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R8C/26 GROUP

Touch Panel Controller with IIC Interface

Abstract

This article introduces an example of controlling the panel and detecting coordinates as part of a larger system by using a R8C/26 to interface with a resistor type of film touch panel. A MigoR platform evaluation board, with a SH7722 (Part number R8A77220AC266BGV) as the main processor and a R8C/26 as the touch panel controller, is used as the emonstration. In this demonstration, the touch panel coordinate information is realized by the Renesas R8C/26 through the IIC bus.

Introduction

The example application is applied to the following configuration:

R8C/26

The R8C/26, part name R5F21262NFP, is a group of the R8C series based on the R8C CPU Core used in the application system with a maximum operating frequency at 20MHz.

ROM: 8K bytes

RAM: 512 bytes

ROM Type: Flash Memory

Package Type: PLQP0032GB-A

MigoR Platform

R8A77220AC266BGV (SH7722) is used as a main processor which incorporates SH4AL-DSP operating at a maximum frequency of 333MHz.

The basic functions of the MigoR, Part Name YTD07DS7722B, are as following.

FLASH ROM: 64M bytes, 16bits width

SDRAM: 64M bytes, 64bits width

QVGA color LCD display in 2.2 inches

VGA camera module build-in

Ethernet, TV out, SD Card, etc are build-in

C Compiler

High Performance Embedded Workshop V4.03 by Renesas Technology Corp.
M16C standard toolchain Ver. V.5.40.00 by Renesas Technology Corp.

Contents

1. R8C/26 Touch Panel Controller

1.1 R8C/26 Key Features

- 8-bit Multifunction Timer with 8-bit Prescaler (Timer RA and RB): 2 channels
- Input Capture/Output Compare Timer (Timer RC): 16-bit x 1 channel
- Real-Time Clock Timer with Compared Match Function (Timer RE): 1 channel
- UART/Clock Synchronous Serial Interface: 2 channels
- I^2C-bus Interface (IIC)/Chip-select Clock Synchronous Serial Interface: 1 channel
- LIN Module: 1 channel (Timer RA, UART0)
- 10-bit A/D Converter: 12 channels
- Watchdog Timer
- Clock Generation Circuits: XIN Clock Generation Circuit, On-chip Oscillator (High/Low Speed), XCIN Clock Generation Circuit
- Oscillation Stop Detection Function
- Voltage Detection Circuit
- Power-On Reset Circuit
- I/O Ports: 25 (incl. LED drive ports)
- External Interrupt Pins: 7

1.2 Concept of Touch Panel

The included resistor type of touch panel uses two films which each have a resistance of several hundred ohms across the film axis. The upper film has an equivalent resistance from Y+ to Y-. To measure vertical location, the upper film is supplied with 3VDC and the lower film is kept floating. When an object presses the upper film into the bottom film, a voltage appears on the bottom film. The value of the voltage is proportional to where the films touch. The closer to the +3VDC side of the panel, the larger the voltage and vice versa. Similarly, to detect horizontal position, a voltage is supplied to the lower film and the upper film is kept floating, and measurements are made the same way. The voltages are measured by two 10-bit analog-to-digital converters inside the R8C/26.

The concept shows as below.

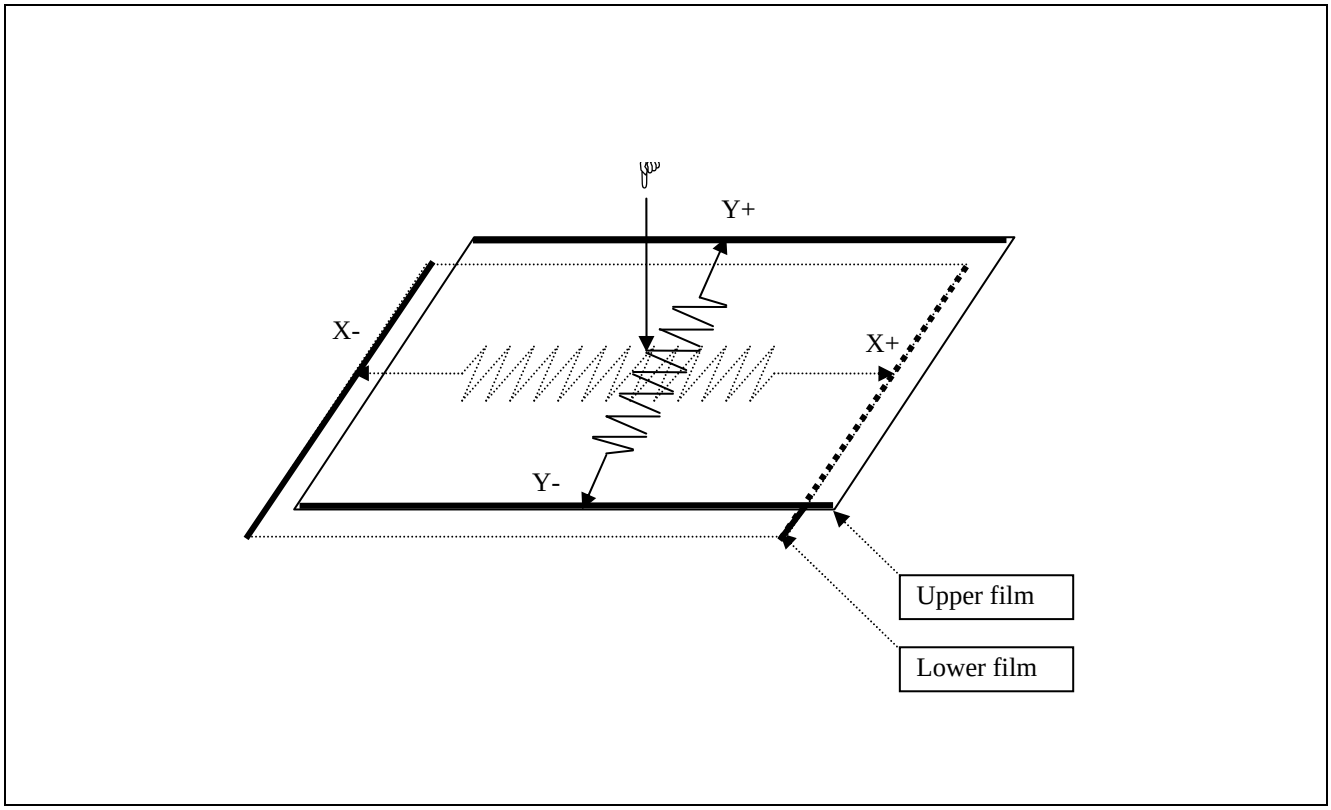


Figure 1 Concept of resistor type touch panel

1.3 Control Circuit

To measure the position on the touch panel, a circuit array is presented, composed of two NPN and two PNP transistors which switch on or off depending on which axis is being measured. There are three GPIOs (General Purpose Input Output) switching the four transistors to meet position measuring method described in above section. These GPIOs are TP_A0, TP_A1, and TP_A2. To measure voltage, the analog inputs TP_AN0 and TP_AN1 are used. The control circuit is shown below in the block diagram.

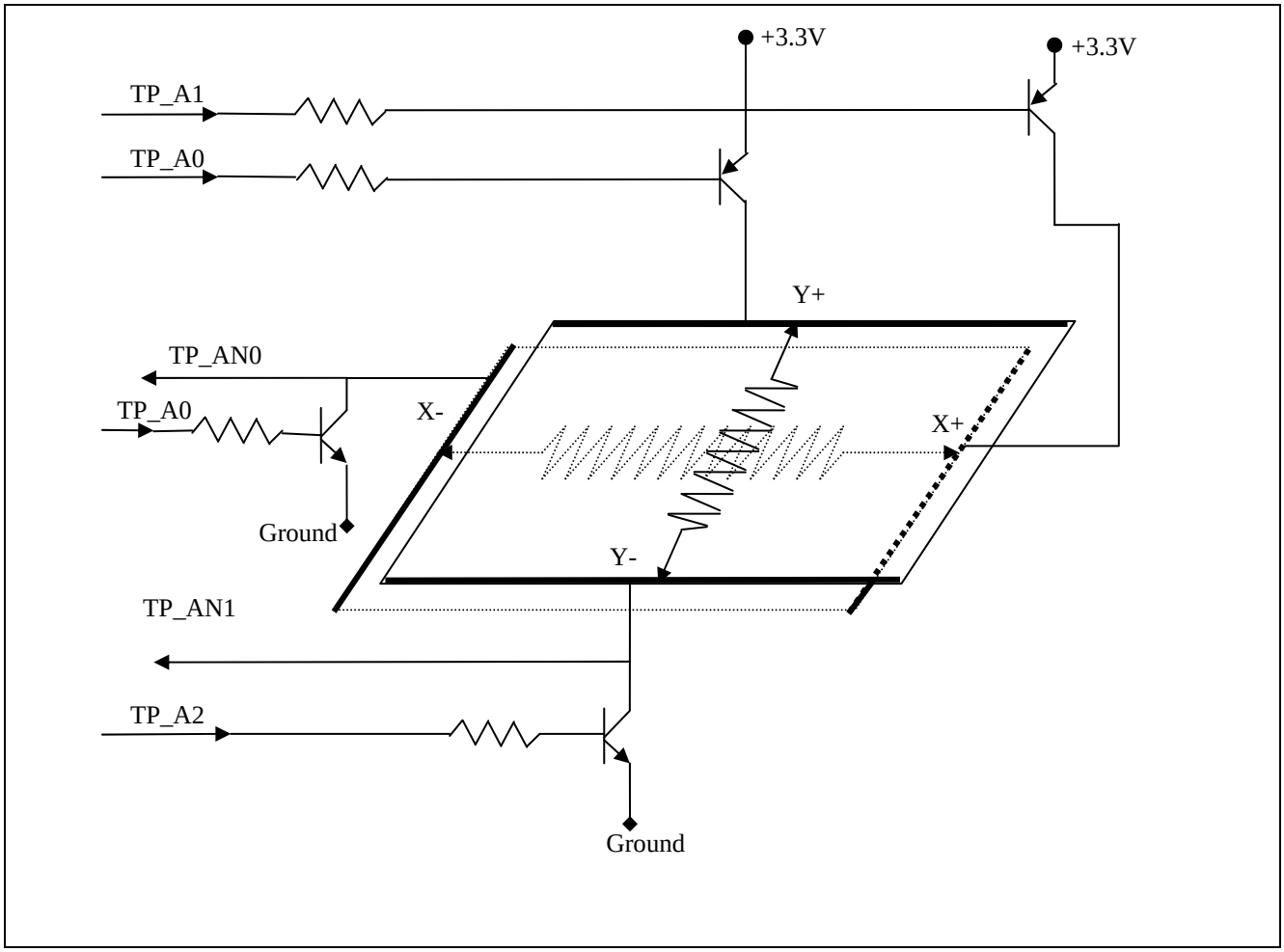


Figure 2 Control circuit

As seen in Figure 2, a combination of TP_A0, TP_A1, and TP_A2 are set to control which axis is being measured. Table 1 outlines these combinations. No other combinations are recommended.

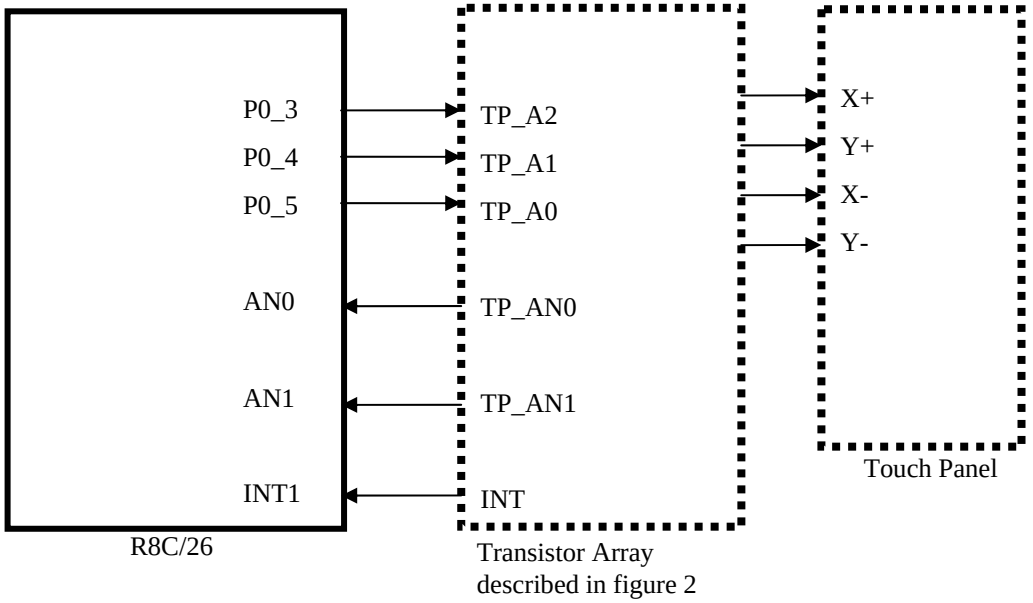
Table 1 GPIO Output and Analog Input

TP_A2	TP_A1	TP_A0	TP_AN1	TP_AN0	Description
1	1	0	—	Input	TP_AN0 measured value is position of Y axis
0	0	1	Input	—	TP_AN1 measured value is position of Y axis

Note: Other than above setting table is prohibited

1.4 R8C/26 Interface with Control Circuit

The controller R8C/26 uses GPIO port 0 bit 5 (P0_5) for TP_A0, bit 4 (P0_4) for TP_A1, and bit 3 (P0_3) for TP_A2. And input AN0 is connected to TP_AN0 and input AN1 is connected to TP_AN1. Its connection interface is shown in the figure below.



Note: R8C 26 uses A/D converter pin (AN0, AN1) to detect the voltage for Y,X axes.
INT1 is an interrupt pin to start scanning, however it is not used in this application example

Figure 3 R8C/26 interface with control circuit

1.5 Distortion and Calibration of Touch Panel

As mentioned in sections above, touch panel axis measurement is switched by pairs of NPN and PNP transistors, which are given +3.3VDC or GND. However, each transistor has an equivalent resistance when it is turned on, it does not perform as an ideal switch. Also, the touch panel must be sized larger than the display screen, to allow coverage over the whole display area. Thus, the touch panel position measured by a 10-bit analog-to-digital converter is not an ideal result with a range from 0x000 to 0x3FF.

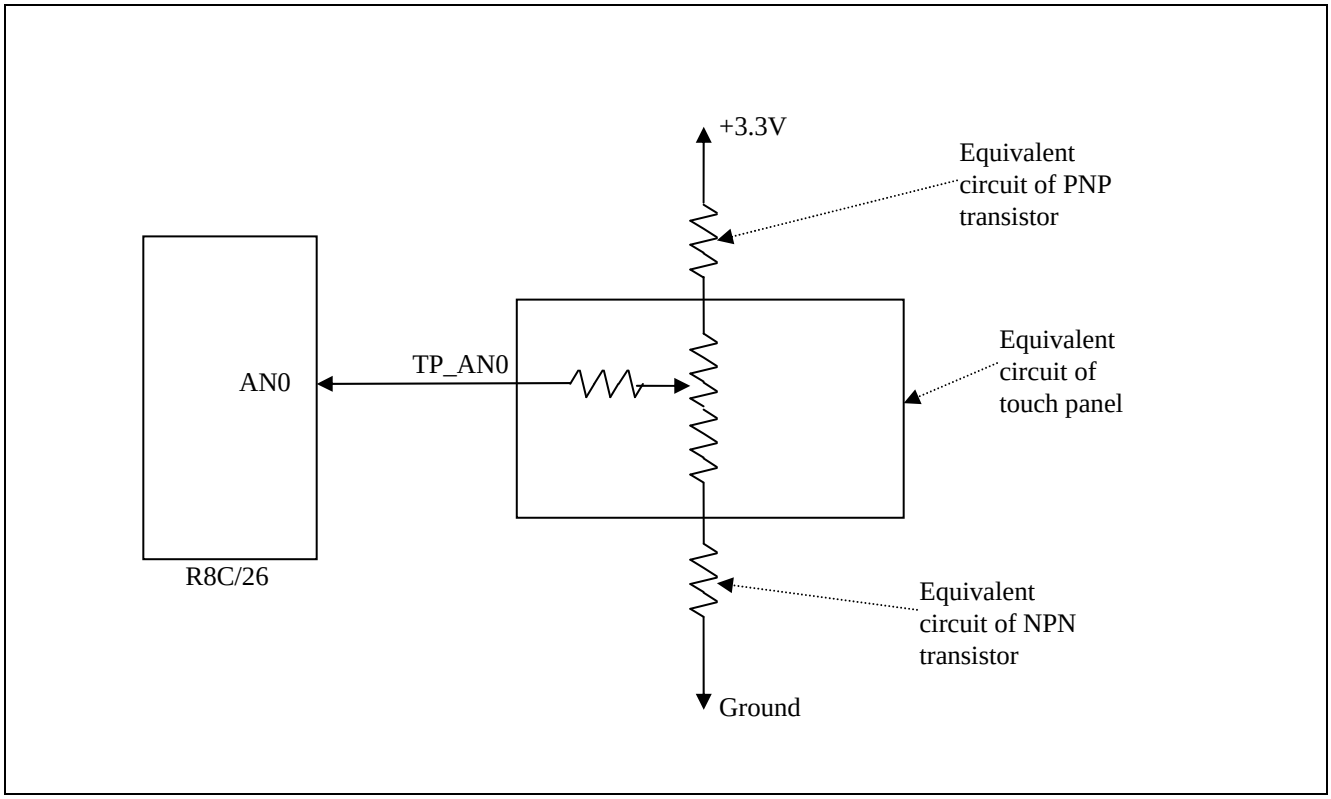


Figure 4 Equivalent circuit of resistor type touch panel

When the touch panel is not pressed, the two films are isolated. The position measured by AN0 and AN1 from the floating film is around 0x3C0 to 0x3F8. This range was derived from experimentation. The touch panel thusly defines any value over 0x3A0 as a "no press" state, and makes no additional attempts to relay coordinate information to the SH7722 main processor. The experimental measurements of vertical position show measured values may happen between 0x50 and 0x3A0.

Since the touch panel size is larger than the active display area, as shown in Figure 5, the controller can eliminate the border area defined as the area in which the touch panel extends beyond the display area. Calibration is required since it may not be accurate to get exact mapping from the touch panel to the active display. The main processor has a display controller that can draw a set of crosshairs at a certain physical location on the active display, and request the end user to touch the crosshair. A table, then, can be setup that will convert touch panel coordinates to active display coordinates. This method is not explained any further in this application note.

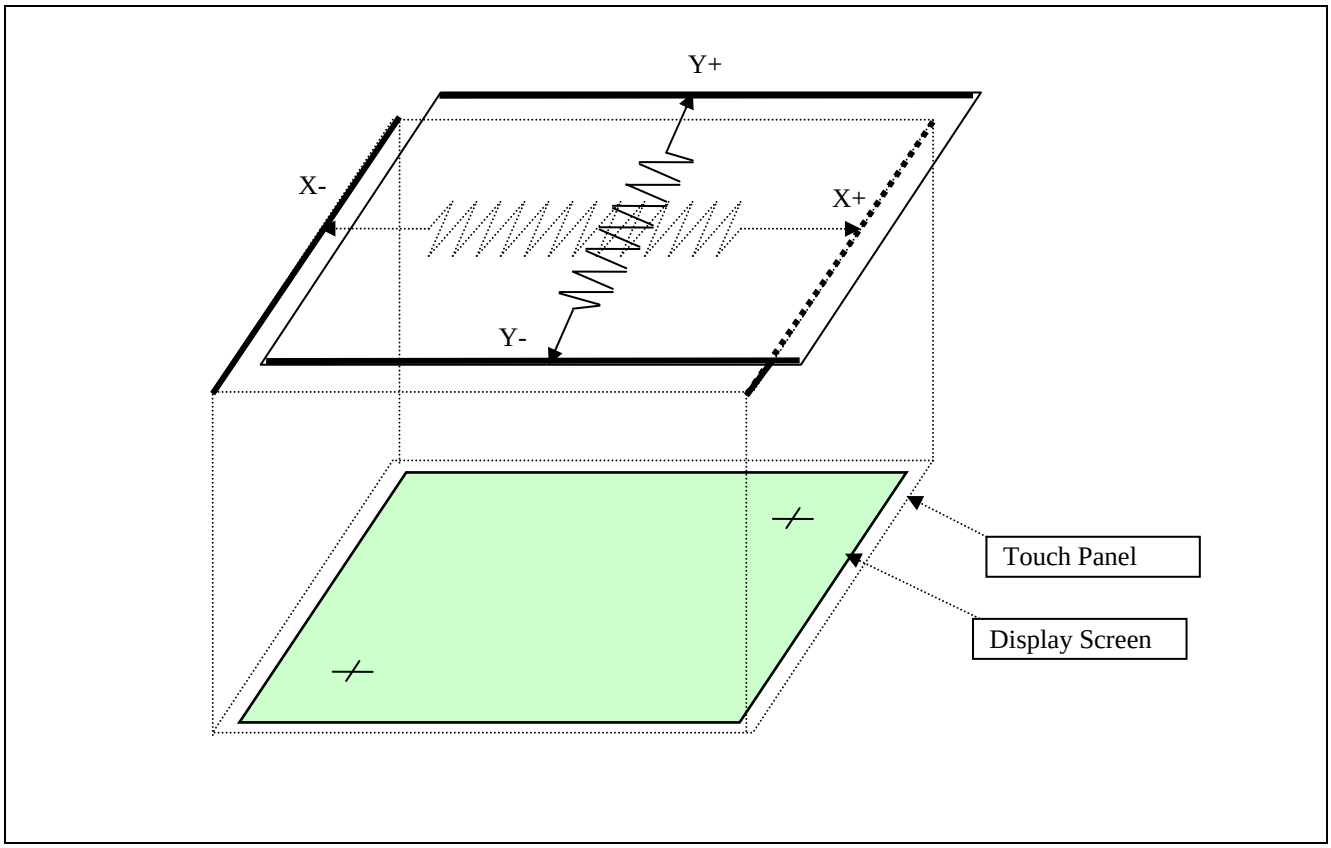
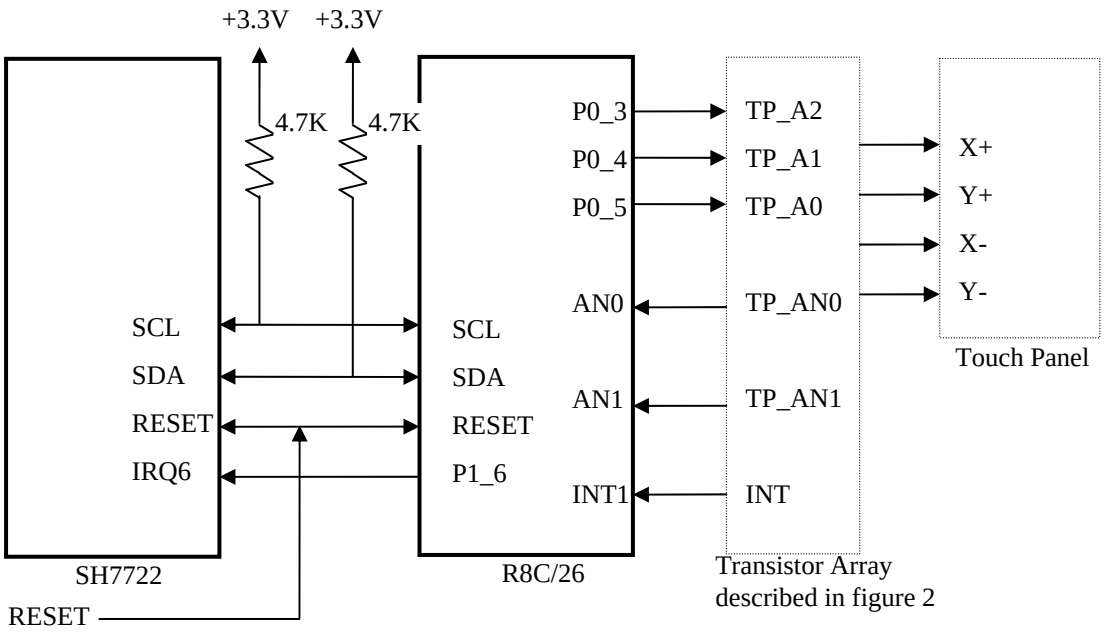


Figure 5 Touch panel and display Panel

1.6 Interface with the Main Processor SH7722

Except for controlling and scanning the touch panel, R8C/26 acts as a slave device accessed by the SH7722 main processor through the IIC bus. When it is started by a system reset, it begins periodic control and measurement of the X and Y positions from the touch panel. The R8C/26 has the capability to detect pen-down edge, pen-up edge, or pen-down repeating at twenty times per second. It generates an interrupt signal to SH7722 IRQ6 from GPIO power 1, bit 6 (P1_6) whenever the R8C/26 controller has any of those three events. The R8C/26 slave address is assigned to 0x51 on the IIC bus. Combined with the R/W bit, the device ID is 0xA2/0xA3, which is easily modified by changing program code. Through the IIC bus protocol, accessing 0xA2 after IIC start results in a READ command, and continuously gets single bytes of data, which are read into the SH7722. Next, 0xA3 is accessed, and an INDEX command indicates the register number to be accessed inside the R8C/26. The function registers of the touch panel controller are defined in the R8C/26. Please refer to chapter 2.

Through the IIC bus, the SH7722 can access the configuration register of the R8C/26, to enable or disable touch panel control routing. Touch panel control routing is enabled by default when the R8C/26 starts. Details are given in chapter 2.



Note: R8C/26 uses I2C to connect with SH7722
RESET: Power on Reset
IRQ: Interrupt Pin

Figure 6 Interface between SH7722 and R8C/26

2. Registers Definition in R8C/26

2.1 Device ID

For the MigoR system, the SH7722 is an IIC bus master, and the R8C/26 is the slave device with device ID shown in table 2 below.

R8C/26 slave address is assigned to 0x51 in table 2 below, which is combined with the R/W bit ID. 0xA2 would be used for READ command, and ID 0xA3 would be used for WRITE command.

Table 2 Device ID for touch panel controller

SA6	SA5	SA4	SA3	SA2	SA1	SA0	R/W	Description
1	0	1	0	0	0	1	0	READ ID
0	0	1	0	0	0	1	1	WRITE ID

2.2 Touch Panel Controller Registers

There are six registers defined for the touch panel controller to provide enable/disable function, coordinate information, and touch panel events to SH7722 through IIC bus. The six registers are listed in table 3 below.

Table 3 Registers for touch panel controller

Index(HEX)	Initial value	Register name	Read/ Write	Description
0x00	0x01	SYSCFG	R/W	configuration
0x08	0x00	YDL	R	Bit 7 to 0 are bit 7 to bit 0 of Y axis coordinate
0x09	0x00	YDH	R	Bit 1 to 0 are bit 9 to bit 8 of Y axis coordinate
0x0A	0x00	XDL	R	Bit 7 to 0 are bit 7 to bit 0 of X axis coordinate
0x0B	0x00	XDH	R	Bit 1 to 0 are bit 9 to bit 8 of X axis coordinate
0x0C	0x00	SYSFLAG	R	Event flag to indicate pen-down/up or repeat

2.3 Register Descriptions

Register SYSCFG is provided to enable touch panel controller. It also provides coordinate information, and touch panel events to SH7722 through IIC bus.

Register SYSCFG: Index = 0x00, width = 8 bits.

Bit number	Initial value	Read/ Write	Description
7	0	R/W	No use
6	0	R/W	No use
5	0	R/W	No use
4	0	R/W	No use
3	0	R/W	No use
2	0	R/W	No use
1	0	R/W	No use
0	1	R/W	1 : Enable touch panel controller, scanning panel is started 0 : Disable touch panel controller, scanning panel is halted

Register YDL: Index = 0x08, width = 8 bits.

Bit number	Initial value	Read/ Write	Description
7	0	R	Y coordinates bit 7 to bit 0
6	0	R	
5	0	R	
4	0	R	
3	0	R	
2	0	R	
1	0	R	
0	0	R	

Register YDH: Index = 0x09, width = 8 bits.

Bit number	Initial value	Read/ Write	Description
7	0	R	No use
6	0	R	No use
5	0	R	No use
4	0	R	No use
3	0	R	No use
2	0	R	No use
1	0	R	bit 1, bit 0 : Y coordinates bit 9 to bit 8
0	0	R	

Register XDL: Index = 0x0A, width = 8 bits.

Bit number	Initial value	Read/ Write	Description
7	0	R	X coordinates bit 7 to bit 0
6	0	R	
5	0	R	
4	0	R	
3	0	R	
2	0	R	
1	0	R	
0	0	R	

Register XDH: Index = 0x0B, width = 8 bits.

Bit number	Initial value	Read/ Write	Description
7	0	R	No use
6	0	R	No use
5	0	R	No use
4	0	R	No use
3	0	R	No use
2	0	R	No use
1	0	R	bit 1, bit 0 : X coordinates bit 9 to bit 8
0	0	R	

Register SYSFLAG: Index = 0x0C, width = 8 bits.

Bit number	Initial value	Read/ Write	Description
7	0	R	No use
6	0	R	No use
5	0	R	No use
4	0	R	No use
3	0	R	Bit 3-0 = 0000 : No event
2	0	R	Bit 3-0 = 0001 : Pen-down event
1	0	R	Bit 3-0 = 0010 : Pen-down repeat
0	0	R	Bit 3-0 = 0011 : Pen-up event

3. Flowchart

3.1 R8C/26 Touch Panel Controller Main Routine

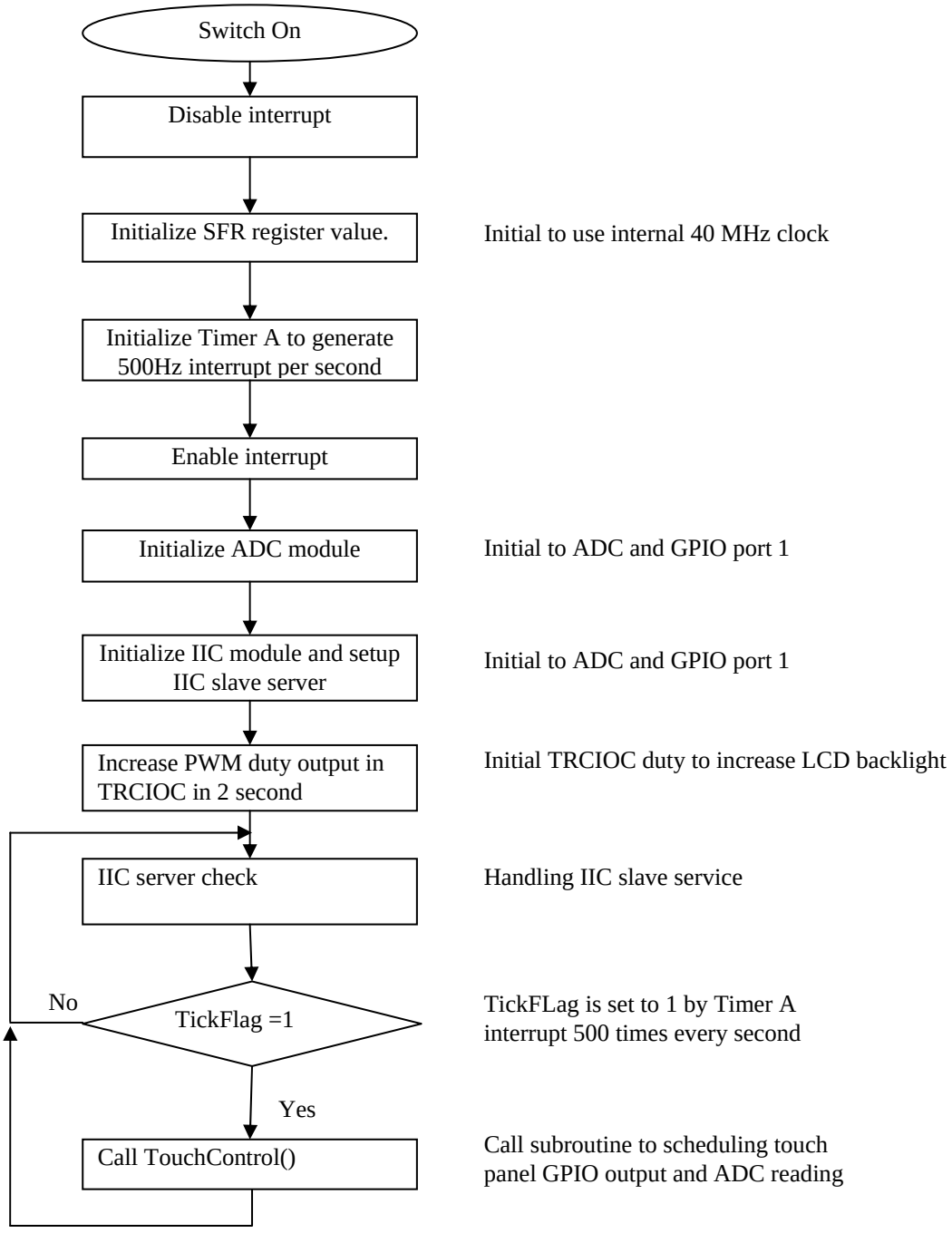


Figure 7 R8C/26 touch panel controller main routine

3.2 TouchControl() Function Call Flowchart

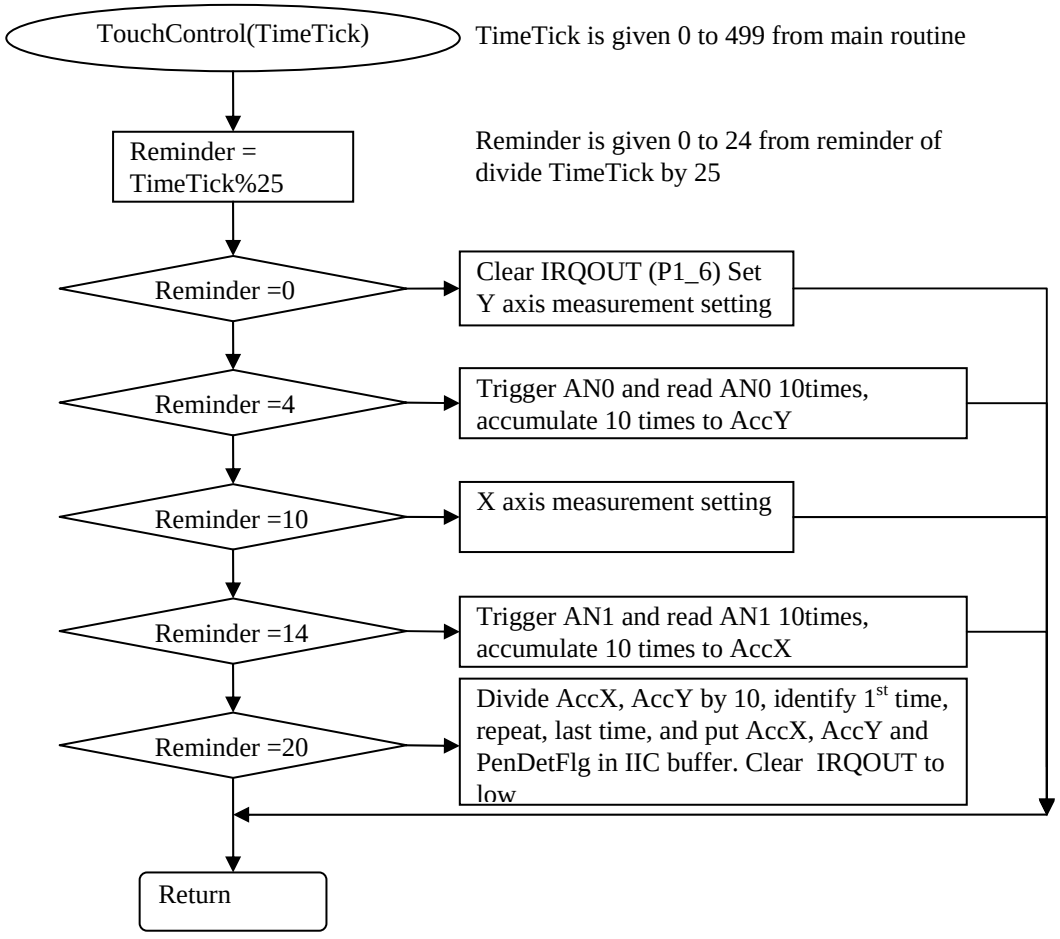
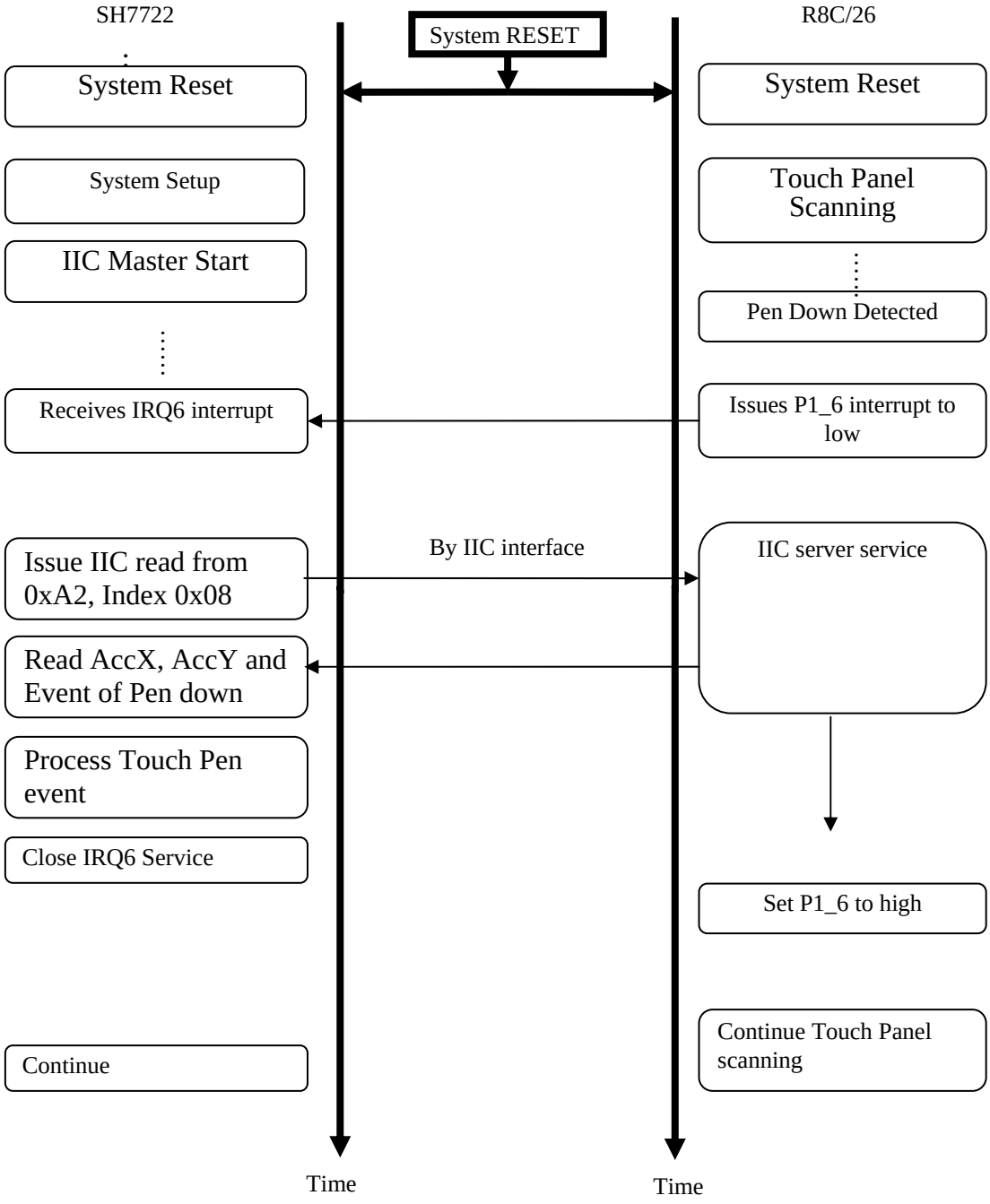


Figure 8 TouchControl() function call flowchart

3.3 System Communication Model with SH7722



4. Program Code

4.1 Source File

All Source files including whole workspace for HEW (High Performance Embedded Workshop) project file are compressed in one file named MigoR8CTPC.ZIP. Please extract from folder /MigoR8CTPC, and copy MigoR8CTPC to c:/workspace/MigoR8CTPC when downloaded.

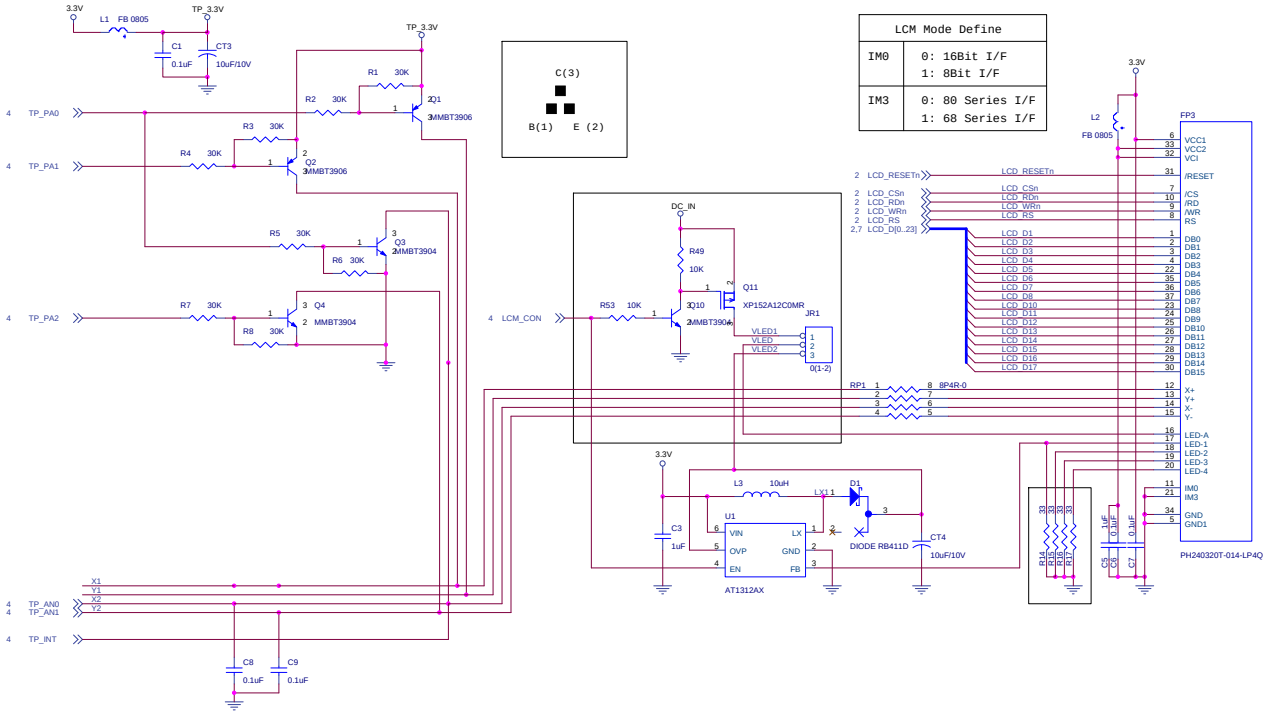
4.2 Program Source Code File List

Table 4 Source file list

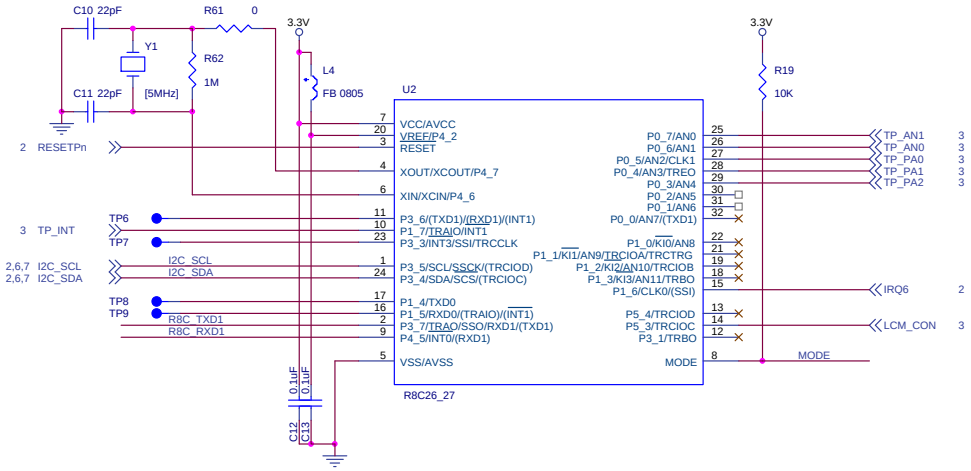
Number	Directory	File name	File type	Function description
1	Source\Common	Ncrt0.a30	Assembly code	Start up assembly program for R8C
2	Include	R8CMigoC.h	Header file	Header for this application
3	Source\IIC	R8C_IIC.h	Header file	Header for IIC
4	Include	Sfr_r827.h	Header file	R8C/26,R8C/27 special function register define
5	Source\Common	Sect30.inc	Assembly Including file	Assembly including file for ncrt0.a30. To applicable when using basic I/O library. To do section definition.
6	Source\AD	R8c_AD.c	C	ADC converter and touch panel control. To initialize ADC component, trigger X-Y value, and generate interrupt to notify MigoR platform interrupt handler.
7	Source\IIC	R8c_IIC.c	C	Salve IIC program. To initialize IIC component, write IIC buffer, switch and handle IIC state.
8	Source\Timer	R8c_timer.c	C	Timer component. To initialize and setup timer component.
9	Source\Common	R8CMigoC.c	C	Main Program. This is the main tutorial code. For components initialization, and interrupt handler.
10	Source\Common	Sfr_r827.inc	Assembly Including file	To definition of R8C/26 & R8C/27 Group SFR

5. Reference Circuit

5.1 Touch Panel Interface Circuit



5.2 R8C/26 Circuit



6. Reference Document

Datasheet
R8C/26 Group Data sheet (R8C Tiny Series)
Download the latest version from the Renesas Technology website.

SH7722 Group Data sheet ()
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Technical News/Technical Update
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Revision Record of Touch Panel Controller with IIC Sample Code

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Oct.31.08	-	First edition issued

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