Digital tube display driver and I/O expansion chip CH422

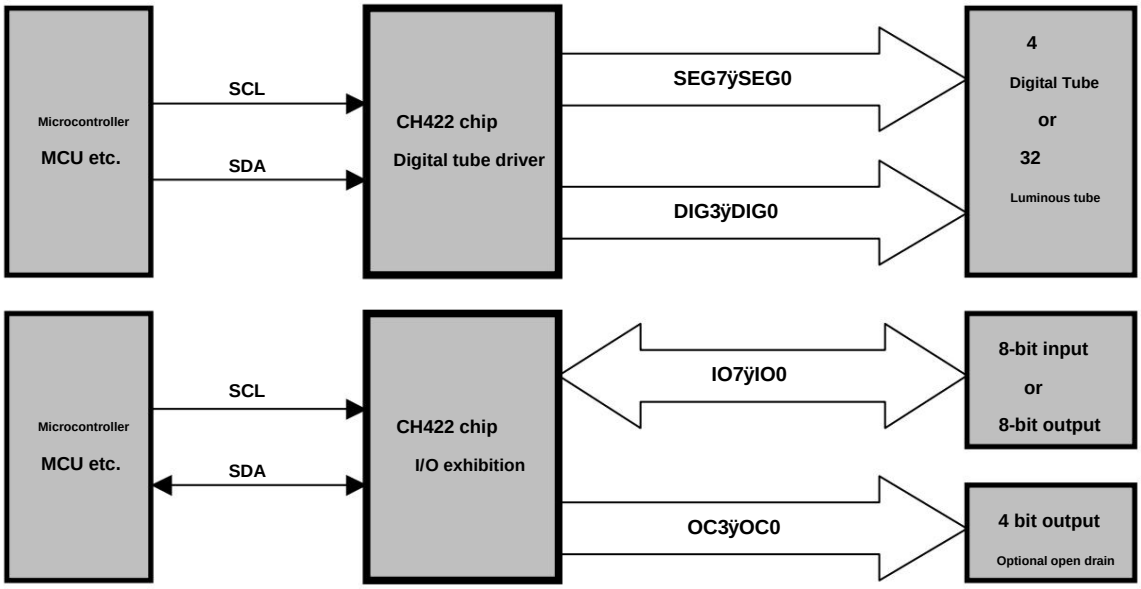
manual

Version: 2

http://wch.cn

1 Overview

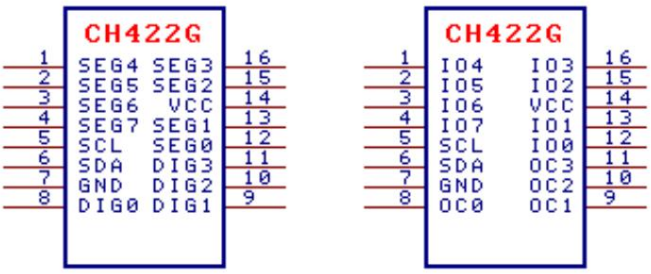
CH422 chip can be used for digital tube display driver or I/O expansion. CH422 has a built-in clock oscillation circuit that can dynamically drive 4 Digital tube or 32 LED light-emitting tubes; when CH422 is used for I/O expansion, it can provide 8 bidirectional input and output pins and 4 pass Use the output pin; CH422 exchanges data with the microcontroller through a 2-wire serial interface.



2. Features

- Dynamic display scanning control, directly driving 4-digit digital tubes or 32 light-emitting tube LEDs.
- Built-in current driver stage, the segment current drive capability is not less than 15mA, and the output word current is not less than 100mA.
- Built-in clock oscillation circuit, no external clock or external oscillation components are needed, and it is more resistant to interference.
- Remotely expand 8 general-purpose input and output pins GPIO and 4 general-purpose output pins GPO through a two-wire serial interface.
- 4 general-purpose output pins can be selected as push-pull output or open-drain output.
- Supports 3V~5V power supply voltage, supports low-power sleep, and can be woken up by input level changes.
- High-speed 2-wire serial interface, clock speed from 0 to 1MHz, compatible with two-wire I2C bus, saving pins.
- Adopt SOP16 lead-free package, compatible with RoHS.

3. Encapsulation



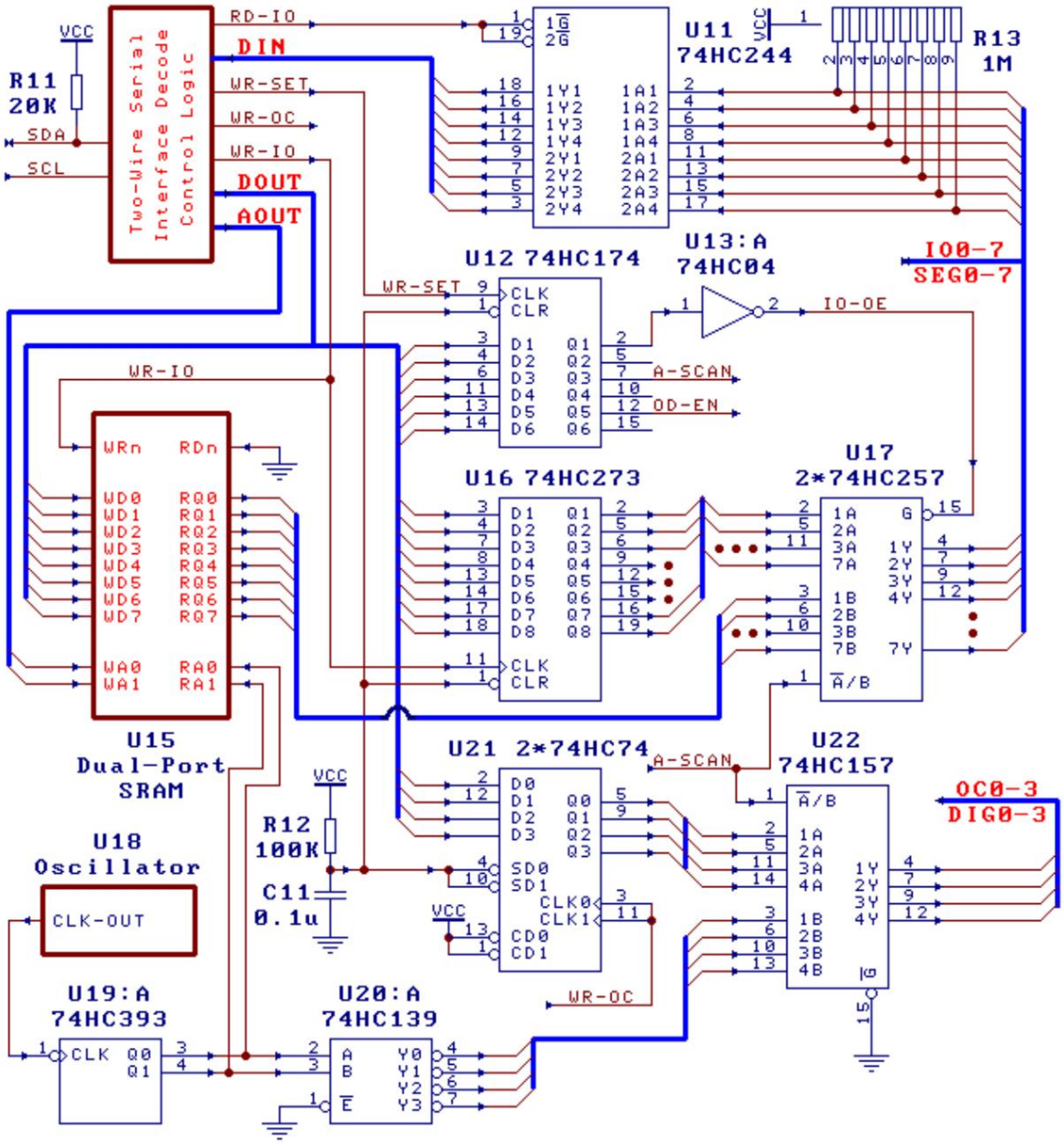
Package form	width		Pin Pitch Package Instructions Ordering Model		
SOP16	3.9mm	150mil	1.27mm	50mil standard 16-pin patch CH422G	

4. Pin

Pin number pin name		Type	Pin description
14	VCC	power	Positive power supply, continuous current is not less
7	GND	supply	than 100mA Public ground, continuous current is not less than 100mA
12ÿ13ÿ 15ÿ16ÿ 1ÿ4	SEG0ÿSEG7 IO0ÿIO7	Three-state output and input	Segment driver of digital tube, effective at high level, Bidirectional input and output, built-in weak pull-up resistor
8ÿ11	DIG0ÿDIG3 OC0ÿOC3	Push-pull or open-drain output	The word driver of the digital tube is active at low level. Universal output, optional open-drain output, active low level
6	SDA open-drain output and input 2-wire serial		interface data input and output, built-in pull-up resistor
5	SCL	enter	Data clock for 2-wire serial interface

5. Function description

5.1. Internal circuit principle (used to explain functions, for reference only)



5.2. General instructions

The data in this manual, those ending with B are binary numbers, those ending with H are hexadecimal numbers, otherwise they are decimal numbers, marked A bit that is x means that the bit can have any value.

The single-chip computer (can also be a CPU, DSP, microprocessor, MCU and other controllers) controls the CH422 chip through a 2-wire serial interface. The 2-wire serial interface of CH422 is implemented by hardware. The single-chip computer can frequently perform operations through the serial interface. High-speed operation without reducing the working efficiency of CH422.

5.3. Display driver

CH422 uses dynamic scanning drive for digital tubes and light-emitting tubes, the order is DIG0 to DIG3. When one of the pins draws current, the other pins do not draw current (refer to U20, U22, T1~T4 in the figure). CH422 has an internal current driver stage that can directly drive common cathode digital tubes from 0.5 inches to 1 inches. The segment drive pins SEG6~SEG0 correspond to segment G~segment A of the digital tube respectively. The segment drive pin SEG7 corresponds to the decimal point of the digital tube. The word drive pins DIG3~DIG0 are connected to the cathodes of four digital tubes respectively; CH422 can also be connected to an 8×4 matrix of light-emitting diode LED arrays or 32 independent light-emitting tubes, or it can support common anode digital tubes through an external inverting driver. Or connect an external high-power tube to support large-size digital tubes.

CH422 has four internal 8-bit data registers (U15 in the figure), which are used to save 4 words of data, corresponding to the 4 digital tubes driven by CH422 or 4 groups of 8 light-emitting diodes each. Bits 7 to 0 of the word data in the data register correspond to the decimal point and segment G to segment A of each digital tube respectively. For a light-emitting diode array, the data bits of each word data uniquely correspond to a light-emitting diode. When the data bit is 1, the corresponding data tube segment or luminous tube will light up; when the data bit is 0, the corresponding data tube segment or luminous tube will go out. For example, bit 0 of the third data register is 1, so the corresponding segment A of the third digital tube lights up. The picture below shows the segment names of the digital tube.

5.4. Bidirectional input and output pins

The IO7~IO0 pins of CH422 are bidirectional input and output pins. The default is the input direction. They are used to input the current status of external pins. When set to the output direction, it can output high and low levels to drive LED light-emitting tubes or perform I/O expansion.

5.5. General output pins

The OC3~OC0 pins of CH422 are push-pull or open-drain output pins, and the default is push-pull output. After selecting the open-drain output mode, there are only two states of outputting low level and no output. It cannot output high level. The default is no output state. In the dynamic scan display driving mode, the OC3 ~ OC0 pins can be used to drive the common terminals of the common cathode digital tube, and can Absorb larger sink currents in pulse mode.

5.6. Power-on reset

CH422 has a built-in power-on reset circuit (R12 and C11 in the figure), which is used to restore the internal registers to default when the chip is first powered on. recognition status. For example, after each power-on, the bidirectional input and output pins are in the input state, and the general-purpose output pins are in the high level state.

5.7. Serial interface

CH422 has a hardware-implemented 2-wire serial interface, including 2 signal lines: serial data clock input line SCL, serial data output line input and output lines SDA.

SDA is a quasi-bidirectional signal line with a pull-up resistor, and the default is high level. SDA is used for serial data input and output, high level indicates Bit data 1, low level indicates bit data 0, the order of serial data input is high bit first, low bit last.

SCL is the input signal line, which defaults to high level. SCL is used to provide the serial clock. CH422 inputs data from SDA on its rising edge and outputs data from SDA on its falling edge. The falling edge of

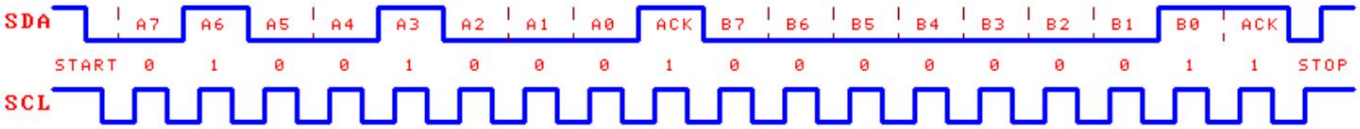
SDA that occurs during SCL is high level is defined as the start signal of the serial interface, and the rising edge of SDA that occurs during SCL is high level is defined as the stop signal of the serial interface. CH422 only receives and analyzes commands after detecting the start signal. Therefore, when the I/O pin resources of the microcontroller are tight, the SCL pin can be shared with other interface circuits while keeping the SDA pin state unchanged; if it can be ensured that the SDA pin changes only when the SCL pin is low level occurs, then both the SCL pin and the SDA pin can be shared with other interface circuits. The communication process between the microcontroller and CH422 is always

divided into 6 steps, which are divided into two types according to the operation direction of the microcontroller. One is to write Operations are used to output data, and one is read operations, which are used to input data. For the specific process, please refer to the instructions in the example program.

The write operation includes the following 6 steps: output start signal, output byte 1, response 1, output byte 2, response 2, and output stop signal. Among them, the start signal and stop signal are as mentioned above, response 1 and response 2 are always fixed to 1, and output byte 1 and output byte 2 each contain 8 data bits, that is, one byte of data.

The read operation includes the following 6 steps: output start signal, output byte 1, response 1, input byte 2, response 2, and output stop signal. Among them, the start signal and stop signal are as mentioned above, response 1 and response 2 are always fixed to 1, and output byte 1 and input byte 2 each contain 8 data bits, that is, one byte of data.

The figure below is an example of a write operation. Byte 1 is 01001000B, which is 48H; byte 2 is 00000001B, which is 01H.



6. Operation commands

The operation commands of CH422 are divided into 4 groups. The start signal, stop signal, response 1 and response 2 of each command are the same. The difference lies in the different data of output byte 1 and byte 2 and the different transmission direction of byte 2. Byte 1 is used for two-wire serial port control logic, or used to generate addresses (AOUT bus in the figure), byte 2 is used for input and output data (DIN and DOUT buses in the figure).

6.1. Set system parameter command (WR-SET control line in the figure)

The output byte 1 of this command is 01001000B, which is 48H; the output byte 2 is [SLEEP]00[OD_EN]0[A_SCAN]0[IO_OE]B. The set system parameter command is used to set the system-level parameters of CH422 (written to U12 in the figure): output enable IO_OE of bidirectional input and output pins IO7~IO0, dynamic display automatic scan enable A_SCAN, output pins OC3~OC0 Open-drain output enable OD_EN, low-power sleep control SLEEP. After power-on reset, the above parameters default to 0.

IO_OE is used to control the three-state output of the bidirectional input and output pins IO7~IO0. When it is 0, the output is disabled (used to pass U11 in the figure) input), when it is 1, output is allowed (U17 output in the figure).

A_SCAN is used to control the automatic scanning function of dynamic display. When it is 0, the I/O expansion function is enabled. IO7ÿIO0 and OC3ÿOC0 are used for general input and output (select U16 in the figure to provide IO pin data and U21 to provide OC pin pin data), when it is 1, the digital tube dynamic display function is enabled (select U15 in the figure to provide segment data and U20 to provide word data).

OD_EN is used to enable the open-drain output of the output pins OC3~OC0. When it is 0, OC3~OC0 are push-pull outputs (can output low level and high level). When it is 1, OC3~OC0 are open-drain outputs (only Output low level and no output).

SLEEP is used to put CH422 into a low-power sleep state, thereby saving power. CH422 in the low-power sleep state can be awakened by any of the following two events. The first event is the input level change, that is, the detection of the current status of the IO7~IO0 pin input and the prior writing of IO7 ~The data in the output register of the IO0 pin (U16 in the figure) is different; the second event is receiving the next operation command issued by the microcontroller. When CH422 wakes up, the SLEEP bit will be automatically cleared to 0. The sleep and wake-up operations themselves will not affect other working states of CH422.

This command does not affect the data in the output registers and internal data buffers of each pin. Several commonly used commands are as follows: ÿ.
Byte 2 is 00H, enabling the I/O expansion function, IO7~IO0 are inputs, OC3~OC0 are general outputs; ÿ. Byte 2 is 11H, enabling the I/O expansion function. IO7~IO0 are outputs, OC3~OC0 are open-drain outputs; ÿ, Byte 2 is 05H, enable the digital tube automatic scanning function, SEG7~SEG0 and DIG3~DIG0 are outputs.

6.2. Set general output command (WR-OC control line in the picture)

The output byte 1 of this command is 46H, and the output byte 2 is 0000[OC_DAT]B, that is, 8-bit data between 00H and 0FH. Use For writing to the output register of general-purpose output pins OC3~OC0 (U21 in the figure), writing 0 will cause the pin to output low level, and writing 1 will cause the pin to output low level. Output high level.

6.3. Load segment data command/set bidirectional input and output command (WR-IO control line in the picture)

The output byte 1 of this command is 70H, 72H, 74H, 76H, of which bit 2 to bit 1 are addresses (AOUT bus in the figure), use To select the address of dual-port SRAM (U15 in the figure); output byte 2 is [IO_DAT]B, which is 8-bit data between 00H and 0FFH. Used to write the specified address of the dual-port SRAM, and also used to write the output register of the bidirectional input and output pins IO7~IO0 (in the figure U16), if IO_OE is 1 to allow output, then writing 0 will cause the pin to output low level, and writing 1 will cause the pin to output high level.

6.4. Read bidirectional input and output commands (RD-IO control line in the picture)

The output byte 1 of this command is 01001101B, which is 4DH; the input byte 2 is the current value of the bidirectional input and output pins IO7~IO0 pin status.

The read bidirectional input and output command is used to obtain the current status of the IO7~IO0 pins. When IO_OE is 0, it is used to obtain the input status. Otherwise, get the output status. This command is a read operation and is the only command with data return. The microcontroller must first release the SDA pin. pin (three-state output is disabled or pulled up to high level), and then CH422 outputs the current pin status from the SDA pin.

7. Parameters

7.1. Absolute maximum value (critical or exceeding the absolute maximum value may cause the chip to work abnormally or even be damaged)

name	Parameter	Minimum value	Maximum value	unit
FACING	Description Ambient	-40	85	ÿ
TS	temperature during operation	-55	125	ÿ
VCC	Ambient temperature during storage Power supply	-0.5	6.0	IN
SAW	voltage (VCC is connected to the power	-0.5	VCC+0.5	IN
IMoc	supply, GND is connected to the ground) Voltage	0	30	mA
IMdig	on the input or output pin Continuous drive current of a	0	120	mA
IMio	single DIG/OC pin 1/4 of a single DIG/OC pin Pulse	-25	25	mA
IMall	drive current Continuous drive current of a single SEG/IO pin Sum of continuous drive currents of all SEG/IO pins or the sum of the continuous drive currents of all DIG/OC pins	0	160	mA

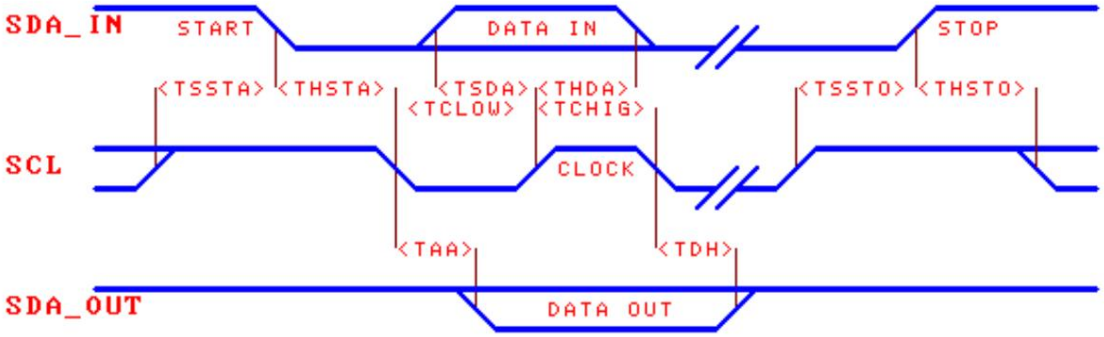
7.2. Electrical parameters (test conditions: TA=25ÿ, VCC=5V, if VCC=3.3V, then the current value in the table needs to be multiplied by 40%)

name	Parameter	Minimum value	Typical value	Maximum value	Unit
VCC	Description Power	3	5	5.3	IN
ICC	Supply Voltage Operating Current	0.1	80	150	mA
ICCs5	Quiescent current at 5V (SCL and SDA high)		0.4	0.9	mA
ICCs3	Quiescent current at 3.3V (SCL and SDA are high level) SCL and SDA		0.1	0.3	mA
WILL	pin low-level input voltage SCL and SDA pin high-	-0.5		0.8	IN
HIV	level input voltage IO pin low-level input voltage	2.0		VCC+0.5	IN
Crying	IO pin high-level input Voltage	-0.5		0.6	IN
VIHio	VOLoc DIG/OC pin low-level output	1.9		VCC+0.5	IN
voltage (-100mA) DIG/OC pin low-level output voltage (-30mA) DIG/OC pin			0.6	0.8	IN
Voloc	high-level output voltage (5mA) VCC-0.5		0.2	0.3	IN
VOHoc					IN

Loved	SEG/IO pin low-level output voltage (-15mA) SEG/IO pin high-			0.5	IN
VOHIO	level output voltage (20mA) VCC-0.5 SDA pin low-level output voltage (-4mA) Input				IN
VOL	weak pull-up of IO pin current			0.5	IN
IUP1		1	5	10	uA
IUP2	Input pull-up current for SDA pin Default	150	250	400	uA
VR	voltage threshold for power-on reset	2.3	2.6	2.9	IN

7.3. Timing parameters (test conditions: TA=25ÿ, VCC=5V, refer to the attached picture)

(Note: The measurement unit of this table is mainly nanoseconds, that is, 10-9 seconds. If the maximum value is not indicated, the theoretical value can be infinite)



name	Parameter	Minimum value	Typical value	Maximum value	Unit
TPR	Description Reset time generated by power-on detection	15	30	80	mS
TSSTA	SDA falling edge start signal setup time	100			nS
THSTA	SDA falling edge start signal holding time	100			nS
TSSTO	SDA rising edge stop signal setup time	100			nS
THSTO	SDA rising edge stop signal holding time	100			nS
TCLOW	SCL clock signal low level width	100			nS
TCHIG	SCL clock signal high level width	100			nS
TSDA	SDA input data to SCL rising edge setup time 30				nS
THDA	SDA input data holding time for SCL rising edge 10				nS
TODAY	Delay of SDA output data valid to SCL falling edge 3			30	nS
TDH	Delay of SDA output data invalid to SCL falling edge 3 Average data transfer			40	nS
Rate	rate	0		1M	bps

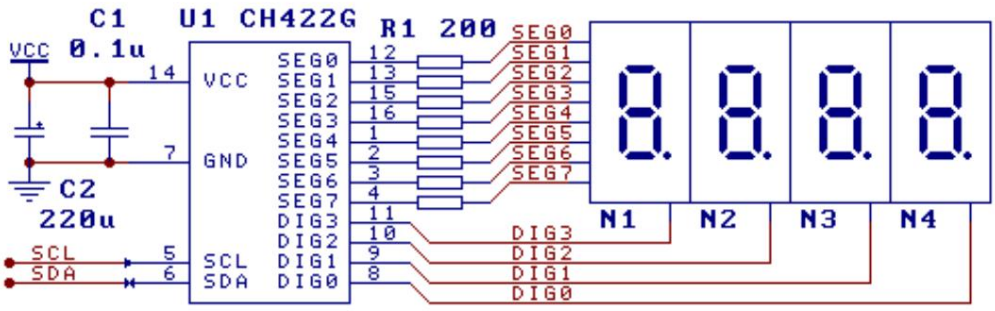
8. Application

8.1. Digital tube display driver (picture below)

CH422 is connected to the external microcontroller through 2-wire serial interfaces SCL and SDA. Capacitors C1 and C2 are arranged in the power supply of CH422 Near the pin, it is used for power supply decoupling to reduce interference caused by driving large current.

CH422 can dynamically drive 4 common cathode digital tubes. The same segment pins (segment A~segment G and decimal point) of all digital tubes are connected in parallel. Then the segment drive pins SEG0~SEG7 of CH422 are connected through the series current limiting resistor R1. The common cathode of each digital tube is connected by CH422 respectively. DIG0~DIG3 pins are driven. The resistor R1 connected in series with the segment pin is used to limit and balance the segment drive current. Under the 5V power supply voltage, A 200ÿ resistor connected in series usually corresponds to a segment current of 13mA. CH422 can limit the segment drive current internally, so R1 can be omitted.

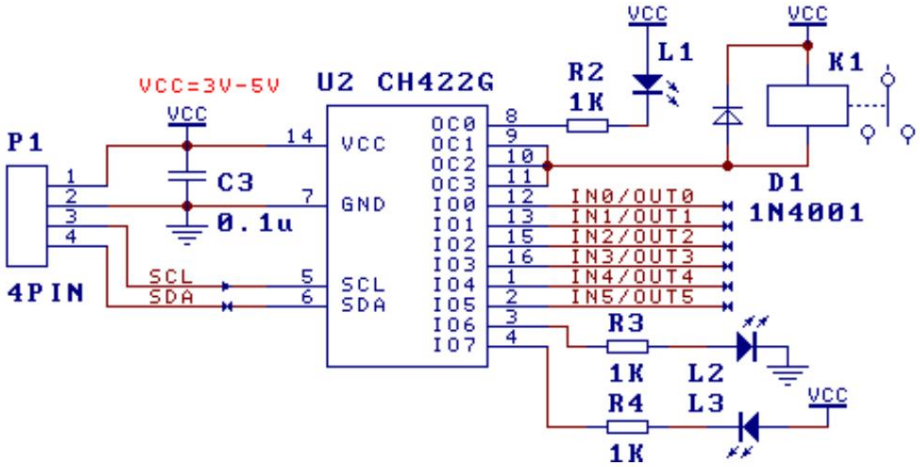
If you need to drive the common anode digital tube or increase the drive current, you can refer to the method in the CH452 data sheet.



8.2. Remote I/O expansion (picture below)

CH422 is connected to the external microcontroller through 2-wire serial interfaces SCL and SDA, and capacitor C3 is used for power supply decoupling.

The IO7~IO0 pins of CH422 can be used for input or output. In the figure, the IO6 and IO7 pins are used to drive LED light-emitting tubes of two polarities. The OC3~OC0 pins of CH422 can only be used for output. In order to obtain a larger continuous current driving capability, the open-drain output can be enabled, and the OC1, OC2, and OC3 pins are connected in parallel to drive relay K1 as shown in the figure.



8.3. Anti-interference

Since the driving current of CH422 is large, it will produce a large glitch voltage on the power supply. Therefore, if the PCB layout of the power line or ground wire is unreasonable, it may affect the stability of the microcontroller or CH422. It is recommended to use thicker power lines. and ground wire, and connect the power supply decoupling capacitor in parallel between the positive and negative power supplies close to CH422.

For application environments with strong interference, the microcontroller can refresh CH422 regularly every few seconds, including reloading each I/O pin. pin output register, and reset system parameters.

In addition, if the CH422 is driven over a long distance by the I/O pins of the standard MCS-51 microcontroller, it is usually necessary to strengthen the pull-up capability of the I/O pins of the MCS-51 microcontroller in order to maintain a long distance transmission. Good digital signal waveform. The resistance of the pull-up resistor can be from 500ÿ to 10Kÿ, and no pull-up resistor is needed at close range.

8.4. Microcontroller interface program

The website provides C language and ASM assembly interface programs for some microcontrollers.