

Quadravox

QV531, MP3 RS232 playback module

Features:

- plays all *.mp3 and *.mp2 files from CompactFlash memory.
- standard (+/-10V) RS232 control input
- fourteen trigger control inputs with input protection
- status/power LED
- line-level outputs
- 22W stereo amplifier and speaker connectors (optional)
- IR remote control operation (optional)

General description:

The QV500 series playback modules use MP3 (MPEG I, layer 3) perceptual coding to reproduce sound at a variety of data rates and quality levels. At the standard music rate of 128000bps, the system can produce near-CD quality sound using approximately one megabyte of data per minute. The systems can also accept lower data rate and monaural files, so capacity can be extended if an application does not need the full capability for all sounds.

The system has been optimized for industrial use in the following ways:

- the control interface is RS232 plus 14 programmable inputs supporting a wide variety of contact and sensor arrangements.
- the memory interface is for CompactFlash format flash memories. This style of memory is much more rugged than the smaller formats used for consumer MP3 players. It is also available in larger capacities; up to 320Mbytes, or 5 ½ hours of continuous stereo sound.
- the memory cartridges use standard Windows formats. A standard CompactFlash programmer is used to program the memories.
- volume and channel balance are controlled through the interface.
- volume, balance and mode are saved in non-volatile memory so that startup and brownout recovery will restore the last settings.

System Architecture:

The QV531 contains a core audio section combined with a main board with various utility functions and its own programmable processor.

The core audio section uses a Micronas MAS3507D decoder and DAC3550, affording full analog volume and balance controls. It accepts 9600B 5V RS232 commands and produces volume-controlled stereo line level outputs. It provides an amplifier-enable pin to minimize power dissipation in amplified systems. The core software can read standard Windows directory structures (FAT12, 16, and 32) and fragmented files. The core accepts +5V and generates independent regulated 3.0V analog and digital supplies for the cleanest possible sound.

The main board of the QV531 system adds the following functions:

- +5V regulation from a 6.7-to-16VDC input (amplifiers in the amplified versions utilize the input voltage directly).
- power supply monitoring for brownout and slow rise time conditions.
- an independent programmable processor for implementing alternative control interfaces
- optional 22W/channel stereo amplifier
- optional common-ground 6W/channel headphone jack (available only on amplified versions)
- optional IR remote control sensor and decoding

- **QV531 Basic Controls:**

- Power switch and system status LED; when RED indicates that the system is not ready for play. This occurs when the module is removed, and also when the system is building the table for the next sound. A command sent during this period will be ignored. When GREEN, indicates that the memory is inserted and that the system has read all the structure information and is ready to play. This LED doubles as a power on indicator.
- Power supply; amplified QV531s are shipped with a regulated 12 or 15VDC, 3.3A power supply. Line-level systems are shipped with a 9VDC, 300mA supply. If you want to supply power from another source, equip it with a standard concentric power plug with center hole for a 2.1mm pin. The center is positive.
- Changing the memory: You can do this at any time. The sound will stop and you will have to press another button to restart it with this or another module. You can change sounds simply by swapping memories. The system will recognize that a new cartridge has been inserted and will re-initialize itself within about two seconds.

Playing files:

File play can be initiated from either the RS232 or the parallel interfaces. If another file is playing, the playback will be stopped immediately and the second file begun. If a non-existent file is selected, the system will return immediately. The file will be played with the current volume, balance, and loop settings.

Setting volume:

The volume can be set with the RS232 command set only unless a manual volume control is specially ordered. The default level is 32 on a scale of 0-56. Levels 8-56 have 1.5dB spacing. Levels below 8 have 3dB spacing. The Set Volume command field allows access to all levels. If a value greater than 56 is specified, 56 will be used. The Increment Volume and Decrement Volume adjust volume by 1.5 or 3dB depending on the current level.

Setting balance:

In order to prevent inadvertent clipping distortion, the balance control is effected by reducing the level of the left or right channels. I.E. moving the balance left results in the right channel's output being attenuated. A Jog Left or Jog Right command decreases the opposite channel by 1.5 or 3dB depending on the current level. Setting the balance directly with a value of +/-15 achieves the same goal in a single step. Setting the balance to 0 restores the base volume level to both channels.

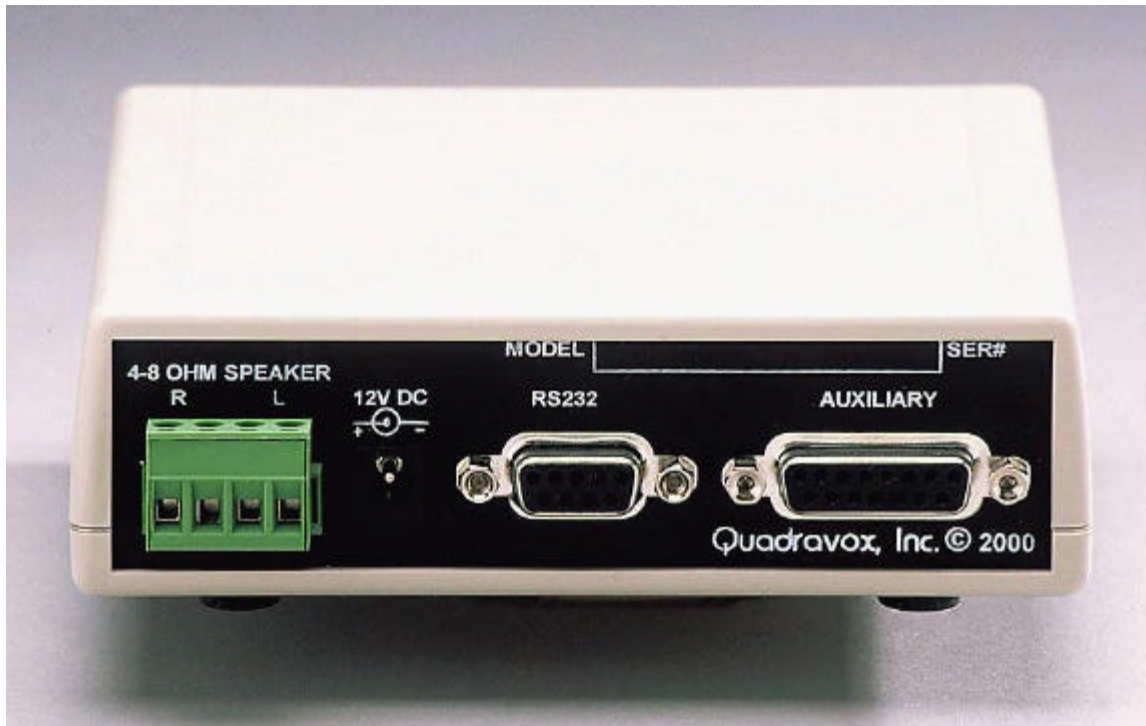
Loop mode:

Looping mode can be entered or exited at any time. If a file is playing when the mode is changed, the change in mode will be seen upon its completion. If a new file is begun in the middle of play, the looping mode will remain as established.

Pause and Resume:

Playback in progress will be halted immediately. Resume restart the file from the current point. Play will initiate playback of the new file.

Rear Panel Connections



QV531 RS232 Command Set (DB9 Connector):

The most frequently used commands consist of a single 9600B RS232 byte. Extended commands are provided to access the full range of the directory and other functions that require field data.

The **single byte commands** are:

0x01-0x7f: play file number 0 through 127. If a file is being played when the new command is issued, it will be terminated and the new one will start. If looping mode is set, it will remain set. (returns file number at end of play)

0x80-0xb8: set volume; the base volume for both channels is set to one of the 56 available levels

0xc0-0xdf: set balance; +/-15 levels - if positive, the right channel is attenuated 0-15 levels. If negative, the left channel is attenuated.

- 0xf0 (240) - stop instantly
- 0xf4 (244) - set loop mode; play in progress will loop on completion
- 0xf1 (241) - reset loop mode; play in progress will go to completion
- 0xf8 (250) - pause
- 0xf9 (251) - resume
- 0xf2 (243) - increment volume
- 0xf3 (242) - decrement volume
- 0xfa (248) - jog balance towards left channel
- 0xfb (249) - jog balance towards right channel
- 0xf5 (245) - get status (returns status byte defined below)
- 0xf6 (246) - get errors (returns error byte defined below)
- 0xf7 (247) - s/w reset; re-establishes default values
- 0xfc (252) - get volume (returns volume byte)
- 0xfd (253) - get balance (returns signed balance byte)

- 0xfe (254) - get revision (returns firmware revision code)
- 0xff (255) - get type (returns module type)
(from firmware revision 1.07e)
- 0xef (239) - get number of files (returns number of files mod 256)
- 0xed (237) - mute right channel
- 0xed (236) - unmute right channel
- 0xed (235) - mute left channel
- 0xed (234) - unmute left channel

Two byte commands (from firmware revision 1.07e) are:

- 0xe0 (224) - play file (x) in bank 0; file numbers 0-255
- 0xe1 (225) - play file (x) in bank 1; file numbers 256-511
- 0xee (238) - set balance (extended); second byte is +/- 0-56. If negative, attenuates right channel by specified number of levels. If positive, attenuates right channel.

Except as noted, commands return the status value.

Status byte bits:

- 7: hardware error
- 6: sector error (CF is not formatted with 512 bytes/sector)
- 5: no card in socket
- 4: pause
- 3: blank (selected file does not exist in this memory)
- 2: mute
- 1: loop
- 0: playing

Error values:

The error byte bits indicate:

- 7: (not used)
- 6: I2C no acknowledgment
- 5: I2C timeout
- 4: (not used)
- 3: memory manager not responding
- 2: DAC3550
- 1: MAS3507
- 0: serial EEPROM

QV531 Power input and requirements:

Board level versions of the QV531 are delivered without power supplies. The user must provide a suitable DC supply matched to the center positive 2.1mm pin connector at the rear edge of the board. For -L versions without on-board power amplification, a common 9VDC, 200mA supply is sufficient. This supply need not be regulated. The amplified QV531 uses the input voltage directly to power the amplifier, so best results will be obtained if this is a regulated supply. We recommend a 12-14.4VDC supply capable of providing 3.3A . If the content is not too demanding, reasonable results can be obtained with lower current supplies. The amplifier used in the QV531 was designed for car stereo applications, so its power rating assumes a nominal operating voltage of 14.4VDC.

QV531 Parallel input and output (Auxiliary DB15 connector):

The DB15 parallel input connector utilizes a separate programmable microcontroller to internally generate the RS232 control sequences used by the core system. Although it is not intended that the external RS232 interface be used simultaneously with internally generated commands, no switching is necessary to select the control means.

As delivered in standard form, the parallel input can launch up to 13 separate messages (codes 1-13), each triggered when the corresponding pin is connected through a low impedance to system ground (pin 9). 0-5V voltage levels can also be used with 0 defined as the active level. As with the RS232 commands, a new trigger will cancel current playback in favor of the new entry. To utilize the DB15 interface, pin 15 of the connector should be grounded.

The use of an independent processor makes this a potentially very powerful command interpreter. It is used, for example, to decode the IR remote control commands for that option. A few of many possible controls are:

- keyboard or X-Y switch scan for up to 49 switches
- volume or balance in addition to phrase controls
- bus-based controls (e.g. eight bit data bus + six additional clock or control lines)
- PIR input filtering
- touch or proximity sensors or sensor arrays (e.g. Quantum Research's QT60320)
- custom IR or RF module protocols
- other serial protocols

The fourteen lines can also be configured to operate as outputs, allowing control of peripheral devices in synchronization with sound. Call Quadravox for your special requirements.

QV531 Speaker Connections:

The amplified versions of the QV531 utilize a four conductor pluggable connector on the rear of the unit. The screw-terminal section of the connector can be removed for easier installation of the speaker wires. Please note that the amplifier has a bridge-tied-load configuration and therefore none of the four connections can be shorted to ground or to each other. For best results, the speakers should be properly phased – that is, the + and - terminals of each pair should be connected in the same manner to their respective speakers.

QV300s2 Programming and Test Software

Description:

The QV300S2 software has two functions when used in conjunction with the QV531: it simplifies the transfer of data to the CompactFlash and it provides a means of testing and demonstrating the QV531 operation. The software has been written to be compatible with Windows 95, 98, 2000, and NT4 operating systems.

Operation:

System setup- use the System Setup tab to set the module type (always QV531 for this module), the disk drive letter for the removable drive used to program the CF card, and the serial port. The baud rate will be set automatically to 9600B. The Capacity window will show the unformatted capacity of the CF card presently inserted and the Space Available window will show the free space on the card.

Project management- use the Data Setup tab to set up, save, and restore projects. Beginning with a new project, add files in MP3 or MP2 format as required. Files will be recorded in the order of the listing with the first file in the list being assigned the value 1. Files can be rearranged by dragging and dropping them in the list. As files are added, the project size is displayed.

Recording and playback- use the Recording/Playback tab to do two separate functions: write files to the CompactFlash, transparently renaming them 001.mp3 to nnn.MP3 based on the position in the list, and play files from the QV531 module. Please note that the Transfer function works only with the CF adapter; it does not cause the files to be loaded via the RS232 control stream. In addition to the files themselves, the project table file is also written to the CF. It is best to delete all files prior to writing a new set to eliminate the possibility of a conflicting file name. The controller looks only at the first three characters of the name, so a file named "000blah.mp3" would be confused with "000.mp3". It is not necessary to format the disk. The current version of QV300S2 does not have a facility for erasing all files, so this must be done using normal Windows functions first. The Free Memory value will reflect the capacity used by the project.

Playing files is possible only after the CF has been replaced in the unit. To play a single file, double-click on it in the list. To play all files, use the "Play" button. The volume may be set at any time using the volume slider.

Hardware development- use the Hardware View tab to see the detailed operation of the device interface. As each command is selected, its single-byte RS232 code appears in the window. If the command requires additional data, as do play file, loop file, and set volume, enter the additional data in the data window. Set Volume accepts positive numbers from 0 to 56. Set Balance accepts numbers from -15 to +15, positive numbers yielding a balance shifted left. The entry mode can be switched from hexadecimal to decimal using the radio buttons. Play File accepts numbers from 1 to 239.

Clicking on a command in the list will cause its RS232 code to appear in the Command window. Double clicking the command will cause it to be executed. The same is true for the file list- a single click displays the file number and a double click causes it to be played in single-play mode. The value returned by the controller will be displayed in the "returned" window. Get Status can be used at any time. If the returned status indicates a hardware error, Get Error will provide further information.

QV531 Infrared Remote Control (optional):

The optional remote control unit is a generic RCA remote control set to the NEC 009 VCR code. The keys and their functions are:

0-9: enter one digit of a two-digit file number (only 98 phrases can be accessed by the remote control). Playing a phrase resets the key buffer pointer, so you need enter only one digit to access phrases 0-9. If you do not enter a new number between plays, the same phrase will play again.

PLAY: enter. Begin playing the phrase designated by the last numeric entry.

>>: set looping mode. Can be entered prior to or during the playback of a phrase.

<<: stop looping. A currently playing phrase will continue to its end.

STOP: stop. The currently playing phrase will stop immediately. Looping mode will be turned off.

PAUSE: halt playback, but keep current position. A subsequent Play command will restart the playback.

MUTE: the volume is reduced smoothly by 22.5dB. A subsequent VOL> command will restore the original level.

VOL>: increment volume by one level. This control repeats if held.

<VOL: decrement volume by one level. This control repeats if held.

CHAN^: jog balance left by one level. This control repeats if held.

CHANv: jog balance right by one level. This control repeats if held.

PRE CH: restore the channels to equal levels.

If you enter a phrase number that does not exist, the unit will simply return, ready for the next.

Electrical Characteristics:

Absolute Maximum Ratings:

Stresses above these limits may cause permanent damage to the system. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may effect device reliability.

Ambient temperature under bias	-40°C to +125°C
Storage temperature	-65°C to +150°C
Power supply voltage	0 to +18 V
Maximum voltage, DB15 control pins	+30V
Minimum voltage, DB15 control pins	-24V

DC Characteristics: standard operating temperature $0^{\circ}\text{C} \leq \text{TA} \leq +70^{\circ}\text{C}$

Power supply

Symbol	Description	Min	Typ	Max	Unit	Conditions
VDD	Supply voltage (line)	6.7		16.0	V	
VDD	Supply voltage (amp)	9.0		16.0	V	
IDD	Supply current (line)	--	150	200	mA	
IDD	Supply current (amp)	--	1000	3300	mA	V _{DD} = 12.0V

Control lines

Value	Description	Min	Typ	Max	Unit	Conditions
VIL	Input low (on) voltage DB15 1-8,10-15	Vss	--	0.7	V	voltage-driven relative to Vss, pin 9
VIH	Input high (off) voltage DB15 1-8,10-15	3.0	--	5.0	V	voltage-driven relative to Vss, pin 9
ZIL	“On” impedance DB15 1-8,10-15	0	--	0.7	Ω	contact closure to Vss, pin 9
ZIH	“Off” impedance DB15 1-8,10-15	1M	--	--	Ω	contact closure to Vss, pin 9

AC Characteristics: standard operating temperature $0^{\circ}\text{C} \leq \text{TA} \leq +70^{\circ}\text{C}$

Value	Description	Min	Typ	Max	Unit	Conditions
Tdb	Debounce time DB15 1-8,10-15	--	100	125	ms	
Baudrate	RS232 Baud rate DB9 RS232	--	9600	--	B	
SpkPwr	Amplifier output power	20	22	--	W	V _{DD} = 14.4V R _L =4Ω
HPPwr	Headphone output power	--	6	--	W	V _{DD} = 14.4V R _L =4Ω
V _{OLL}	Line level output voltage	--	1.8	--	V _{P-P}	volume=44

Online Support:

Quadravox maintains the latest specifications, schematic diagrams, and support software in the support section of our website, www.quadravox.com/support.htm.

For questions not answered there or for other inquiries, please write us at support@quadravox.com, or call 1-800-779-1909 from the U.S. and Canada, or 1-972-669-4002 from other countries.

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