Quadravox

QV30   parallel/serial playback module for ISD33000-4000 series ChipCorders®

Features:
- operates in parallel or serial modes
- parallel mode:
    - allows access to up to 127 messages (depending on addressing mode)
    - four addressing modes, resistor programmable
    - automatic power down of system after each operation
    - mute / amplifier power control / busy pin
    - built-in switch de-bouncing
- serial mode:
    - for use with simple RXD/TXD RS232 controls
    - up to 240 messages
    - three addressing modes
    - separate amplifier power control and busy functions
    - digitally controlled analog volume control
- delivered with 4 minute ISD4003-04
- low power dissipation: <2mA at 5V, less than 1uA in power down mode
- single supply;3.6-5.5V (m4) or 9-16V (m2, m3)
- amplifier on-board, 300mW (m4), 11W (m3), 22W (m2)
- built-in sequential record mode for initial ChipCorder® setup
- automatic sensing of number of phrases when used with our recording software
- uses QV430P programming cradle and QV300s2 software.

General description:

The QV301m modules provide a simple method of adding voice and sound to your system. They comprise a controller based on a Microchip PIC processor, an ISD4003-04 ChipCorder® analog recording chip with four minutes capacity at 4kHz bandwidth, and an audio amplifier of various power ratings. A line level output is also available. The modules are controlled with a simple two-wire, 9600B, RS232 connection (the return path is optional) or through the parallel connection.

The QV301m modules can operate in parallel mode stand-alone or with a microcontroller, or in serial mode, in which case the function is identical to that of the QV305 except that the Baud rate is fixed at 9600 and hard RESET line is not available.

Parallel mode:

The QV301 controller provides a simplified interface to the ISD4000 family ChipCorder® analog recording chips. The QV301m is optimized for simple processor-less systems where the primary function is the playing back of pre-recorded messages. Nonetheless, it is possible to control the 301 with a microprocessor, and to record messages using the built-in sequentially addressed record function.

By taking advantage of the ChipCorder's® cueing mode, the QV301mx can manage up to 127 separate messages without explicit reference to physical addresses. Four phrase selection modes are provided and are selected via resistor programming of the mode select pins M0 and M1. As these pins are read continuously, the addressing mode can be changed between operations.

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Seven pins are available for message selection. Depending on addressing mode, these pins can select one of seven or one of 127 messages, or determine the upper bound of a group of sequentially (optionally, randomly) played messages. If the recording has been made to suit (see Recording), the system can automatically detect the number of messages and define its own maximum upper bound. On special order, these pins plus ground can form a 4x4 scan matrix to select one of 16 messages.

Setting the addressing mode:

The QV301m offers two independent options for playback addressing. In order to leave the maximum possible pins for user controls, the mode setting is accomplished by biasing the mode pins, M0 and M1, with large value resistors within the module. This method allows the two lines to also be used as control lines for the ISD ChipCorder®. The mode pins are read continuously, so it is possible to use all four modes in an application.

M1 determines whether the phrase selection is to be used directly or as the upper limit for a random selection. Connecting M1 to ground will cause the trigger input to be used directly. Connecting M1 to Vdd will cause the QV301m to make a random selection of all phrases with a value less than or equal to the trigger value.

If M0 is connected to Vdd, the unit will interpret the trigger lines as a direct selection of up to eight phrases. If M0 is connected to ground, the unit will interpret the trigger lines as a code from 0 to 126 (all ones, or code 127, is the inactive state). The lines forming the code must be synchronous within 10ms to be correctly interpreted. If a code is selected which is greater than the actual number of phrases present, the last phrase will be played. Coded addresses can be used even by simple mechanical systems by employing a diode matrix or simple logic to create the codes.

For example, to have four phrases triggered by specific events and a different set of four randomly selected by a fifth event, do the following:
- Specify the "random" option when ordering the devices.
- Record the phrases in order with the four randomly selected ones as the first four in the list.
- Assuming button mode (M0=1), set M1=0. Triggers 4-7 will now select the upper four phrases directly.
- Set M1=1.Trigger 3 then causes a sequentially selected one of the first four phrases to be spoken.
Of course, there can be an overlapping of the two categories, simply by choosing a higher valued trigger pin for the sequential event.

The same logic applies in coded mode but gives access to up to 127 messages.

Recording messages:
The primary function of the QV301m is to manage message playback. The recording function is intended to be used only to set up the system initially and is fairly rigidly constrained. Messages must be recorded in the order they are to be selected, that is, from number 0 to n, and must all be recorded in the same session, then completed by resetting the record line to inactive. This will automatically place an end-of-project mark (a very short file). Quadravox provides the QV300S2 software and (optionally) hardware to perform this operation, but it is simple enough to be done even with a couple of push-buttons, as follows:

-Connect power and a signal source to the system, observing the level and coupling requirements shown in figure 2. The mode selection is ignored during recording.
-Set the INT_/REC_ line low for at least 200ms

-Perform the following for each recording:
 Wait 50ms
 Set T0 low for duration of first recording
 Bring T0 high to set the individual end-of-message mark
-When all the messages have been recorded, set the record line high
-Wait for re-initialization (400ms maximum with 4004-16 device)
---done----

Note: If you have a switch or signal permanently connected to the REC_/INT_ line, it must be open-circuit when inactive. Otherwise, the INT_ output of the ChipCorder can be damaged and at a minimum, the signal will not be seen by the QV301m.

Playing messages:
In order to have as much addressing precision as possible from a small set of lines, several modes have been provided. The idle state is defined as all inputs at a logical one. Typically, pull-up resistors would be used to establish the resting state and switch closures would be made to ground to initiate playback.

Use M0, M1 to select mode as described in "Setting the addressing mode". The trigger lines T0-T6 will be interpreted according to the mode.

Set the trigger line or lines low for at least 25ms (The QV301m has "debounce" logic to eliminate spurious entries). The amplifier will be enabled and the selected file will be played. The amplifier will then be disabled, as will the ChipCorder® device.

To play the next message, you must release all trigger lines for at least 25ms, then repeat the process.

The PWR_ line can be used to determine when the message is complete.

Power management:
The QV301m sends a power up command just prior to playback or the beginning of a recording sequence. It sends a power down command after each playback and after the "set last" function at the end of a recording session.

After each operation, the controller itself will power down to standby mode, but will check the inputs every 18ms for an entry. This time is considered in the specification of minimum trigger pulse width. System standby current will depend on the ISD device and amplifier as well. A system based on the ISD4003 would have a typical standby current of 5uA plus that of the amplifier, if any. This makes the QV301m ideal for battery operated systems.

Serial mode:

To set serial mode, trigger T4 must be connected to the PWR_ line.

By taking advantage of the ChipCorder's® cueing mode, the QV301m can manage up to 240 separate messages without explicit reference to physical addresses. Three phrase selection modes are provided and are selected via a mode setting command. The addressing mode can be changed at any time.

A single byte transfer (n,8,1, 9600B) selects one of 240 messages (subject to the constraints explained later in this document). A code of 0fxh is interpreted as a set mode command. A byte in the range 0-239 selects a single message in direct addressing mode, or determines the upper

bound of a linear sequence or random selection. Upon power up or after a recording, the system will automatically detect the number of messages and define its own maximum upper bound.

By default, the QV301m is powered from start-up until the sleep mode bit is set with a set mode command after which the wakeup time checks the interface once every 20ms. The PWR_ pin can be used to switch power to an external amplifier. A low-power mode can be selected with the setlp command.

The QV430P programming cradle and QV300s2 project management software can be used to program the QV301m. The diagrams for the QV430P and the QV300s2 software are also available free from <www.quadravox.com>. If required, the Quadravox QV401P gang programmer can be used to mass produce formatted ChipCorder® devices.

Setting the addressing mode:

The QV301m offers three modes of playback addressing. The modes are selected using the two low-order bits of the set mode command. Bit 0 selects direct or sequential addressing. In direct addressing (bit 0 = 0), the value transferred in the command byte is used to select the phrase of the same number. If a value exceeding the maximum number of recorded phrases is sent, the last phrase in the memory will be played. If bit 0 is set to one, the phrase played will lie within the bounds of zero and the number transferred in the command byte. If bit 1 of the mode value is 0, the phrases in this range will be played in sequence, rolling back to zero after the top phrase (the one corresponding to the command byte) has been played. If bit 1 is 1, a randomly-selected one of the same range will be played.

The mode can be changed at any time, so system operation can combine the different addressing options. For example, to have ten phrases triggered by specific events and a different set of ten randomly selected by a fifth event, do the following:
 - Record the phrases in order with the ten randomly selected ones as the first ten in the list.
 - To randomly select one of the bottom group, first issue a set mode command specifying "random sequence" (0f3h). Repeatedly sending a command byte of "9" will produce a random selection of phrases 0-9.
 - To select one of the fixed phrases, issue a set mode command for "direct" (0f0h), the send the number of the phrase to be played.
 - If you desire that the phrases in the first group be played in sequence, issue a set mode "linear sequence" (0f1h) instead of 0f3h.

Recording messages:
The primary function of the QV301m is to manage message playback. The recording function is intended to be used only to set up the system initially. Messages must be recorded in the order they are to be selected, that is, from number 0 to n, and must all be recorded in the same session. Resetting record mode places a very short file on the ChipCorder to serve as the "last" marker. Quadravox provides the QV300S2 software and optional QV430P hardware to perform this operation, but it is simple enough to be easily integrated into your application.
 To record a new set of messages:
 - issue a set mode "record" command (0f4h)
 - send a command byte of "1" (01h) and at the same time start applying the analog signal to be recorded to the analog-in+ pin of module. The recording level may have to be adjusted to achieve the best overall recording quality, as explained in ISD's documentation.
 - When the analog segment is complete, send a command byte of "0" to stop the recording and place an EOM marker in the ChipCorder.
 - When all phrases have been recorded, issue a set mode command of 0f0h.(or 0f1h or 0f3h for different playback modes)

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Playing messages:
To play a message, first ensure that the mode (as explained as above) matches your intentions. Then, issue a single byte in a contiguous range from 0 to the number of recorded messages – 1 (maximum 239). When the phrase has completed, a byte with the number of the phrase spoken will be returned.

 Message play can be stopped by issuing a stop command (0f6h). There is no return code for a stop command. Be aware that the ISD ChipCorder may require up to 50ms to effect the stop after it is received. Commands sent during this time may fail to execute properly.
 The BUSY_ line can also be used to determine when the message is complete.

String play:
 In some cases it is desirable to set up a long string of words or phrases to be played as one utterance. This simplifies message management and allows the segments to be closer together as the amplifier does not need to be powered down between phrases. To use the string mode, open a new string by sending the command 0f9h. Send up to 32 phrase numbers. The phrases will not be spoken in this process. Send the close string command, 0fah. Until you change the string by reopening it, the stored sequence can be played by issuing the play string command, 0fbh. Individual words are still accessible in the usual way- playing them does not affect the stored string.

Serial commands:

Value	Record mode?	Action
0-239	No	Play phrase <value> according to mode settings
240-255	No	Set mode: see mode table for functions
1	Yes	Start recording individual phrase
0	Yes	Stop recording individual phrase

Serial set mode functions:

Value (hex)	Function
0f0h	set play mode to direct addressing
0f1h	set play mode to linear sequence
0f3h	set play mode to random sequence
0f4h	record mode; subsequent 1 and 0 commands start and stop recording
0f6h	stop play
0f8h	sleep
0f9h	open string
0fah	close string
0fbh	play string
0fch	set volume with next byte transmitted. Only values 0-31 are valid
0fdh	software reset
0feh	return version byte (0bh)
0ffh	return type byte (031h)

QV301m pinout and control lines:

Control lines	pin	level	Function
T0	**1**	**low**	trigger 0 in parallel mode
T1/RXD	**2**	**low**	trigger 1 in parallel mode or RS232 receive line
T2	**3**	**low**	trigger 2 in parallel mode
T3/TXD	**4**	**low**	trigger 3 in parallel mode or RS232 transmit line
T4	**5**	**low**	trigger 4 in parallel mode; strap to PWR_ for serial
T5/BUSY_	**6**	**low**	trigger 5 in parallel mode or system busy in serial
T6/RECLED_	**7**	**low**	trigger 6 in parallel mode or record LED out in serial
REC_	**8**	**low**	record enable for parallel manual recording
M0	**9**	**--**	lsb of parallel mode selection; must be +5V or GND
M1	**10**	**--**	msb of parallel mode selection; must be +5V or GND
PWR_	**11**	**low**	BUSY_ in parallel mode.
+9-18V	**12**	**--**	power input for QV301m2, QV301m3
+3.6-5.5V	**13**	**--**	power input for QV301m4
GND	**17**	**0**	system ground
GND	**18**	**0**	system ground
ANA_IN-	**19**	**--**	line level analog input for recording (QV301m4 only)
ANA_IN+	**20**	**--**	line level analog input for recording

Applications:

The QV301m is intended for message playback applications where the user requires the large capacity of ISD's serial interface ChipCorders®, but does not want to develop custom microprocessor algorithms to manage the devices.
 The QV301m can also be used in conjunction with a host microprocessor in lieu of developing custom real-time code on the host platform. When used in cueing mode, the ISD chips in this series require either constant polling or an interrupt driven service routine for advancing to the proper address. If used in address mode, they require that the microprocessor maintain an address table with entries for each of the independently accessed phrases. The QV301m can offload these functions as well as system power management from the main processor.

Limitations:

The QV301m is limited to 240 phrase selections in serial mode, 127 in parallel mode.

The minimum allowable phrase length is 200ms, which in practical terms means that the minimum valid phrase length is more than a single segment for most ISD part types. This restriction is due to the necessity of using a particularly short phrase as an end-of-project marker.

The QV301m uses ISD's cueing mode for message management. Playback starting delay depends on both the position of the data in the chip and the number of messages in the project. Although the cueing mode scan runs 1600 time faster than normal chip speed, this still can amount to 150ms for a four-minute chip. To this is added the overhead of restarting the scan after each message is located. This delay complicates use of the QV301m for phrase concatenation, but with care in the data preparation, some limited use is possible. Place all the frequently concatenated sounds (e.g. numbers) at the beginning of the list, followed by ending phrase segments, and finally by beginning phrase sections. This will optimize the allocation of the unavoidable delays

Electrical Characteristics:

Absolute Maximum Ratings:

Stresses above these limits may cause permanent damage to the PIC16C505 controller device. 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
Voltage on V+ supply with respect to Vss	0 to +18 V
Voltage on all other pins with respect to Vss	-0.6 v to 5.6V
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > 5.6V$)	+/- 20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > 5.6V$)	+/- 20 mA
Maximum output current sunk by RECLED	25 mA

DC Characteristics: standard operating temperature $0°C \leq T_A \leq +70°C$

Power supply pins:

Symbol	Description	Min	Typ[1]	Max	Unit	Conditions
V_{DD}	**Supply voltage (m4)**	3.5		5.5	V	
V_{DD}	**Supply voltage (m2,3)**	9.0		16.0	V	
V_{POR}	**V_{DD} start voltage to ensure power-on reset**	--	Vss	--	V	See section on power-on reset for details
S_{VDD}	**V_{DD} rise rate to ensure power-on reset**	0.05	--	--	V	See section on power-on reset for details
V_{IL}	**Input low voltage** T0-5, REC_	Vss	--	0.5	V	
V_{IH}	**Input high voltage** T0-5, REC_	2.0	--	5.0	V	
I_{IL}	**Input leakage current[2]** T0-5, REC_	--	--	+/- 1	µA	$Vss \leq V_{PIN} \leq 5.6V$
V_{OL}	**Output low voltage** RECLED_,BUSY_	--	--	0.6	V	I_{OL}=8.5mA, V_{DD}=4.5V
V_{OH}	**Output high voltage** RECLED_, BUSY_	4.3V	--	--	V	
C_{IO}	**Capacitive loading specs on output pins**	--	--	50	pF	

Note 1: Data in the typical ("typ") column is based on characterization results at 25°C. This data is for design guidance only and is not tested.

2: Negative current is defined as coming out of the pin

AC Characteristics: standard operating temperature 0°C $\leq$ TA $\leq$ +70°C

Symbol	Description	Min	Typ[1]	Max	Unit	Conditions
TioR	**Pin output rise time**	--	10	25[2]	ns	
TioF	**Pin output fall time**	--	10	25[2]	ns	

Note 1: Data in the typical ("typ") column is based on characterization results at 5V, 25°C. These parameters are for design guidance only and are not tested.

2: These parameters are design targets and are not tested. No Characterization data available.

Power up timing:
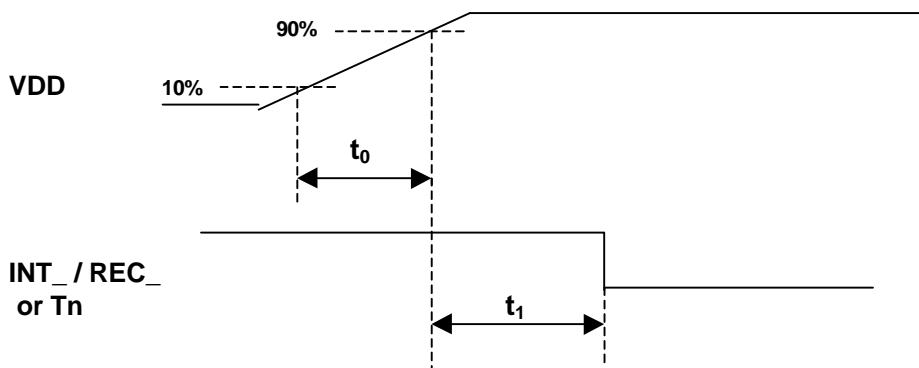
Timing values:

Symbol	Event	min	typ	max	unit
t0	Vcc rise time			9	ms
t1	Delay to first command	500			ms

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 1-972-669-4002.

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