0603, 1/10W, 1%	191465-24R9	
R12	10 OHM, CHIP, 0603, 1/10W, 1%	191465-10R0	
R13	10 OHM, CHIP, 0603, 1/10W, 1%	191465-10R0	
R14	10K, CHIP, 0603, 1/10W, 1%	191465-1002	
R15	931 OHM, CHIP, 0603, 1/10W, 1%	191465-9310	
R16	549 OHM, CHIP, 0603, 1/10W, 1%	191465-5490	
R17	10 OHM, CHIP, 0603, 1/10W, 1%	191465-10R0	
R18	16.2K, CHIP, 0603, 1/10W, 1%	191465-1622	
R19	100 OHM, CHIP, 0603, 1/10W, 1%	191465-1000	
R20	332 OHM, CHIP, 0603, 1/10W, 1%	191465-3320	
R21	2.55K, CHIP, 0603, 1/10W, 1%	191465-2551	
R22	3.32K OHM, CHIP, 0603, 1/10W, 1%	191465-3321	
R23	51 OHM, CHIP, 0603, 1/10W, 5%	199403-510	
R25	549 OHM, CHIP, 0603, 1/10W,1%	191465-5490	
R26	10K, CHIP, 0603, 1/10W, 1%	191465-1002	
R27	18.2K, CHIP, 0603, 1/10W, 1%	191465-1822	
R28	10K, CHIP, 0603, 1/10W, 1%	191465-1002	
R29	274 OHM, CHIP, 0603, 1/10W, 1%	191465-2740	
R32	3.32K OHM, CHIP, 0603, 1/10W, 1%	191465-3321	
R33	3.32K OHM, CHIP, 0603, 1/10W, 1%	191465-3321	
R34	10K, CHIP, 0603, 1/10W, 1%	191465-1002	
R35	10K, CHIP, 0603, 1/10W, 1%	191465-1002	
R37	1.0K, ARRAY, SMT, 4 POS, 5%	186433-1024	
R38	1.0K, ARRAY, SMT, 4 POS, 5%	186433-1024	
R39	1.0K, ARRAY, SMT, 4 POS, 5%	186433-1024	
R43	10K, CHIP, 0603, 1/10W, 1%	191465-1002	
R44	1.5K, CHIP, 0603, 1/10W, 1%	191465-1501	
R45	165K, CHIP, 0603, 1/10W, 1%	191465-1653	
R46	53.6K, CHIP, 0603, 1/10W, 1%	191465-5362	
R47	10.0K, CHIP, 0805, 1/10W, 1%	133625-1002	
R48	10.0K, CHIP, 0805, 1/10W,1%	133625-1002	
R50	10K, CHIP, 0603, 1/10W, 1%	191465-1002	
R51	53.6K, CHIP, 0603, 1/10W, 1%	191465-5362	
R52	3.32K OHM, CHIP, 0603, 1/10W, 1%	191465-3321	
R53	, 3.32K OHM, CHIP, 0603, 1/10W, 1%	191465-3321	
R54	3.32K OHM, CHIP, 0603, 1/10W, 1%	191465-3321	
R56	127K, CHIP, 0603, 1/10W, 1%	191465-1273	

ELECTRICAL PART LIST

Radio Data Link

Resistors (continued)

Reference Designator	Description	Part Number	Note
R57	4.75K, CHIP, 0603, 1/10W, 1%	191465-4751	
R58	100K, CHIP, 0603, 1/10W, 1%	191465-1003	
R59	53.6K, CHIP, 0603, 1/10W, 1%	191465-5362	
R63	100 OHM, CHIP, 0603, 1/10W, 1%	191465-1000	
R64	10 OHM, CHIP, 0603, 1/10W, 1%	191465-10R0	
R68	10K, CHIP, 0603, 1/10W, 1%	191465-1002	
R69	3.32K OHM CHIP, 0603, 1/10W, 1%	191465-3321	
R70	3.32K OHM, CHIP, 0603, 1/10W, 1%	191465-3321	
R71	1.0K OHM, CHIP, 0603, 1/10W.1%	191465-1001	
R80	100 OHM, CHIP, 0603, 1/10W, 1%	191465-1000	
R90	100 OHM, CHIP, 0603, 1/10W, 1%	191465-1000	
R91	3.32K OHM, CHIP, 0603, 1/10W, 1%	191465-3321	
R92	243 OHM, CHIP, 0603, 1/10W, 1%	191465-2430	
R93	3.09K, CHIP, 0603, 1/10W, 1%	191465-3091	
R99	53.6K, CHIP, 0603, 1/10W, 1%	191465-5362	

Capacitors

Reference Designator	Description	Part Number	Note
C2	.5pF, 0603, COG, 50V, 5%	188454-0R5	
C3	.1uF, 0603, X7R, 16V, 5%	258498-104	
C4	1000pF, 0603, X7R, 50V	191470-102	
C5	120pF, 0603, COG, 50V, 5%	188454-121	
C6	.5pF, 0603, COG, 50V, 5%	188454-0R5	
C7	1000pF, 0603, X7R, 50V	191470-102	
C8	5pF, 0603, COG, 50V, 5%	188454-5R0	
C9	3pF, 0603, COG, 50V, 5%	188454-3R0	
C10	1.5pF, 0603, COG, 50V, 5%	188454-1R5	
C11	1.5pF, 0805, COG, 50V, 5%	133622-1R5	
C12	8pF, 0603, COG, 50V, 5%	188454-8R0	
C13	680pF, 0603, X7R, 50V	191470-681	
C14	.022uF, 0603, X7R, 25V	196999-223	
C15	1.7pF +/-0.1pF, HF, 50V, SMD	251073-1R7	
C16	.1uF, 0603, X7R, 16V, 5%	258498-104	
C17	5pF, 0603, COG, 50V, 5%	188454-5R0	
C18	3pF, 0603, COG, 50V, 5%	188454-3R0	
C19	.5pF, 0603, COG, 50V, 5%	188454-0R5	
C20	1pF, 0603, COG, 50V, 5%	188454-1R0	
C21	.5pF, 0603, COG, 50V, 5%	188454-0R5	
C23	1000pF, 0603, X7R, 50V	191470-102	
C24	.1uF, 0603, X7R, 16V, 5%	258498-104	
C25	.1uF, 0603, X7R, 16V, 5%	258498-104	
C26	15pF, 0603, COG, 50V, 5%	188454-150	
C27	8pF, 0603, COG, 50V, 5%	188454-8R0	
C28	3pF, 0603, COG, 50V, 5%	188454-3R0	
C29	1000pF, 0603, X7R, 50V	191470-102	
C30	5pF, 0603, COG, 50V, 5%	188454-5R0	

ELECTRICAL PART LIST

Radio Data Link

Capacitors (continued)

Reference Designator	Description	Part Number	Note
C31	5.6pF, 0603, COG, 50V, 5%	188454-5R6	
C32	100pF, 0603, COG, 50V, 5%	188454-101	
C34	.5pF, 0603, COG, 50V, 5%	188454-0R5	
C35	1pF, 0603, COG, 50V, 5%	188454-1R0	
C36	130pF, 0603, COG, 50V, 5%	188454-131	
C37	.01uF, 0603, X7R, 50V, 5%	191470-103	
C38	.47uF, X7R, 0805, SM, 15V, 5%	196995-474	
C39	.022uF, 0603, X7R, 25V, 10%	196999-223	
C40	4.7uF, TANT, 10V, 10%, A SIZE	196981-A475A1	
C41	4.7uF, TANT, 10V, 10%, A SIZE	196981-A475A1	
C42	10uF, TANT, 6.3V, 20%, A SIZE	196981-J106A2	
C43	0.1uF, 0805, X7R, 50V, 10%	133624	
C44	.1uF, 0603, X7R, 16V, 5%	258498-104	
C48	.01uF, 0603, X7R, 50V, 10%	191470-103	
C49	.01uF, 0603, X7R, 50V, 10%	191470-103	
C51	33pF, 0603, COG, 50V, 5%	188454-330	
C52	22pF, 0603, COG, 50V, 5%	188454-220	
C54	.01uF, 0603, X7R, 50V, 10%	191470-103	
C56	470pF, 0603, COG, 50V, 5%	188454-471	
C57	3pF, 0603, COG, 50V, 5%	188454-3R0	
C58	4700pF, 0603, X7R, 50V, 10%	191470-472	
C59	1000pF, 0603, X7R, 50V, 10%	191470-102	
C60	1000pF, 0603, X7R, 50V, 10%	191470-102	
C61	1000pF, 0603, X7R, 50V, 10%	191470-102	
C62	1000pF, 0603, X7R, 50V, 10%	191470-102	
C63	3300pF, 0603, X7R, 50V, 10%	191470-332	
C65	6800pF, 0805, SL, 25V, 5%	199481-682	
C69	100pF, 0603, COG, 50V, 5%	188454-101	
C70	.5pF, 0603, COG, 50V, 5%	188454-0R5	
C73	.5pF, 0603, COG, 50V, 5%	188454-0R5	
C76	1pF, 0603, COG, 50V, 5%	188454-1R0	
C82	100pF, 0603, COG, 50V, 5%	188454-101	
C83	.1uF, 0603, X7R, 16V, 5%	258498-104	
C85	.047uF, 0603, X7R, 16V, 5%	258498-473	
C88	27pF, 0603, COG, 50V, 5%	188454-270	
C89	27pF, 0603, COG, 50V, 5%	188454-270	
C92	100pF, 0603, COG, 50V, 5%	188454-101	
C95	10pF, +/-.5pF, 0603, COG, 50V	188454-100	
C99	2200pF, 0603, X7R, 50V, 10%	191470-222	
VC1	10pF, VAR, 25V, SMT	262295-004	

ELECTRICAL PART LIST

Radio Data Link

Diodes

Reference Designator	Description	Part Number	Note
D1	SI TUNING, RF, BBY52-03W	189942-001 or 266532-001	
D2	SWITCHING, SOT-323	196986	
D5	MMBD914LT1, SOT	148582	

Transistors

Reference Designator	Description	Part Number	Note
Q1	NE68018, NPN, SIL, HIFREQ	191466	
Q2	SOT323, NPN, RF, NE68530	195342	
Q3	NE68018, NPN,SIL, HIFREQ	191466	
Q4	2SA1521, P, SOT, 2.2K	180789	
Q5	NE68018, NPN, SIL, HIFREQ	191466	
Q6	BP, N, 40V, 200MA, SOT-323	195357	
Q8	BP, N, 40V, 200MA, SOT-323	195357	
Q90	NE68018, NPN, SIL, HIFREQ	191466	

Integrated Circuits

Reference Designator	Description	Part Number	Note
U1	PLL, FREQ SYNTH, SSOP-16	199541	
U2	SOT363, FREQUENCY CONV, .270MW	256361-001	
U3	SWITCH, RF	196993	
U4	uC, TMP87C808M, RDL, US-EURO	188943-001	
U4	uC, TMP87C808M, RDL, AUS	189963-001	
U5	SA636DK, MIXER, FM IF, SSOP,	266515-001	
U6	POS REG, LOW DROP OUT, SOT-23	191452-3R3F	
U9	LM393, DUAL COMPARITOR, SO-8	148584	

Inductors

Reference Designator	Description	Part Number	Note
L1	15 nH, 1608, SMT	191488-150J	
L2	18nH, 1608	191488-180J	
L3	18nH, 1608	191488-180J	
L4	15 nH, 1608, SMT	191488-150J	
L8	470nH, 0805	191469-471J	
L9	QUADRATURE DETECTOR	193234	
L10	39.8MHz FILTER, I.F	195798	
L11	.1uH, 5%, SMD	178336-R10J	
L13	3.9nH, 1608, SMT	191488-3R9S	
L14	2.2nH, 1608, SMT	191488-2R2S	
L90	15 nH, 1608, SMT	191488-150J	

ELECTRICAL PART LIST

Radio Data Link

Miscellaneous

Reference Designator	Description	Part Number	Note
Y1	CRYSTAL, SMT, HC45U, 21.8MHz	195349	
Y2	CRYSTAL, SMT, HC49S, 29.12MHz	196646	
Y3	CER, 10.7MHz, 150KHz, SMD	198683	
Y4	CER, 10.7MHz, 150KHz, SMD	198683	
Y5	CRYSTAL, SMT, HC49S, 5.04MHz	191474	
J1	VERT, 1.0MM, 4-8 CIR, TAPED	191484-T4	
P1	ZIF, 1MM, 14 POS, SMT	191479-14	

PACKAGING PART LIST

Refer to Figures 10, 11 and 12

Item Number	Description	Part Number	Qty.	Note
1	SATELLITE ASSY., SINGLE, BLACK SATELLITE ASSY., SINGLE, WHITE	194420-019 194420-029	1	
2	CARTON, D/C, SATELLITE	190207-002	1	
3	SATELLITE TRAY	190211-001	1	
4	CARTON, D/C, CABLE PACK	190216	1	
5	CABLE, DIN-13 TO DIN-8, S/PDIF CABLE, 24AWG, 5-8 PIN, DIN/MINI DIN	253346 191492	1	
6	CABLE, AUDIO, DUAL RCA	185931-01	1	
7	CABLE SET, 3PK, L/C/R, BLACK CABLE SET, 3PK, L/C/R, WHITE	193145-04 193045-14	1	
8	CABLE SET, 2PK, LS/RS, BLACK, LS50 CABLE SET, 2PK, LS/RS, WHITE, LS50	193146-03 1930146-13	1	
8	CABLE SET, 20', LT/RT, BLACK, LS40 CABLE SET, 20', LT/RT, WHITE, LS40	178724-05 178724-15	1	
9	CABLE, CHANGER TO MRI	191491	1	
10	SYSTEM ASSY., MRI, US SYSTEM ASSY., MRI, EURO, EXT. RANGE SYSTEM ASSY., MRI, AUS., EXT. RANGE SYSTEM ASSY., MRI, MEDIA	188945-001 260120-002 260120-005 260299-002	1	
11	SHEET, SAFETY	176236	1	
12	ENVELOPE, PACKING, 3 x 4	180005	1	
13	CARD, WARRANTY, US CARD, WARRANTY, MULTI	181357 181460	1	
14	FOOT, 2.03 x .06	183621	5	
15	CD, DEMO, US, LS50	183768	1	
16	ALL PRODUCT BROCHURE	188898	1	
17	MANUAL, OWNERS, LS40 MANUAL, OWNERS, LS50	189858 189854	1	
18	CD, DEMO, US, LS50	192262	1	
19	BAG, POLY, 3 x 3.5	194392	1	
20	POWER SUPPLY, 120V	178371	1	
21	POWER SUPPLY, 230V, EURO POWER SUPPLY, 230V, UK POWER SUPPLY, 230V, EURO POWER SUPPLY, 240V, AUS	178375 251773 178379 178373	1	3 
22	SYSTEM ASSY., PMC, MUSIC SYSTEM ASSY., PMC, MEDIA	188909-001 260290-002	1	
23	MAGAZINE, CD, 6 DISC	187575	1	
24	PACKING, TRAY, LS, ESS, UTL PET 30	190209-004	1	
25	CARTON, D/C, PMC, WHITE	190208-006	1	
26	ANTENNA ASSY., AM	199824-002	1	
27	BATTERY, AAA SIZE, ALKALINE	179223-01	4	
28	LINE CORD, 120V, POL., DETACH., BLK LINE CORD, 240V, UK/SING LINE CORD, 240V, AUS. LINE CORD, EURO, DETACH., 96"	198603-001 134725 134726 148203	1	3 

PACKAGING PART LIST

Refer to Figures 11 and 12

Item Number	Description	Part Number	Qty.	Note
29	ANTENNA, FM DIPOLE, 75 OHM, F-CONN ANTENNA, FM DIPLOE, PAL, EURO	148589 143185	1	
30	SHEET, QUICKSTART, LS40, MULTILNG SHEET, QUICKSTART, LS50, MULTILNG	192264 190224	1	
31	PACKING, INSERT, D/C, GLUE	196212	1	
32	BASSBOX, ASSY., AM5PC, 120V, WHITE BASSBOX, ASSY., AM5PC, 120V, BLACK BASSBOX, ASSY., AM5PC, 220V, WHITE BASSBOX, ASSY., AM5PC, 220V, BLACK BASSBOX, ASSY., AM5PC, 120/220V, WHITE BASSBOX, ASSY., AM5PC, 120/220V, BLACK	178715-1119 178715-1219 178715-2119 178715-2219 178715-6119 178715-6219		
32	BASSBOX ASSY., AM30P II, 100V, WHITE BASSBOX ASSY., AM30P II, 100V, BLACK BASSBOX ASSY., AM30P II, 120V, WHITE BASSBOX ASSY., AM30P II, 120V, BLACK BASSBOX ASSY., AM30P II, 220V, WHITE BASSBOX ASSY., AM30P II, 220V, BLACK BASSBOX ASSY., AM30P II, 120/220V, WHITE BASSBOX ASSY., AM30P II, 120/220V, BLACK	250128-3119 250128-3219 250128-1119 250128-1219 250128-2119 250128-2219 250128-6119 250128-6219	1	
33	BAG, POLY, 13.5 x 9.5 x 2.5 MIL.	114522	1	
34	PACKING, CORNER POST, EPS	148044	2	
35	CARTON, RSC, LS40 CARTON, RSC, LS50	188005-005 188005-006	1	
36	PACKING, INSERT, EPS	172279	1	
37	CONSOLE ASSY., CHANGER, C1	188930-101C	1	
---	BAG, POLY, 7 x 12 x 2, MRI	188462-001	1	

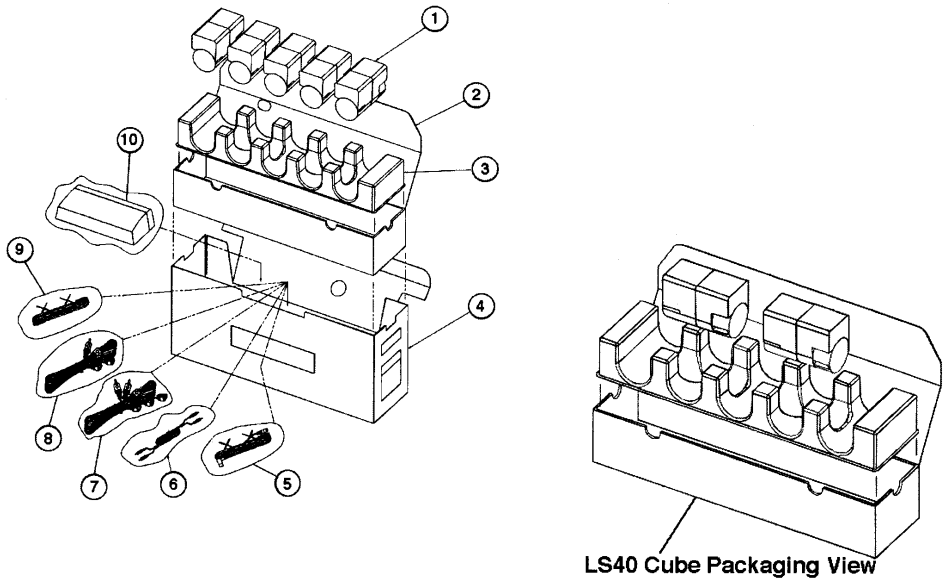


Figure 10. LS40/50 Cube Packaging Exploded View

PACKAGING PART LIST

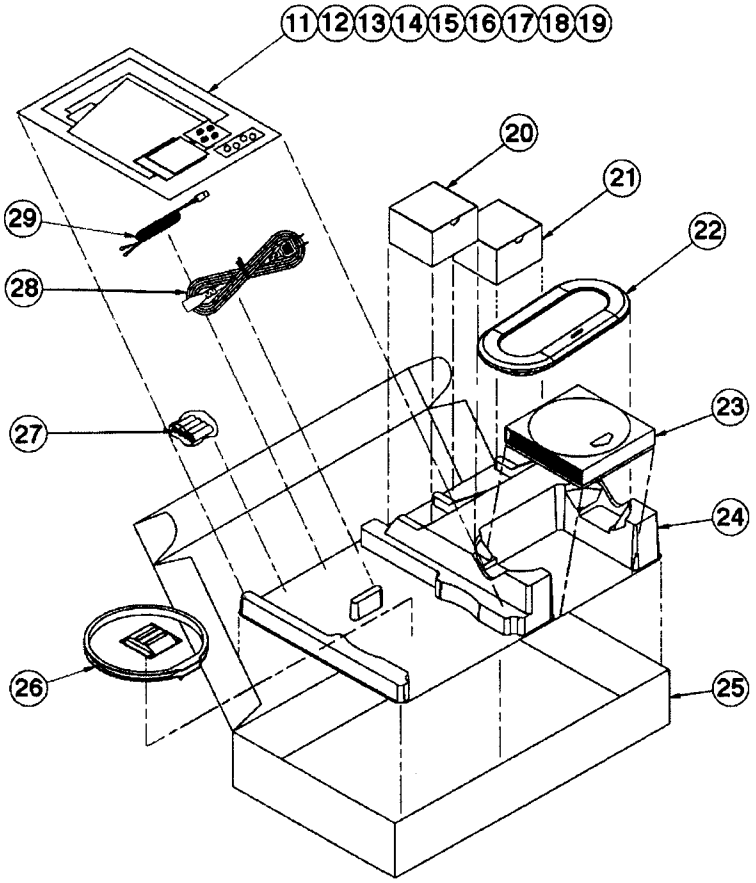


Figure 11. LS40/50 Essentials Packaging Exploded View

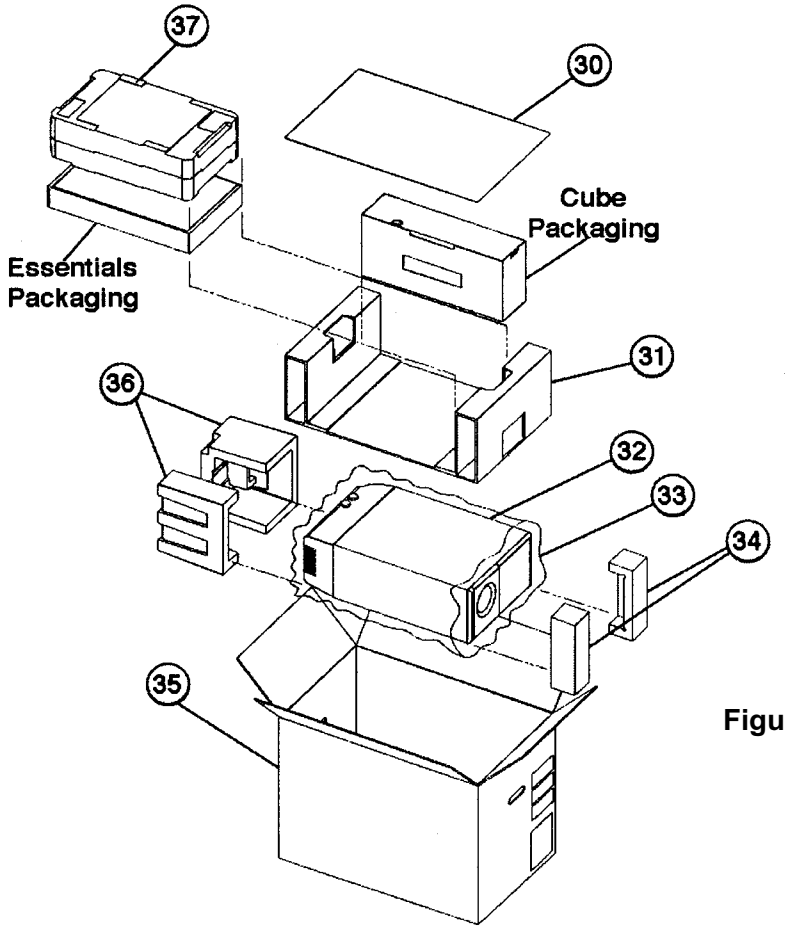
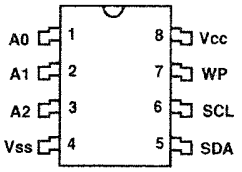
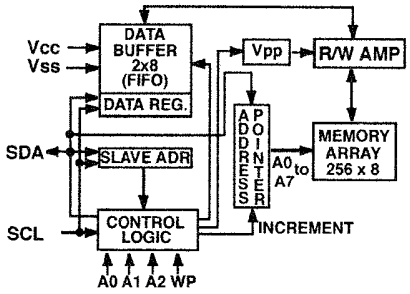


Figure 12. LS40/50 system Packaging Exploded View

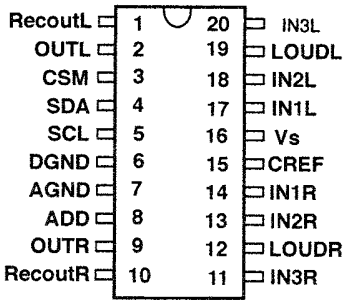
INTEGRATED CIRCUITS

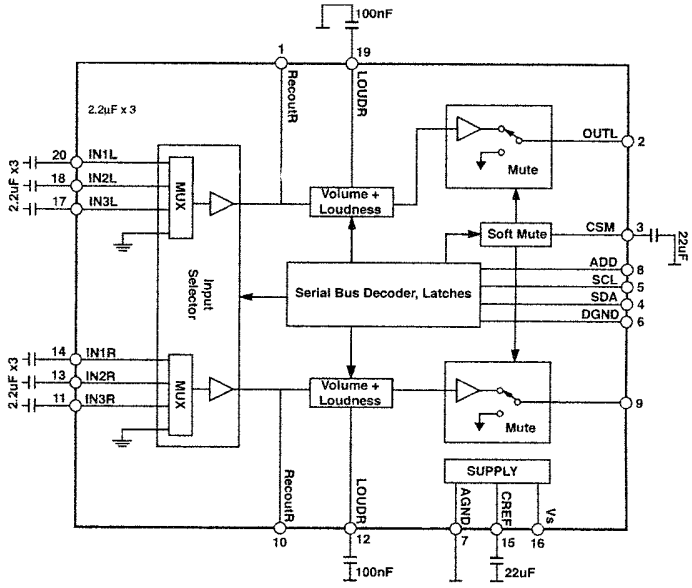
Multi-Room Interface (MRI)



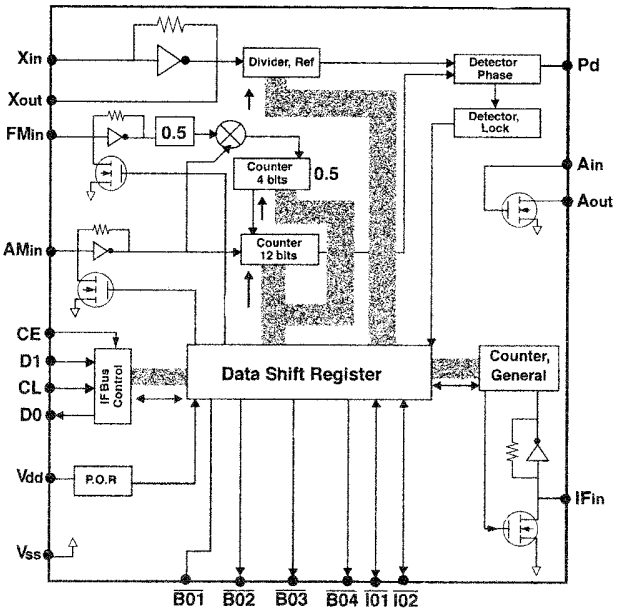


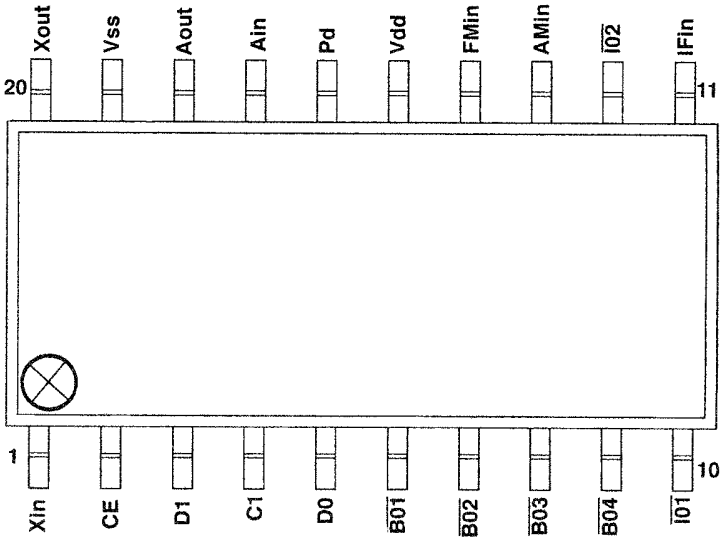
24C02A, 2K bit Electrically Erasable PROM (U401), Bose® part number 177982-2





TDA7309D, Digital Controlled Audio Processor (U102-105), Bose part number 189941-001





INTEGRATED CIRCUITS

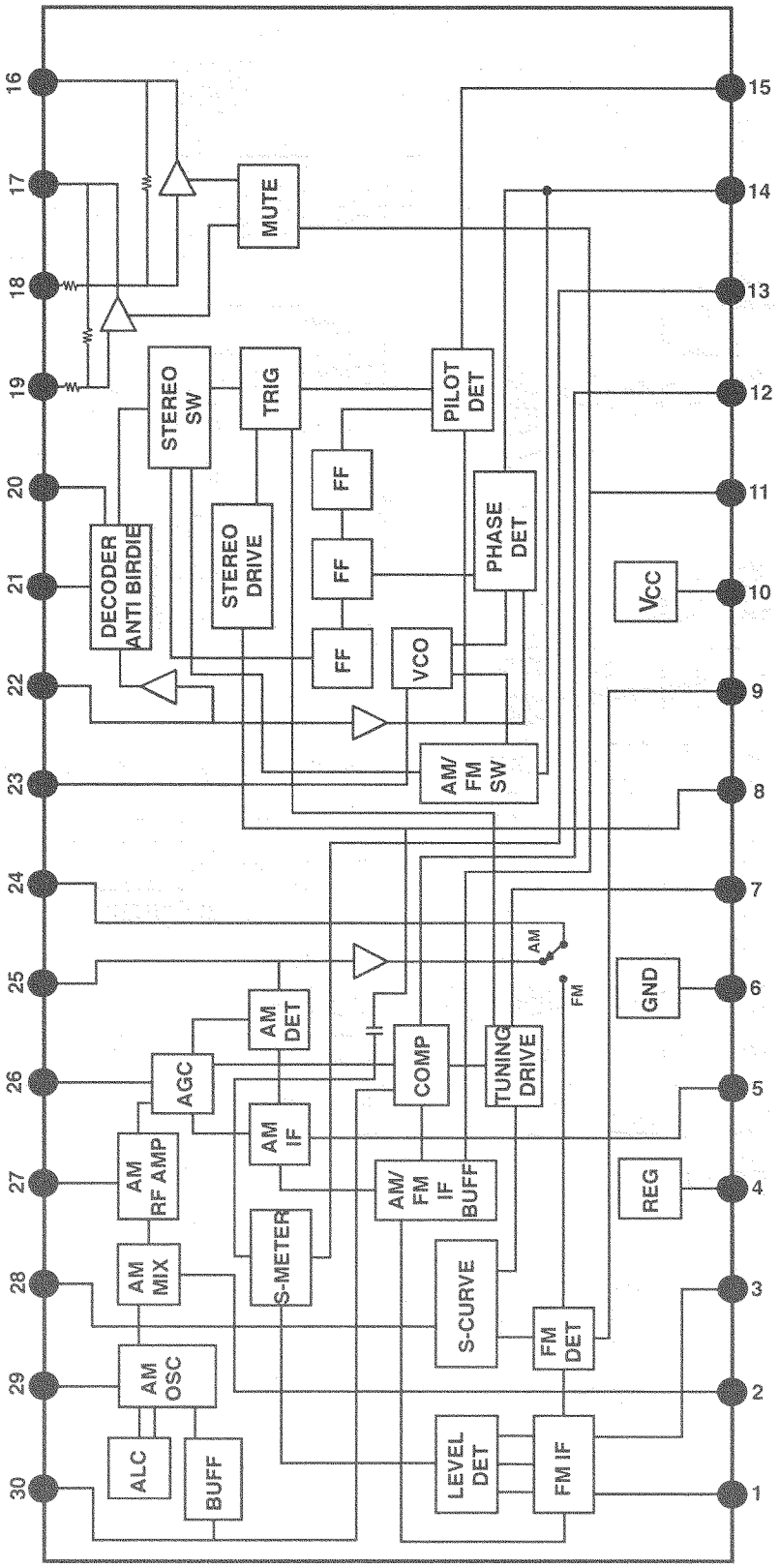
Multi-Room Interface

LC72131 AM/FM PLL Pin Out Table

PIN NUMBERS	SYMBOLS	FUNCTION
1	Xin	X'tal OSC
2	CE	Chip Enable
3	DI	Data Input
4	CI	Clock
5	DO	Data Output
6	$\overline{BO1}$	Dedicated Output
7	$\overline{BO2}$	Dedicated Output
8	$\overline{BO3}$	Dedicated Output
9	$\overline{BO4}$	Dedicated Output
10	$\overline{IO1}$	Input/Output Port
11	IFIN	IF Counter
12	$\overline{IO2}$	Input/Output Port
13	AMIN	AM local Oscillator Signal Input
14	FMIN	FM Local Oscillator Signal Input
15	VDD	Power Supply
16	PD	Charge Pump Output
17	AIN	LPF Amp
18	AOUT	MOSFET
19	VSS	Ground
20	XOUT	X'tal OSC

INTEGRATED CIRCUITS

Multi-Room Interface



LA1836M, AM/FM Tuner IC (U300), Bose® part number 187600-001

INTEGRATED CIRCUITS

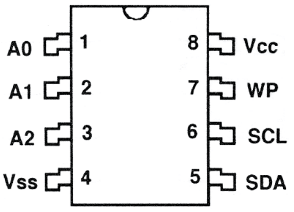
Multi-Room Interface (MRI)

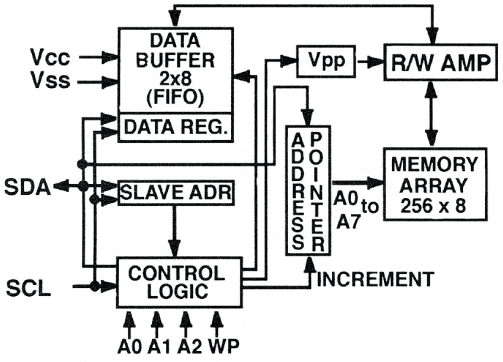
LA1836M, AM/FM Tuner IC Pin Out Table

Pin Number	Name	Description
1	FM IF IN	FM IF, input. 330Ω input impedance
2	AM MIXER OUTPUT	AM mixer output
3	FM IF INPUT BYPASS	FM IF input bypass, also used for AM noise filter.
4	VREG	Voltage regulator output, 3.6V
5	AM IF INPUT	AM IF input, 2 kΩ input impedance
6	GND	Ground
7	TU LED	Tuned LED output, active low.
8	ST LED, AM IF OUTPUT	Stereo LED output, active low. A< stereo IF output.
9	FM DETECTOR	FM discriminator pin.
10	VCC	Supply voltage
11	AM/FM IF BUFFER OUTPUT, MUTE	IF buffer output turns on at 4.0V and greater. Postamplifier muting turns on at 1.3V and greater.
12	S-METER, AM SD ADJ	AM station detect (SD) sensitivity is adjusted with a resistor between this pin and ground. The AM SD sensitivity should be adjusted first since the FM SD sensitivity is affected by this adjustment
13	AM NARROWBAND CERAMIC FILTER	Connecting an AM IF ceramic filter to this pin will produce AM narrowband station detection.
14	PLL, LPF, AM/FM	FM multiplex PLL demodulator loop filter is connected externally. AM mode selected when ths pin is connected to ground. FM selected when this pin is left open.
15	PILOT DET LPF, FORCE MONO	Force mono when a current of 50 microamps or larger flows from this pin; connecting this pin to ground stops the VCO.
16	L OUT	Post amplifier left output, output impedance = 200Ω
17	R OUT	Post amplifier right output, output impedance = 200Ω
18	POST AMPLIFIER L OUT	Post amplifier left input, input impedance = 3.3kΩ
19	POST AMPLIFIER R OUT	Post amplifier right input, input impedance = 3.3kΩ
20	MPX L OUT	Multiplex demodulator left output, output impedance = 3.3kΩ
21	MPX R OUT	Multiplex demodulator right output, output impedance = 3.3kΩ
22	MPX INPUT	Multiplex demodulator input, input impedance = 20kΩ
23	MPX VCO	Multiplex demodulator VCO- attach 456 kHz ceramic resonator to this pin.
24	AM/FM DEMOD OUT	AM/FM demodulator output; output impedance: 1.5kΩ (FM), 10 kΩ (AM).
25	AM LOW CUT	The AM audio frequency low-band frequency response is adjusted with an external capacitor from this pin to ground.
26	AM AGC	AM AGC, internal load resistance = 6.7kΩ
27	AM RF INPUT	AM RF input, this pin must be used at the same potential as pin 28.
28	AFC	FM AFC; the FM SD bandwidth is adjusted with the external resistor connected between this pin and pin 4.
29	OSC	The AM oscillator coil connected between this pin and pin 4.
30	OSC BUFF OUT, FM SD ADJ	The FM SD sensitivity is adjusted with the external resistor connected between this pin and ground; output impedance = 200Ω.

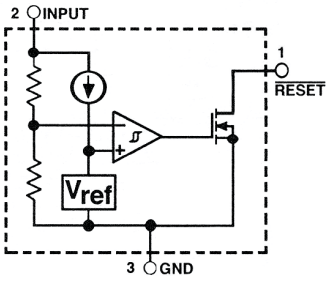
INTEGRATED CIRCUITS

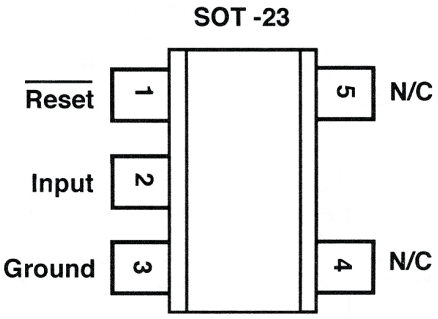
Personal® Music Center



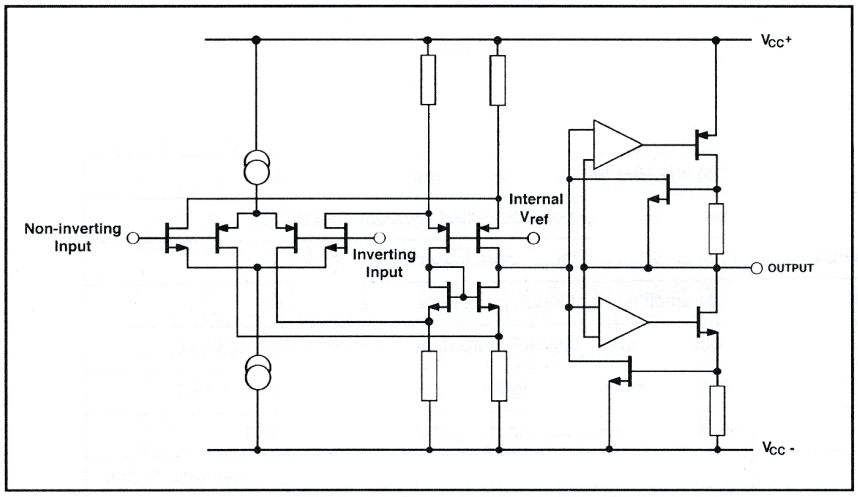


24C02A, 2K bit Electrically Erasable PROM
(U2) Bose® part number 177982-2

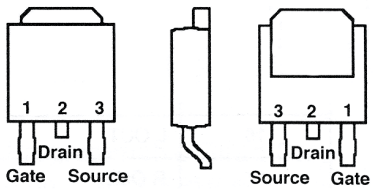




Reset IC, (U3) Bose part number 196983-23R0

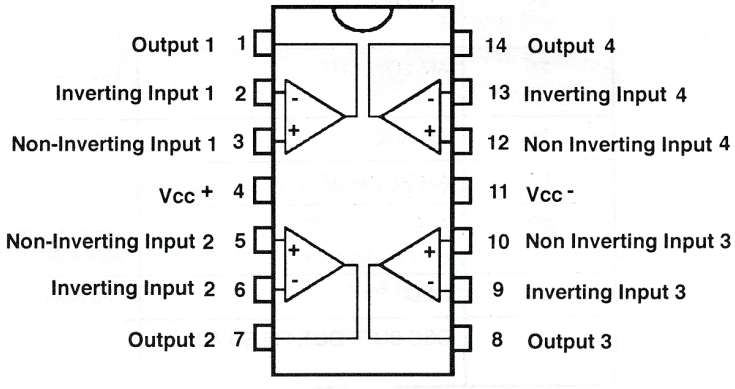


(1/4 Block Diagram)



Power MOSFET SMT (Q2)
Bose part number 191453

CMOS Quad 3V SO14 Op Amp, (U4)
Bose part number 199543

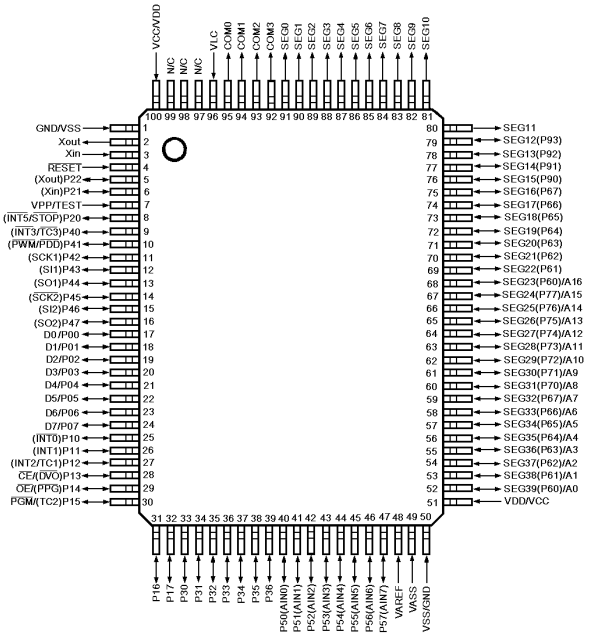


INTEGRATED CIRCUITS

Personal® Music Center

TMP87PM40AF Microcontroller Pin Out Table

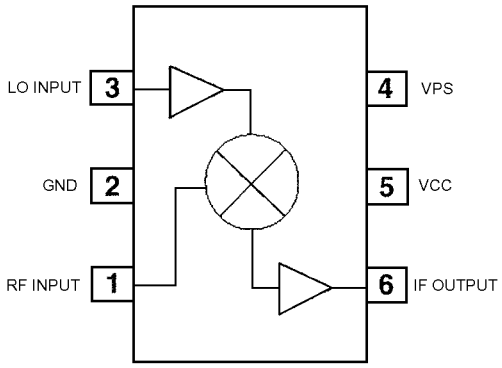
Pin Name (Prom mode)	I/O	Function	Pin Name (MCU mode)
A16 A15 to A8 A7 toA0	I	PROM address inputs	P60 P77 to P70 P87 to P80
D7 to D0	I/O	PROM data inputs/output	P07 to P00
CE OE PGM	I	Chip enable signal input (active low) Output enable signal input (active low) Program mode signal input	P13 P14 P15
VPP VCC GND	Power Supply	+12.75V/5V (Program supply voltage) +6.25V/5V 0V	TEST VDD VSS
P36 to P30 P47 to P40 P57 to P50 P67 to P62 P93 to P90	I/O	Pull-up with resistance for input processing	
P11 P21 P61 P17, P16, P12, P10, P22, P20 RESET	I/O	PROM mode setting pin. Be fixed at high level. PROM mode setting pin. Be fixed at low level	
Xin	I	Connect at 8 MHz oscillator to stabilize the internal state.	
Xout	O		
VAREF VASS	Power Supply	0V (GND)	
COM3 to COM0 SEG11 to SEG0	O	Open	
Vcc	Power Supply		



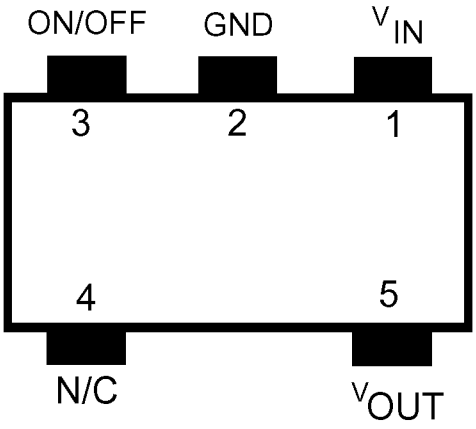
TMP87PM40AF, Microcontroller, (U1) Bose® part number 189966-004

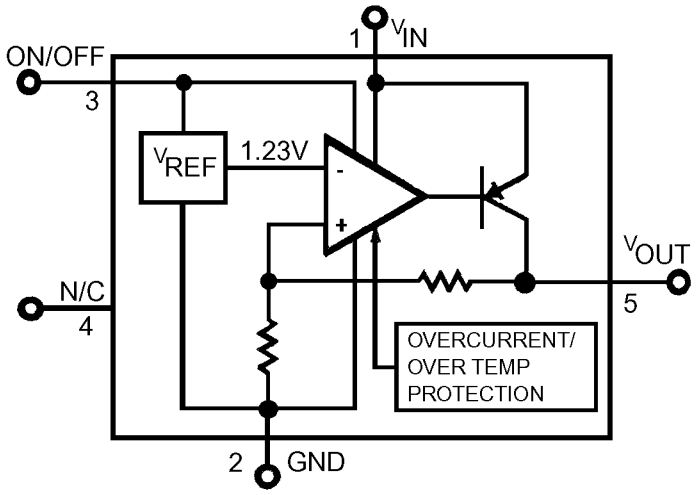
INTEGRATED CIRCUITS

Radio Data Link (RDL)

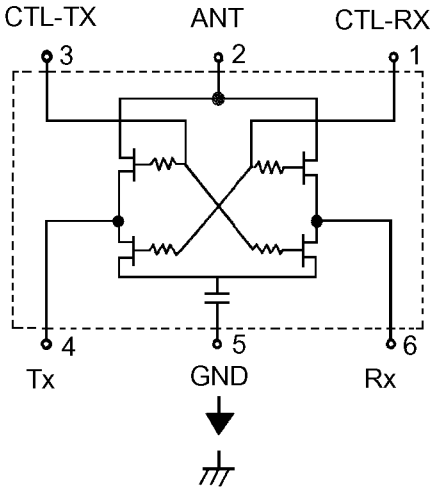


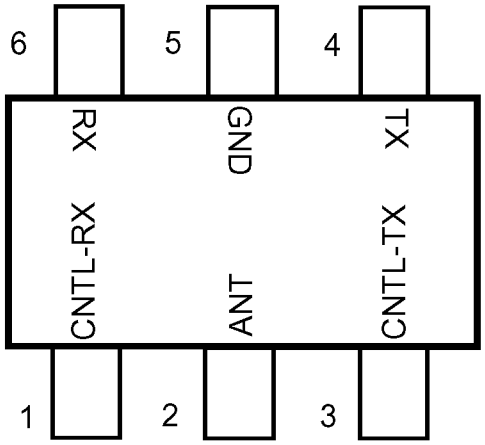
NEC, UPC2757T, L-Band Frequency Converter,
Bose® part number 18946-001





LP29801M5X-3.3, 3.3 Volt Low Drop Regulator, Bose part number 191452-3R3F

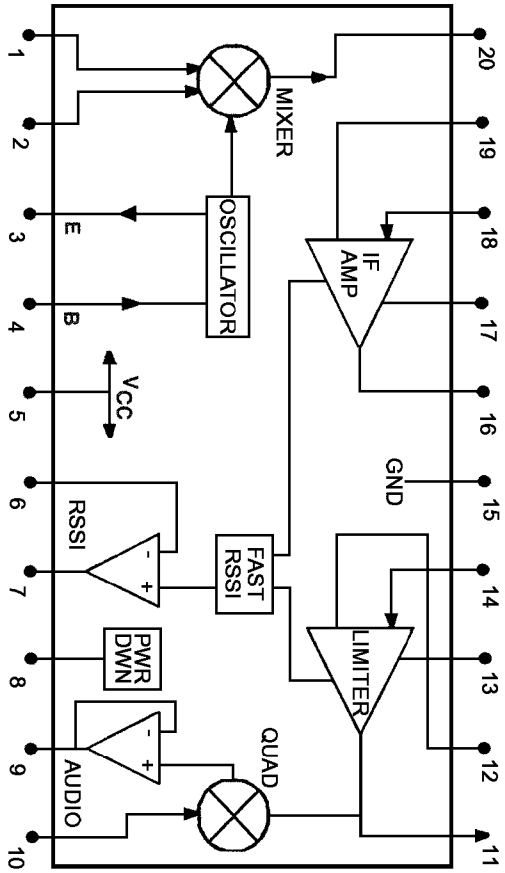




RF Switch IC, Bose part number 196993

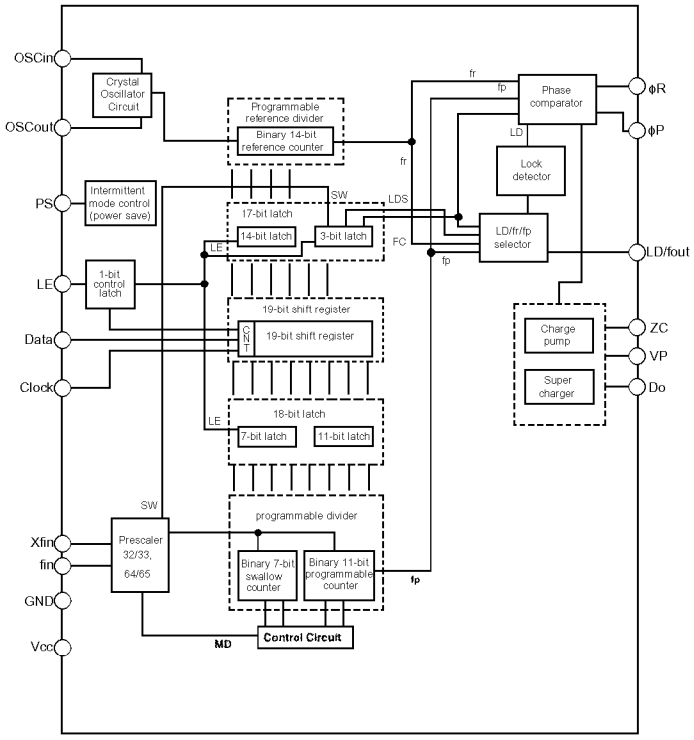
INTEGRATED CIRCUITS

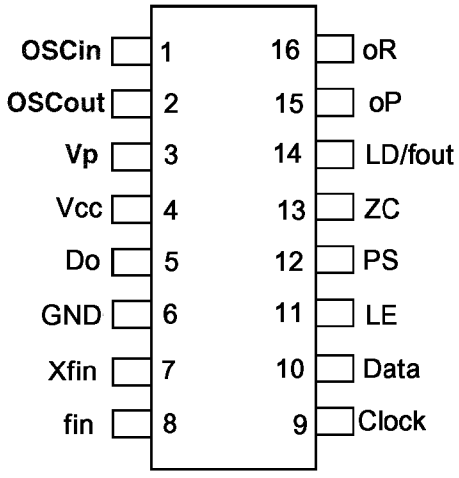
Radio Data Link (RDL)



Pin number	Symbol
1	RF_{in}
2	RF Bypass
3	XTAL OSC Emitter
4	XTAL OSC (Base)
5	Vcc
6	RSSI Feedback
7	$RSSI_{out}$
8	Power down control
9	Audio out
10	Quadrature in
11	Limiter out
12	Limiter decoupling
13	Limiter decoupling
14	Limiter in
15	GND
16	IF amp out
17	IF amp decoupling
18	IF amp in
19	IF amp decoupling
20	Mixer out

SA626DK, FM, IF Mixer, Bose® part number 191486





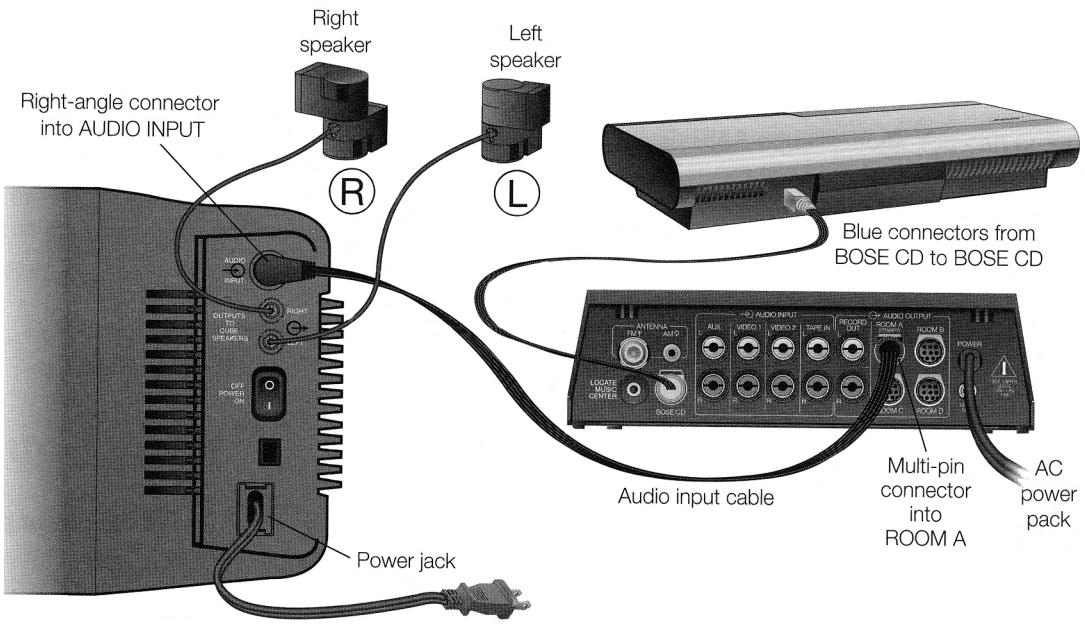
PLL, Frequency Synthesizer, Bose part number 199541

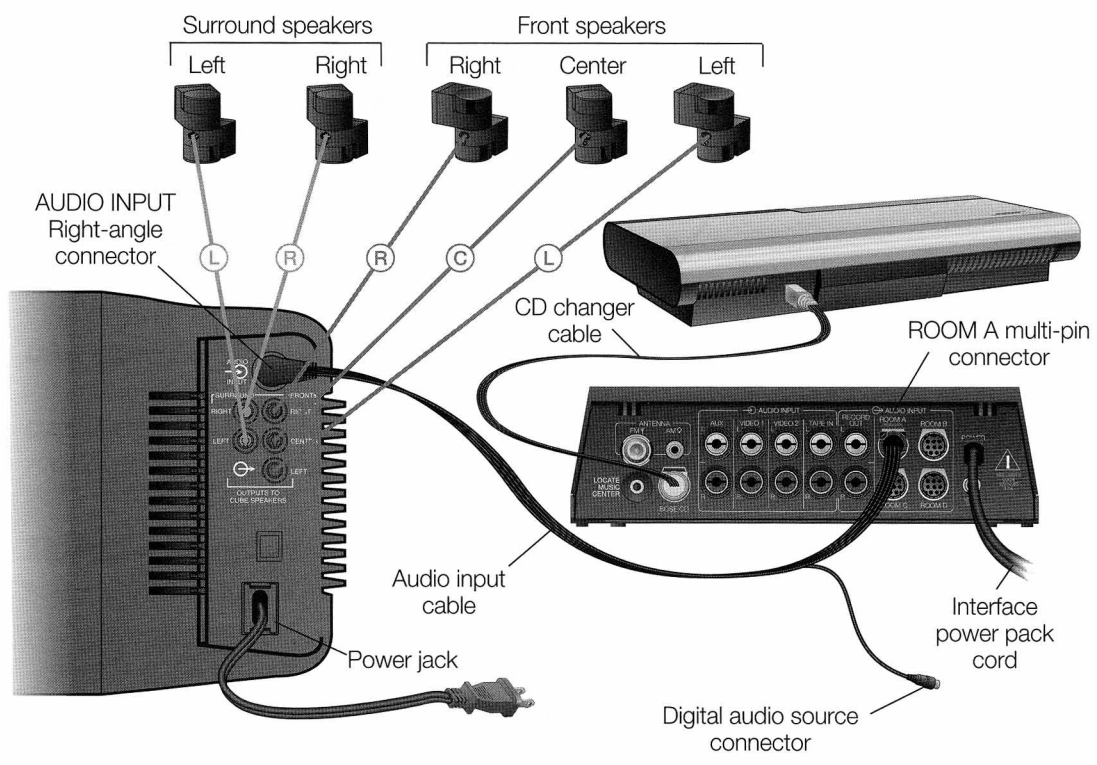
INTEGRATED CIRCUITS

Radio Data Link (RDL)
PLL, Frequncy Synthesizer Pin Out Tablre

Pin Numbers	Symbols	I/O	Function
1	OSC_{in}	I	Programmable reference divider input Oscillator input Connection for crystal or TCXO. TCXO should be connected through a coupling capacitor.
2	OSC_{out}	O	Oscillator output Connection for an external crystal
3	Vp	-	Power supply input for the charge pump
4	Vcc	-	Power supply voltage input
5	Do	O	Charge pump output: Phase of the charge pump can be reversed by FC bit
6	GND	-	Ground
7	Xfin	I	Prescaler complementary input. Xfin should be grounded through AC coupling.
8	Fin	I	Prescaler input: connection with an external VCO should be made through AC copling.
9	Clock	I	Clock input for the 19-bit shift register Data is shifted into the register on the rising edge of the clock (Open is prohibited)
10	Data	I	Serial data input using binary code. The last bit of the data is a control bit (Open is prohibited) Control bit = "H": Data is transmitted to the programmable reference counter. Control bit = "L": Data is transmitted to the programmable counter.
11	LE	I	Load enable signal input. (Open is prohibited) When LE is high, the data in the shift register is transferred to a latch, according to the control bit in the serial data.
12	PS	I	Power saving mode control. This pin must be set to "L" at power on (Open is prohibited) PS = "H": Normal mode PS = "L": Power saving mode
13	ZC	I	Forced high impedance control for the charge pump (with internal pull up resistors) ZC = "H": Normal Do output ZC = "L": Do becomes a high impedance
14	LD/fout	O	Lock detect signal output (LD) / phase comparator monitoring output (fout). The output signal is selected by the LDS bit in the serial data LDS = "H": Outputs fout (fr/fp monitoring) LDS = "L": Outputs LD ("H" at locking, "L" at unlocking)
15	0P	O	Phase comparator output for an external charge pump. Nch open drain output
16	0R	O	Phase comparator output for an external charge pump CMOS output

LS40 AND LS50 SYSTEM COMPONENTS





BOSE®
Better sound through research®

LS-40 and 50 Lifestyle® System
Personal® Music Center
Personal® Media Center
Multi-Room Interface
and Multi-Room Media Interface

Model P1 Personal® Music Center
or
Model P1 Personal® Media Center

Model M1 Multi-Room Interface
or
Model M1 Multi-Room Media Interface

Service Manual
Part Number 199402 Rev 01

SPECIFICATIONS AND FEATURES SUBJECT TO CHANGE WITHOUT NOTICE

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