

INSTALLATION INSTRUCTIONS

RAT1 REMOTE AUTO TRANSFORMER

The RAT1 is an infrared remote controlled stereo speaker volume control with impedance matching capability. It allows individual volume control of from one to 16 pair of stereo speakers from one stereo power amplifier, using one RAT1 for each stereo speaker pair. It is controlled with any Xantech IR Receiver or keypad or with Xantech MIRV1 motorized volume controls. The RAT1 maintains correct impedance matching between the amplifier and the speakers with the use of instant setting S1 to S8 jumpers, located on the unit. This eliminates the need for separate impedance matching devices in multi-room installations.

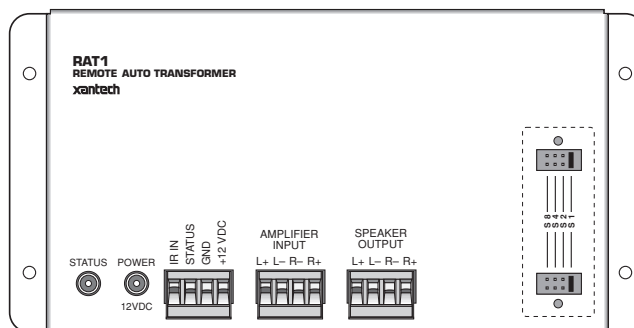


Fig. 1 The RAT1

FEATURES AND SPECIFICATIONS

- 10-position relay driven stepped auto transformer design.
- Tri-Fi™ winding system for highest quality audio performance.
- Amplifier Input: 4-screw plug-in connector.
- Speaker Output: 4-screw plug-in connector.
- IR, STATUS & +12V: 4-screw plug-in connector.
- STATUS Input Jack: 2.1mm coaxial type.
- POWER Input Jack (+12V): 2.1mm coaxial type.
- Power Consumption: 300 mA @ +12V DC. Use Xantech Model 786-00 or 782-00 Power Supply.
- Requires IR commands from the RC68+ (or RC68) Programmer or from the MIRV1, for volume operations.
- Using the RC68+ Programmer, internal E² PROM can be set to different group codes for independent operation of RAT1's when on a common IR bus.
- Factory preset Group Code number is **30**.
- Independent grounds between channels.
- 75 watts per channel music power, 25 watts per channel continuous.
- Frequency response: 20 Hz - 20,000 Hz ±1 dB at 1 Watt power input.
- Attenuation: 10 steps at 3 to 6 dB per step, 35 dB maximum.
- Impedance Multiplier Settings: S1, S2, S4, & S8.
- Plug-in connectors accept wire sizes from 24 to 12 gauge.
- "Flat Pack" design permits easy mounting.
- Dimensions: 8" x 4-1/8" x 2-5/8" (203mm x 105mm x 67mm).

RC68 PROGRAMMER / REMOTE CONTROL

The RC68+ (and the RC68) programmer (available separately) contains all the commands necessary to operate the RAT1.

- You will need it to program universal learning devices such as the Xantech URC-1 learning remote, the Xantech Smart Pads, the 590 Programmable Controller, the 710 Fone Link, etc., with commands that operate the RAT1.
- NOTE:** The RC68+ codes operate several other Xantech models as well, such as the RS41AV, CC12, ZPR68, MIRV1, etc. Therefore, **only** the button descriptions that apply to the operation of the RAT1 are listed below. All others should be ignored.

CAUTION: While the RC68+ can be used as a handheld remote control, it is highly recommended it not be given to the final user for the following reasons:

- Since it includes selectable code groups, the user may inadvertently alter the installer configurations.
- Since the user will require IR commands from other brands of equipment to control the total system, in addition to those of the RAT1, all commands should be consolidated into one learning device for easy use.

APPLICABLE RC68+ BUTTON DESCRIPTIONS

- IR Emitter Lens**
- Instant Volume Presets.** These buttons allow direct preset activation of any of the 10 volume steps on the RAT1. Useful for "audio scene" ambiance settings for rooms or an instant partial mute action.

The relationship of the RC68 buttons to the RAT1 volume step positions is as follows:

RC68+ Button	RAT1 Volume Step #
A, B, C	1 (OFF, MIN. VOL)
ADJ-OFF	2
1	3
2	4
3	5
4	6
5	7
6	8
7	9
8	10 (MAX VOL)

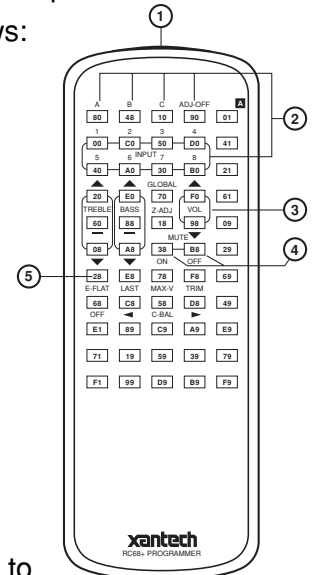


Fig. 2 The RC68+ Programmer

- VOLUME Up/Down buttons.** Each individual press will cause the RAT1 to increase or decrease volume level by one step, over a total of 10 steps. Each step causes a change of 3 to 6 dB. A maximum attenuation of 35 dB occurs at the lowest active step (#2). The lowest step (#1) switches the signal off. When buttons are held down, volume level changes continuously.
- MUTE ON/OFF.** Separate ON / OFF buttons mute and release the signal without knowing what the status is. This is very helpful in a remote room when all adjustments are made "blind" without any visual aid for status.

NOTE: Mute is released (turned off) when a VOLUME or Preset Level button is pressed, in addition to MUTE OFF.

- Code Group Numbers.** If more than one RAT1 is used on a common IR controlled bus, or is included with other Xantech products that respond to RC68+ commands, different Code Groups can be assigned, by the installer, to avoid mutual interaction. Refer to the RC68+ instructions for Code Group setting procedures.

NOTE: When shipped from the factory, the RAT1 is set to Code Group number 30. Be sure to set the RC68+ to the same number!

SETTING THE IMPEDANCE MATCHING JUMPERS

The impedance matching jumpers are located under a clear mylar cover on the right side of the top of the unit. Remove the two screws for access. The proper placement of these jumpers depends on the number of RAT1's and speakers used in the total installation. To set them for the best impedance matching condition, refer to the following charts and procedures:

WHEN USING 8 OHM SPEAKERS

Min. Amp. Impedance	Number of Speaker Pairs Used															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4 Ohms	S1	S1	S2	S2	S4	S4	S4	S4	S8	S8	S8	S8	S8	S8	S8	S8
8 Ohms	S1	S2	S4	S4	S8	S8	S8	S8								

WHEN USING 4 OHM SPEAKERS

Min. Amp. Impedance	Number of Speaker Pairs Used							
	1	2	3	4	5	6	7	8
4 Ohms	S1	S2	S4	S4	S8	S8	S8	S8
8 Ohms	S2	S4	S8	S8				

Procedure for all 4 Ohm or all 8 Ohm Speakers

1. Determine the rated speaker impedance (refer to the manufacturer's specifications - it must be the same for all speakers used in the system).
2. Determine the total number of stereo speaker pairs used in the installation.
3. Determine the minimum safe amplifier operating load impedance (refer to the manufacturer's specifications).
4. Find the correct jumper position from the above charts.
5. Place the jumpers in the same position on each RAT1 used in the system.

Example 1:

13 pairs of 8 Ohm wall speakers are to be used with 13 RAT1's in a 13 room system, all driven by one amplifier rated for 4 Ohms minimum safe operating load impedance.

1. Refer to the chart "WHEN USING 8 OHM SPEAKERS".
2. Locate the number 13 in the top row.
3. On the next row, opposite "4 OHMS" and just below "13", note the letters "S8". These signify the required impedance multiplier.
4. The two jumpers therefore, one for each channel, need to be plugged onto the S8 pins on each RAT1 that feeds each room.

Example 2:

3 pairs of 4 Ohm wall speakers are to be used with 3 RAT1's in a 3 room system, all driven by one amplifier rated for 8 Ohms minimum safe operating load impedance.

1. Refer to the chart "WHEN USING 4 OHM SPEAKERS".
2. Locate the number 3 in the top row.
3. On the third row, opposite "8 OHMS" and just below "3", note the letters "S8". These signify the required impedance multiplier.
4. The two jumpers therefore, one for each channel, need to be plugged onto the S8 pins on each RAT1 that feeds each room.

Procedure for Speakers Other Than 4 or 8 Ohms

In this case, treat all speakers that are rated between 4 and 7 Ohms as 4 Ohm speakers, and use the charts accordingly. Similarly, all speakers that are rated 8 Ohms or higher, treat as 8 Ohms speakers. Again, all speakers used in the system should be the same impedance (i.e. all 6 Ohms, all 7 Ohms, etc.).

Speaker Wire Recommendations

As a rule of thumb, use good quality 18 gauge speaker wire for runs up to 30', 16 gauge up to 70', and 14 gauge up to 150'. The 4-terminal connectors accept wire sizes up to 12 gauge max.

Procedure for Speakers of Differing Impedance Used in the Same System

You may run into installations where you need to combine speakers of different impedance in the same system (8, 6, 4 Ohms, etc.). This is a more complicated situation that requires some calculation to obtain optimum results. You need to find the paralleled impedance for each group of speakers with the same impedance first and pick an "S" setting for each. Then check the overall paralleled "S" settings to see that the impedance is higher than the minimum safe value specified for the amplifier.

Example 1:

2 pairs of 4 Ohm and 7 pairs of 8 Ohm wall speakers are to be used with 9 RAT1's in a 9 room system, all driven by one amplifier rated for 4 Ohms minimum safe operating load impedance.

1. Calculate the total paralleled impedance of the 4 Ohm group first, by dividing 4 Ohms by 2.
 $4 \div 2 = 2$ Ohms.
2. Multiply 2 by 4 (for the S4 setting) = 8 Ohms.
3. Calculate the total paralleled impedance of the 8 Ohm group next, by dividing 8 Ohms by 7.
 $8 \div 7 = 1.14$ Ohms.
4. Multiply 1.14 by 8 (for the S8 setting) = 9.12 Ohms.
5. Next, calculate the overall paralleled impedance with the following formulae:

$$Z_o = 1 \div [(1 \div Z_1) + (1 \div Z_2) + (1 \div Z_N \dots \text{etc.})]$$

Z_o = overall paralleled impedance

Z_1 = 1st paralleled group after S setting

Z_2 = 2nd paralleled group after S setting

Z_N = additional paralleled groups, when used

Since only two paralleled groups are used in this example, the calculation is as follows:

$$Z_o = 1 \div [(1 \div 8) + (1 \div 9.12)] = 4.26 \text{ Ohms.}$$

Since this yields more than 4 Ohms, the **S4 setting for the 4 Ohm group** and the **S8 setting for the 8 Ohm group** are the correct ones to use.

Example 2:

2 pairs of 4 Ohm, 3 pairs of 6 Ohm and 7 pairs of 8 Ohm wall speakers are to be used with 12 RAT1's in a 12 room system, all driven by one amplifier rated for 4 Ohms minimum safe operating load impedance.

1. Calculate the total paralleled impedance of the 4 Ohm group first, by dividing 4 Ohms by 2.
 $4 \div 2 = 2$ Ohms.
2. Multiply 2 by 8 (for the S8 setting) = 16 Ohms.
3. Calculate the total paralleled impedance of the 6 Ohm group next, by dividing 6 Ohms by 3.
 $6 \div 3 = 2$ Ohms.
4. Multiply 2 by 8 (for the S8 setting) = 16 Ohms.
5. Calculate the total paralleled impedance of the 8 Ohm group next, by dividing 8 Ohms by 7.
 $8 \div 7 = 1.14$ Ohms.

6. Multiply 1.14 by 8 (for the S8 setting) = 9.12 Ohms.
7. Next, calculate the overall paralleled impedance Z_o . Since three paralleled groups are used in this example, the calculation is as follows:

$$Z_o = 1 \div [(1 \div 16) + (1 \div 16) + (1 \div 9.12)] = 4.26 \text{ Ohms.}$$

Since this yields more than 4 Ohms, **the S8 setting for the 4 Ohm group**, the **S8 setting for the 6 Ohm group** and the **S8 setting for the 8 Ohm group** are the correct ones to use.

Impedance Setting Tips

1. You may use the above method to calculate the correct impedance matching condition for practically any combination of speakers and RAT1s.
2. Use the lowest "S" setting possible consistent with the requirement to keep above the minimum safe operating load impedance for the amplifier. You may have to try 2 or 3 values of "S" for each impedance group and recalculate the overall paralleled impedance Z_o each time, before you arrive at the final correct value.
3. When you test the system, you may find volume differences between the impedance groups when all RAT1s are set to max. volume. This is normal and is usually not a problem, since the user will be listening at lower levels most of the time. If you feel it necessary to even out the volume levels, move the "S" jumpers to the next higher number on the RAT1s that feed the loudest group.

NOTE: While speakers of differing impedance can be accommodated using these procedures, it is highly recommended you not do so on a regular basis. The easiest and best performing installation is achieved by using speakers of the same impedance throughout the entire system. Then use the charts to determine the correct jumper "S" settings.

INSTALLATION - COMMON IR BUS SYSTEM

Fig. 3 illustrates a typical installation using three RAT1's along with other Xantech products in a 4-room multi-room system. The principles shown should be used as a guide when planning your own specific installations. It is configured as follows:

1. For simplicity, only three RAT1's are shown. Larger systems (up to a max. of 16 using 8-Ohm speakers) may be used. 16 is the maximum number using 8-Ohm speakers and an amplifier with a minimum loading impedance of 4 Ohms. See chart, in: Setting the Impedance Matching Jumpers section).
2. Note that a **Common IR Bus** connects the 780-80 "J" Box IR Receiver, the two MIRV1 Volume Controls, a 480-00 "Dinky Link" IR Receiver and a Smart Pad₃ keypad to each of the RAT1's. In addition, it connects to a 789-44 Connecting Block, so that the source equipment can be controlled from the remote rooms.
3. Since a common IR bus is used, each of the RAT1's and its connected MIRV1 (where used) must use a different IR Code Group number, so that the volume level in each room can be adjusted independent of the others.

To make code group changes, refer to the RC68+ Programmer Instructions.

NOTE: When shipped from the factory, the RAT1 and MIRV1 are set to code group number 30. If you use group 30 or change to a different number, be sure to always set the RC68+ to the same number.

4. When a code group is chosen, "teach" volume commands from the RC68+ Programmer (see **Fig. 2**) into learning remote controls (and the keypad), dedicated to each room. You may use the Xantech URC learning remote controllers for this purpose.

NOTE: With a Common IR Bus system, you cannot carry the same remote control from room-to-room. You must use a dedicated remote for each room into which you have "taught" the specific RC68+ Code Group that operates the specific RAT1 that controls the volume for that room!

If you wish to carry remotes that have the same codes from room-to-room, use a Dedicated IR Bus System as shown in **Fig. 4**.

5. A 490-30 "Micro Link" IR Receiver plugs into the 789-44 for local control of the source equipment (i.e. equipment behind closed doors, etc.).
6. A "STATUS" system is included. This permits the power "ON/OFF" status of the A/V receiver or amplifier system to be visible in each of the remote rooms. It also permits the power management capability of the Smart Pad₃ to operate.
7. The "STATUS" indicator LEDs on the 780-80 "J" Box IR Receiver, the two MIRV1 Volume Controls and the Smart Pad₃, are powered by a 786-00 Power Supply plugged into a "**SWITCHED**" AC outlet on the A/V receiver or amplifier system. When the switched outlet is "ON", +12 Volts from the 786-00 passes through one of the 4 bus-conductors (STATUS line) to the LED indicators.

NOTE: A resistor can be placed in series with the STATUS terminal at each IR receiver (IR receivers only, if so equipped) for adjustment of the brightness of the Status LED. See the specific installation instructions for the IR receiver for details.

NOTE: *When connecting system devices, be sure to carefully match up the terminals according to their markings as follows:*

IR IN (IR), STATUS (ST), GND (G) and +12VDC (V).

Power Supply Considerations

Up to 3 RAT1's plus associated MIRV1's and IR components can be used with one 782-00 Power Supply. (e.g. 9 RAT1's with associated components would require 3 of the 782-00 Power Supplies). Typical power supply connections are shown in **Figs. 3, 4 and 6**.

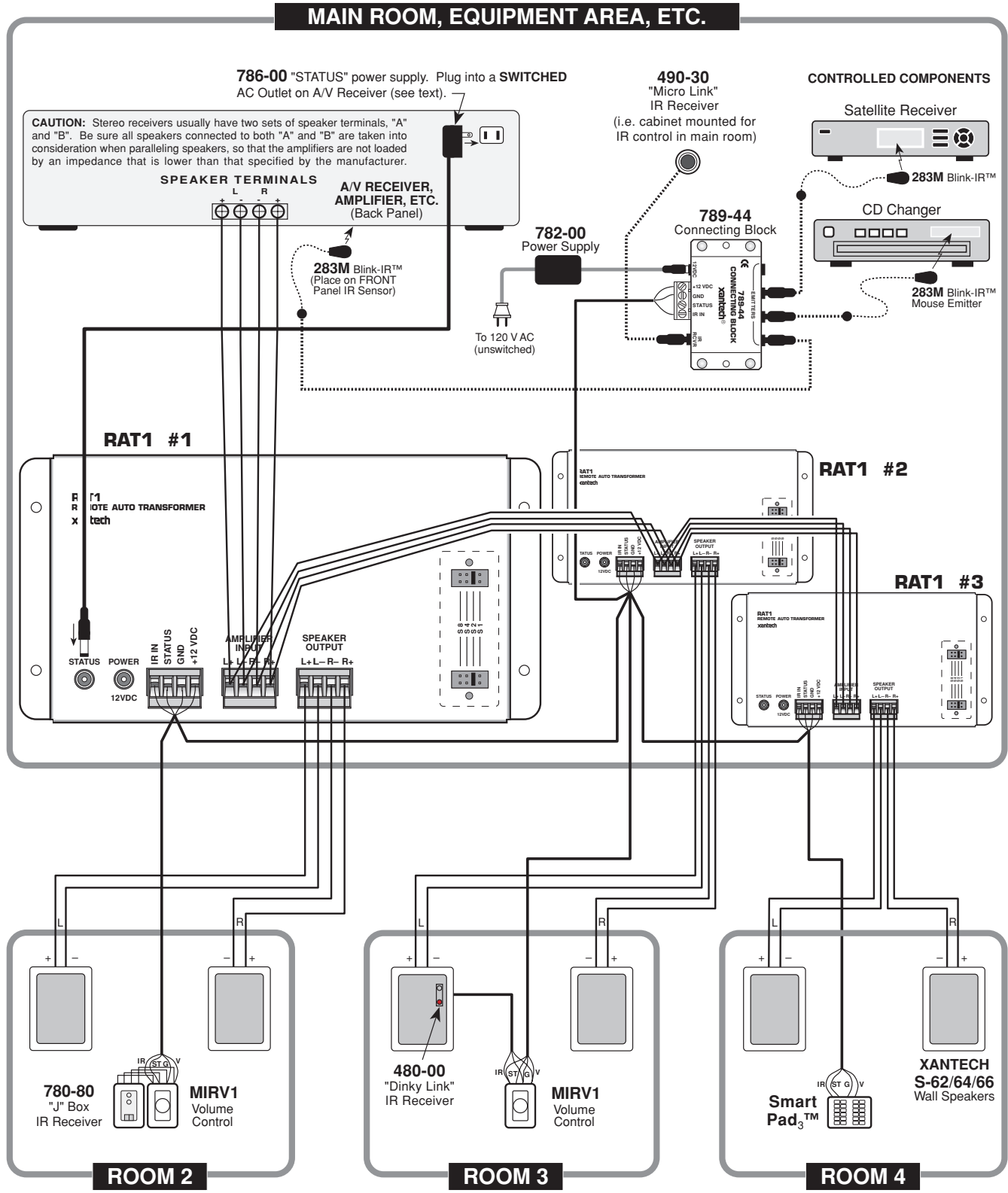


Fig. 3 A RAT1 System Using a Common IR Bus

Speakers & Volume Controls

INSTALLATION - DEDICATED IR BUS SYSTEM

Fig. 4 illustrates an installation where each remote room has a Dedicated IR Bus going to the RAT1 that controls it. The IR bus is not connected in common as it is in **Fig. 3**. This eliminates the need for dedicated remotes, *allowing you to carry the same remote(s) from room-to-room*. It is configured as follows:

1. Again, for simplicity, only three RAT1's are shown. Larger systems may be configured, using the same connection techniques (up to a max. of 16 RAT1's). 16 is the maximum number using 8-Ohm speakers and an amplifier with a minimum loading impedance of 4 Ohms. See chart on page 3.
2. Each Dedicated IR Bus connects the 780-80 "J" Box IR Receiver, the two MIRV1 Volume Controls, a 480-00 "Dinky Link" IR Receiver and a Smart Pad₃ keypad to their respective RAT1's.
3. In order to control the common source components in a Dedicated IR Bus system, it is necessary to use a 793-00 Serial Control Combiner, connected as shown in **Figs. 4 & 5**. The 793 provides diode isolation between the IR signal lines but allows common operation of the source equipment through the 789-44 Connecting Block, as shown.

Set the LOGIC POLARITY SELECTOR DIP switches on the 793 for "active high" operation - that is - all even numbered switches to "ON" - all odd numbered switches to "OFF".

4. The input and output ports on the 793 are 3.5mm mono mini jacks. Use matching mini plug cables with stripped ends when connecting. Polarity must be observed as shown in **Fig. 5**.
For systems using more than five RAT1's, you will need additional 793-00's. These can be easily "daisy chained" as shown in **Fig. 5**.
5. Since a Dedicated IR Bus system is used, each of the RAT1's (and MIRV1's) can operate with the same IR Code Group number. In this case, the Code Group number, as received from the factory, should be used.

NOTE: When shipped from the factory, the RAT1 (and MIRV1's) are set to Code Group number 30. Be sure to set the RC68+ to the same number!

If a particular system requires a code group number change, refer to the RC68+ Programmer Instructions for code group setting procedures.

6. The desired volume commands from the RC68+ Programmer (see **Fig. 2**) need to be "taught" into learning remote controls and keypads used in the system. You may use the Xantech URC learning remote controllers for this purpose.
7. A 490-30 "Micro Link" IR Receiver plugs into the 789-44 for local control of the source equipment.
8. As in **Fig. 3**, a "STATUS" system is included.

NOTE: When connecting system devices, be sure to carefully match up the terminals according to their markings as follows:

IR IN (IR), STATUS (ST), GND (G) and +12VDC (V).

Daisy-Chaining 793-00 Serial Control Combiners for Control of Common Components

Fig.5 illustrates how two 793-00 Serial Control Combiners are "Daisy-Chained" to accommodate additional RAT's in a dedicated IR Bus System. This process can be repeated as necessary to accommodate the number of RAT's needed in the system. Simply connect the "B" CONTROL OUTPUTS port of the next 793 into the "A" CONTROL OUTPUTS port on the preceding 793 with a 3.5-to-3.5mm mono-mini cable as shown.

NOTE: Be sure that all ten LOGIC POLARITY SELECTOR DIP switches on each 793 are set correctly. In this case, set them for "active high" operation - that is - all even numbered switches to "ON" - all odd numbered switches to "OFF".

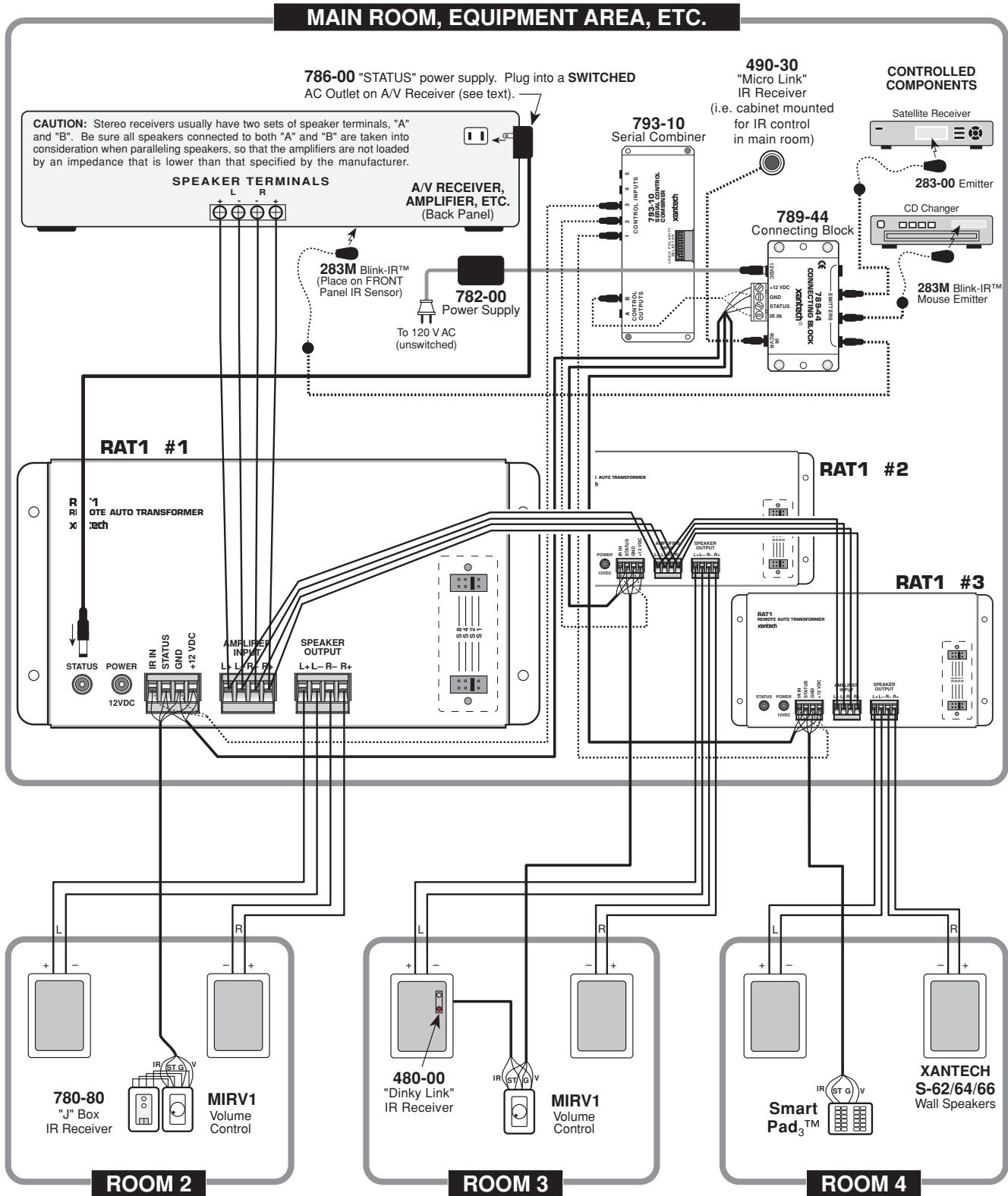


Fig. 4 A RAT1 Dedicated IR Bus System

INSTALLATION (cont'd)

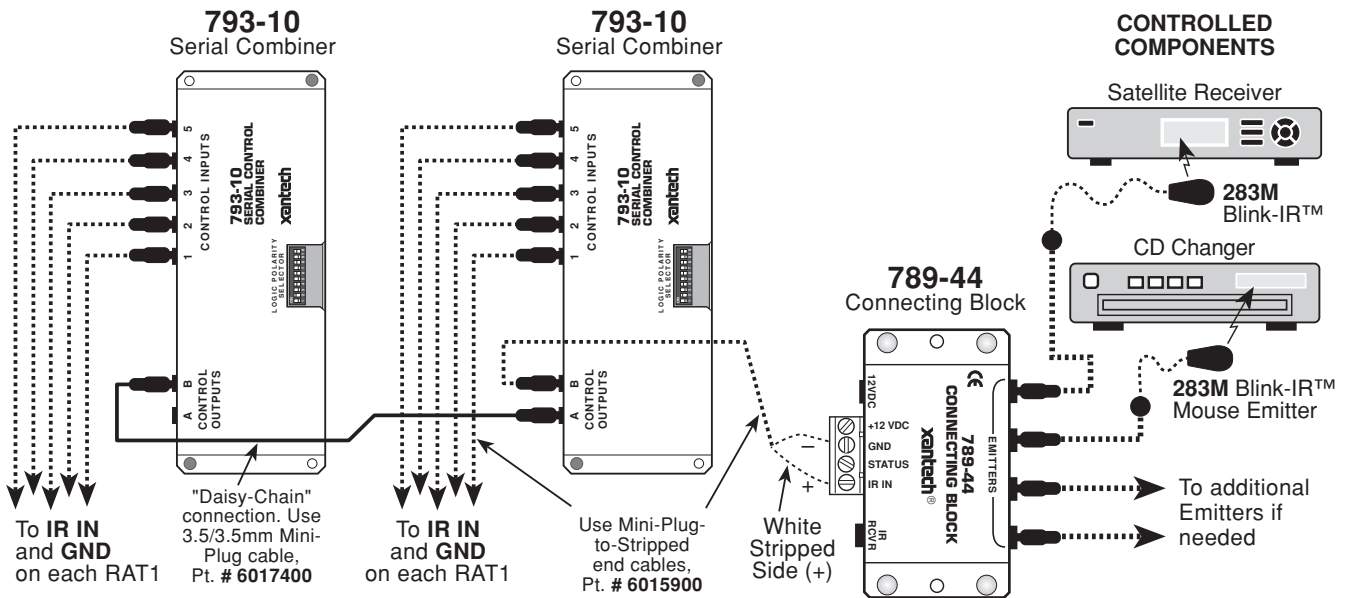


Fig. 5 Daisy-Chaining 793-00's in Multiple RAT1 Dedicated IR Bus Systems

Driving Multiple Speakers From a Single RAT1

In some cases you may need to drive more than one set of speakers from a single RAT1, such as in large rooms or adjoining areas where common volume operation is acceptable. A typical system is shown in Fig. 6.

1. Use the same charts and rules for setting the impedance jumpers. In Fig. 6, all 8-Ohm speakers and an amplifier capable of handling an impedance of 4-Ohms, is assumed; resulting in a jumper setting of **S1**.
2. Note that two MIRV1's are used; one at one location in the room and the 2nd in another, for convenience of use. They both control the same volume level and track each other.

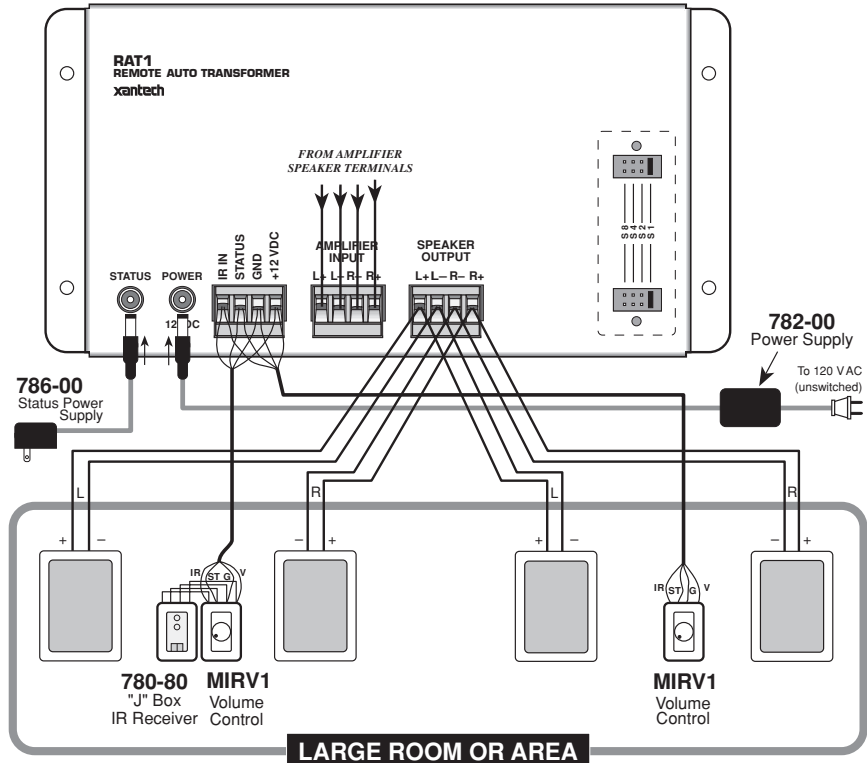


Fig. 6 Driving Two Speaker Pairs From One RAT1

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