low voltageI/OTouch screen control circuit

Overview

ET2046yes4Line touch screen controller, support1.5V~5.5Vof low pressureI/Ointerface.ET2046Has built-in2.5VVoltage source for measurements in auxiliary input, battery monitoring, and temperature sensing modes. When not in use, the built-in voltage source can also be turned off to save power. The built-in voltage source can work at a minimum of2.7Vsupply voltage, while detectable0V~6Vbattery voltage.

becauseET2046has low power consumption (when the supply voltage is2.7Vless than0.75mW), high speed (the highest sampling rate can reach125KHz) and built-in chip drivers, making it a personal digital assistant with a resistive touch screen (PDAs),BPIdeal for mobile phones, mobile phones and other portable devices.ET2046Can work on -40℃~85℃.

Features

Pins andADS7846compatible

Operating Voltage:2.2V~5.25V 1.5V

arrive5.25VnumberI/OBuilt-in

interface2.5Vpower source

Can directly measure battery voltage (0V~6V) On-chip built-

in temperature measurement

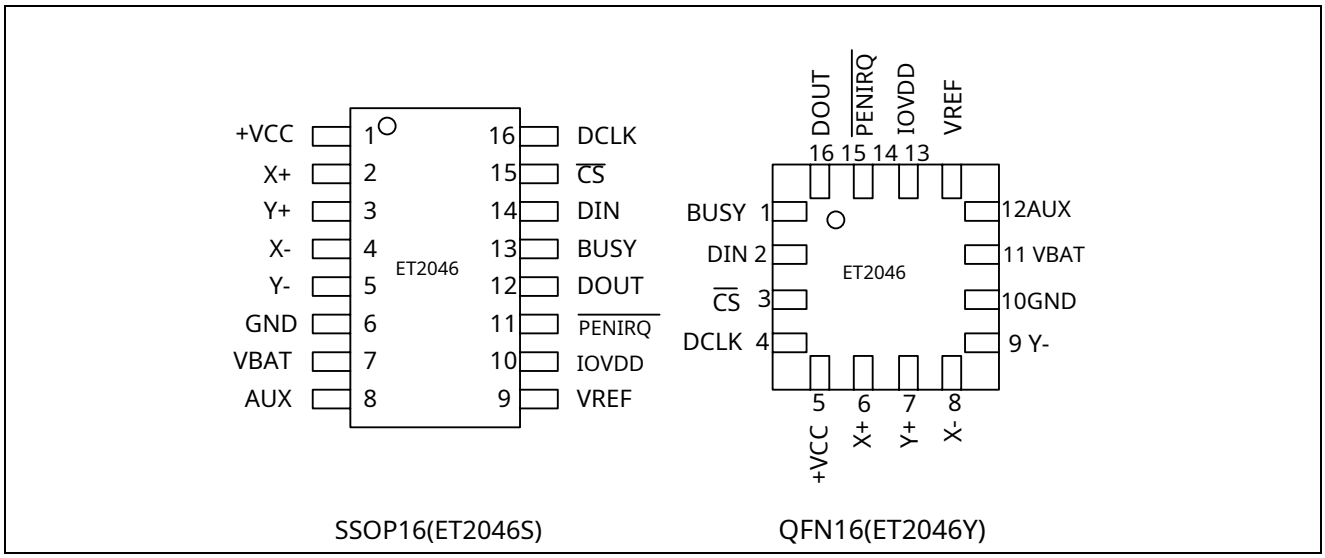
Touch pressure measurement

QSPI™andSPI™3Line interface automatically

saves power

Package form:SSOP16(ET2046S),QFN16(ET2046Y)

Pin arrangement diagram

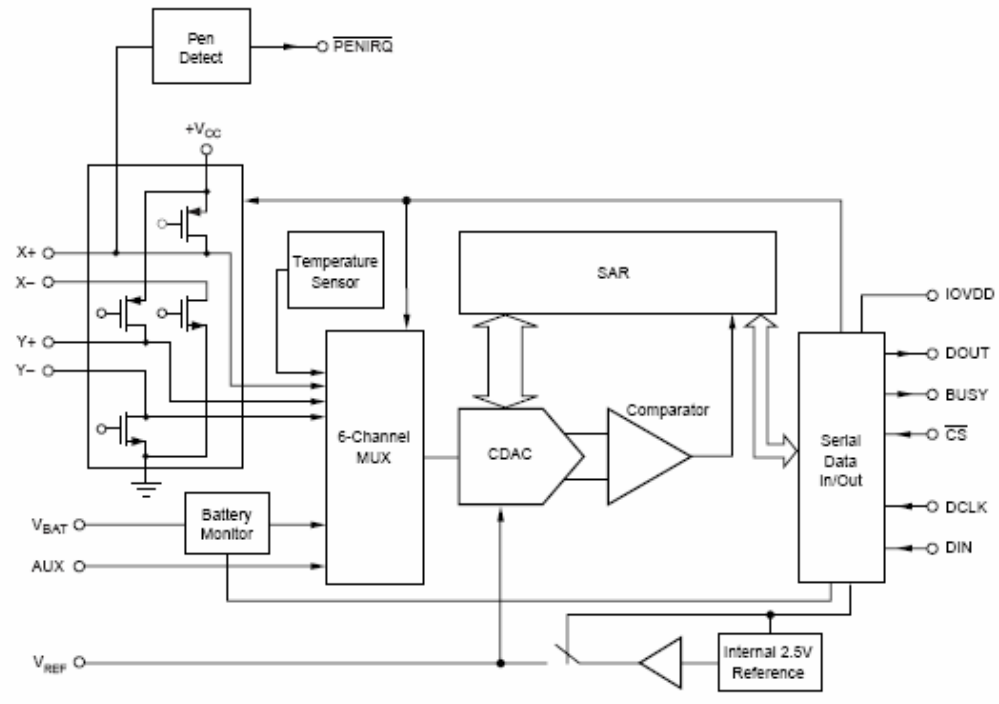


SSOP16(ET2046S) QFN16(ET2046Y)

Pin description

serial number		Pin name	Function Description
SSOP16	QFN16		
1	5	+VCC	power supply.
2	6	X+	X+enter.
3	7	Y+	Y+enter.
4	8	X-	X-enter.
5	9	Y-	Y-enter.
6	10	GND	land.
7	11	VBAT	Battery monitoring input.
8	12	AUX	arriveADCauxiliary input.
9	13	VREF	Voltage reference source input/output.
10	14	IOVDD	numberI/Opower input.
11	15	$\overline{\text{PENIRQ}}$	The stylus is interrupted.
12	16	DOUT	Serial data output. data inDCLKThe falling edge shifts out. when$\overline{\text{CS}}$When high, this output is high-impedance.
13	1	BUSY	BUSYoutput. when$\overline{\text{CS}}$When high, this output is high-impedance.
14	2	DIN	Serial data input. like$\overline{\text{CS}}$is low, the data in theDCLKThe rising edge of is latched into the register.
15	3	$\overline{\text{CS}}$	Chip select input. Controls conversion time and enables serial input/output registers.$\overline{\text{CS}}$ for high =Power-Downmodel(ADC only).
16	4	DCLK	External clock input. This clock is used forSARConversion process and synchronization of serial dataI/O.

Functional block diagram



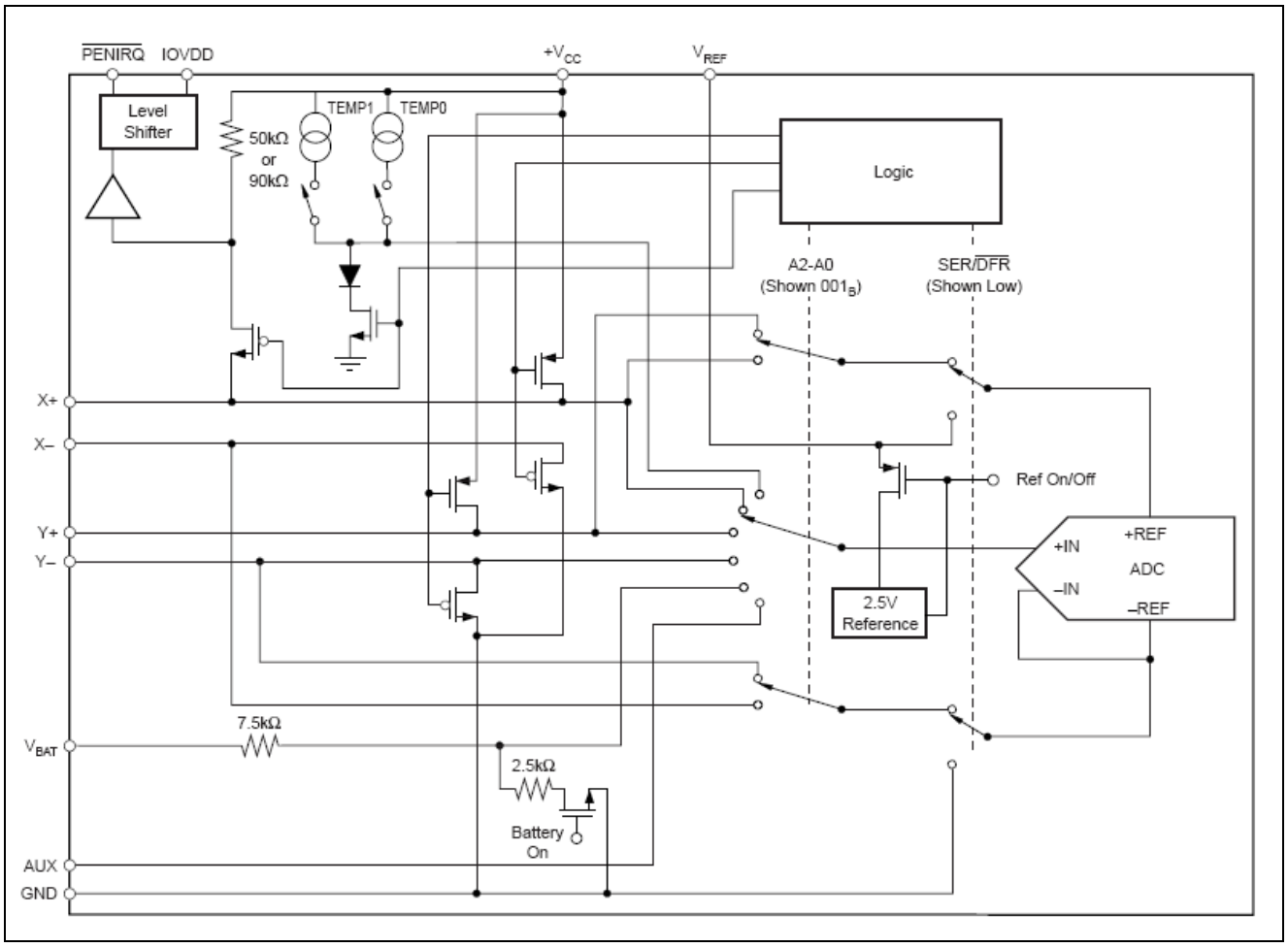
Function Description

ET2046is a classic successive approximation register ADC (SAR ADC). This architecture is based on the principle of charge redistribution and has an inherent sample-and-hold function.

ET2046The basic working principle is shown in the figure below. This device incorporates a2.5Vvoltage source, using an external clock, is available2.7Varrive 5.25Vpower supply. The internal source can be externally low impedance1Vto +VCCdriven by a voltage source. The value of the source voltage directly determines the input range of the converter.

Analog input of the converter (X-,Y-andZcoordinates, auxiliary input, battery voltage and chip temperature) are provided through a multiplexer. A unique low on-resistance touchscreen driver switch allows an unselectedADCOne input channel provides power to an external device, and another adjacent channel provides ground, such as a touch screen. By maintaining the differential input and differential reference structure of the converter, the error caused by the on-resistance of the touch screen driver switch can be reduced if this is a source of error under certain measurement conditions.

Analog input



picture1Analog input

The picture above showsET2046Multiple input selector onADCdifferential input and differential reference mode of the converter. surface1and table2shownA2,A1,A0 and$\overline{\text{SER/DFR}}$The relationship between control words andET2046Configuration. This control word is controlled by the serial portDINsupply. When the converter enters hold mode, +INand-INThe input voltage difference is captured by the internal capacitor array. The analog input current is determined by the slew rate of the device. During the sampling period, the source must be connected to the internal sampling capacitor (typically25pF)Charge. After the capacitor is fully charged there will be no more input current. The transfer rate from the analog source to the converter is a function of the slew rate.

A2	A1	A0	V_{BAT}	AUX_{IN}	TEMP	Y–	X+	Y+	Y-POSITION	X-POSITION	Z_1-POSITION	Z_2-POSITION	X-DRIVERS	Y-DRIVERS
0	0	0			+IN (TEMP0)								Off	Off
0	0	1					+IN		Measure				Off	On
0	1	0	+IN										Off	Off
0	1	1					+IN				Measure		X–, On	Y+, On
1	0	0				+IN						Measure	X–, On	Y+, On
1	0	1						+IN		Measure			On	Off
1	1	0		+IN									Off	Off
1	1	1			+IN (TEMP1)								Off	Off

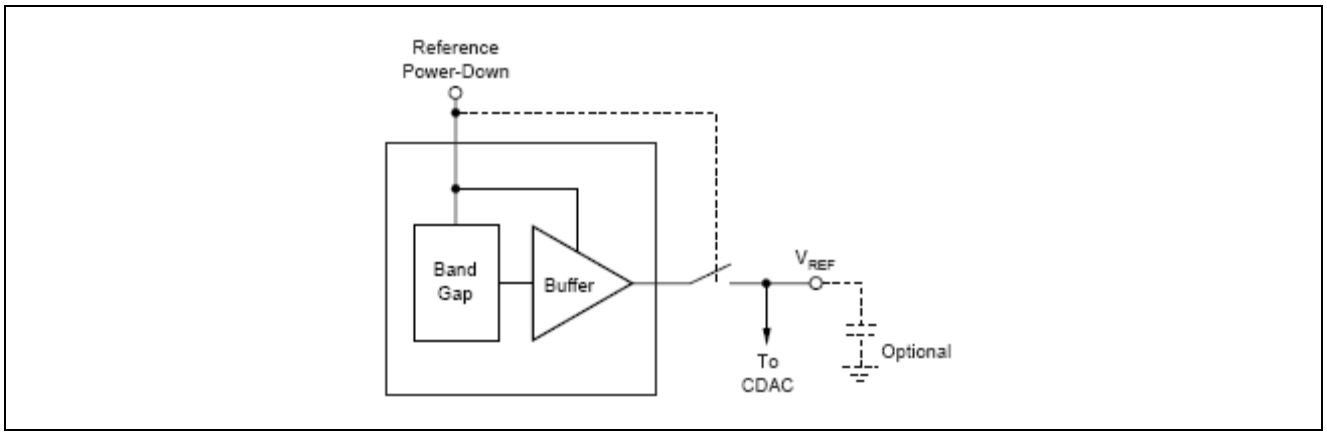
surface1input configuration (DIN), single-ended reference source mode (SER/DFRis high)

A2	A1	A0	+REF	–REF	Y–	X+	Y+	Y-POSITION	X-POSITION	Z_1-POSITION	Z_2-POSITION	DRIVERS ON
0	0	1	Y+	Y–		+IN		Measure				Y+, Y–
0	1	1	Y+	X–		+IN				Measure		Y+, X–
1	0	0	Y+	X–	+IN						Measure	Y+, X–
1	0	1	X+	X–			+IN		Measure			X+, X–

surface2input configuration (DIN), differential reference source mode (SER/DFRis low)

internal reference

ET2046Built-in one2.5Vvoltage reference source, available via the control wordPD1On and off. Generally, this reference source is only used for battery monitoring, temperature measurement and auxiliary input measurement in single-ended mode. The differential mode can optimize the measurement of the touch screen. in order to communicate withADS7843To be compatible, the internal reference voltage source must be turned off. Therefore, after power-up, aPD1=0to ensure that the source is closed.



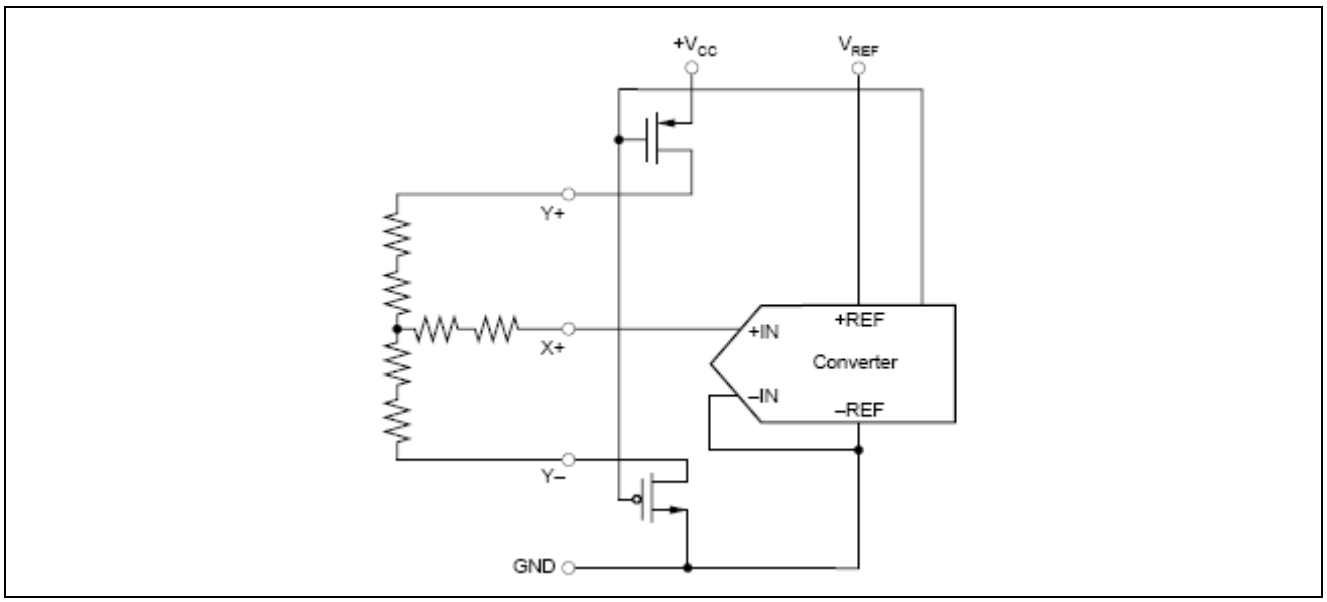
picture2Simplified diagram of internal sources

reference input

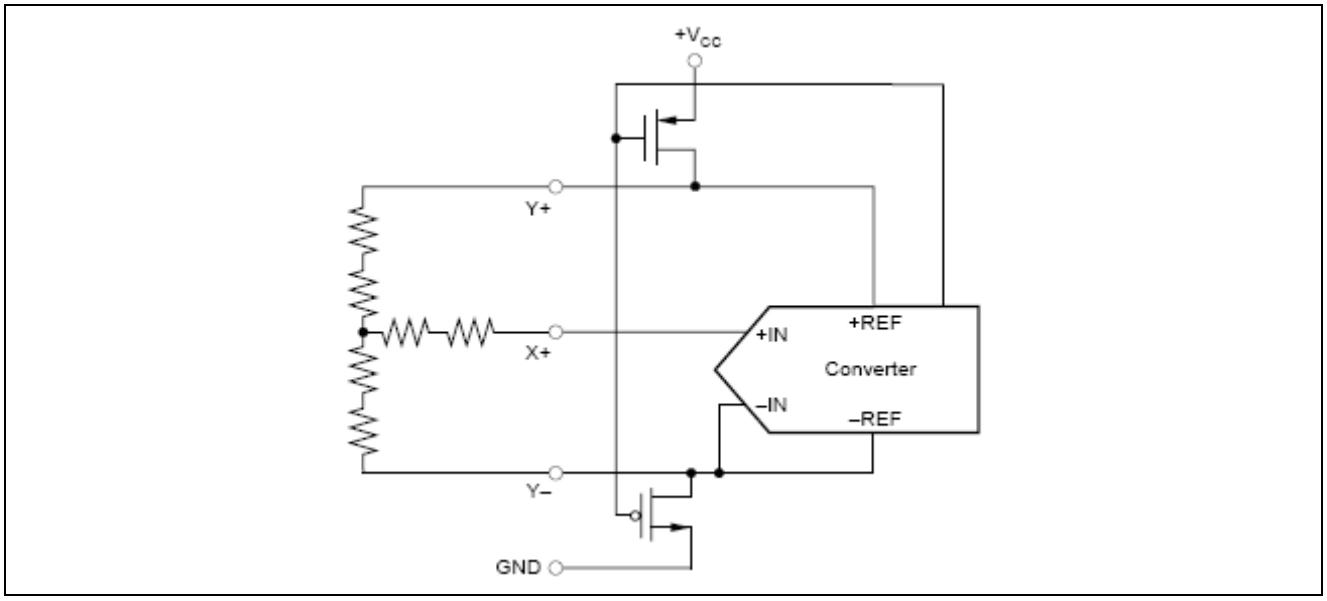
at +REFand-REFThe voltage difference between them determines the operating range of the analog input.ET2046exist1V~+V_{CC}work with a voltage source. There are several key points to note related to the voltage source input and its wide voltage range. When the source voltage drops, the analog input value corresponding to each digital output code also drops accordingly. This is the same as the least significant bit (LSB) related,1LSBcorresponds to the12bitmode source voltage divided by4096value. When the source voltage drops, due toLSBThe value of also decreases, causing thisADCInherent offset and gain errors will rise. For example, in 2.5VThe offset error of the converter under voltage source is2LSBs, while in1VUnder the voltage source, the error can reach5LSBs. But in both cases, the absolute value of the device offset error is the same,1.22mV. At a lower reference voltage, its layout must be carefully designed, sufficient filter capacitors must be added, and low-noise, low-voltagerippleIf an external voltage reference source is used, a low-noise reference source must be used, and a low-noise input signal must be used.

enterV_{REF}The voltage at the port directly drives the digital-to-analog converter (CDAC) of the capacitor part. Therefore, the input current is extremely low (typical value <13μA). There are a few key points to note here regarding shielding measurements but reference sources when the switch driver is on. For ease of illustration, see Figure1. This application diagram represents theET2046For measuring resistive touch screens. for measuring equipment inYThe current value in the direction needs to beX+input connected toADC, OpenY+andY-Drive, requantizeX+voltage on (see figure3module diagram shown). For this measurement,X+The lead resistance does not affect the conversion (it affects the settling time, but the resistance is generally small and the effect can be ignored). But due toY+andY-The resistance between theYThe on-resistance of the driver will have some influence. In summary, no matter where the touch point device on the touch screen is, the input cannot be0Vor full scale, since some voltage has been lost to the internal switches. In addition, the internal switch resistance is not linked to the touch screen resistance, so an additional

external error sources.



picture3Simplified block diagram of a single-ended reference source (SER/ DFR =1,Yswitch enable,X+Analog input) This situation can be shown by the figure5Shown to remedy. in positionSER/DFR=0After, +REFand-REFDirectly connectedY+andX+on, correspondingly causing the analog-to-digital converter to enter the ratio conversion state. The result of the conversion will be a percentage of the external resistance, independent of changes in the ratio of the external resistance to the internal switch on-resistance. Note that power consumption issues need to be taken into consideration when using ratio mode.



picture4Simplified block diagram of a differential reference source (SER/DFR=0,Yswitch enable,X+Analog input) The final point to note in differential mode is that you must use $+V_{CC}$instead ofV_{REF}as +REFsource. When ratio mode is not required, high-precision reference sources and single-ended modes can be used for measurement. Under certain circumstances, the converter can be started from a high-precision reference source. Most reference sources can beET2046Provides sufficient power, but may not provide enough power to external loads such as resistive touch screens.

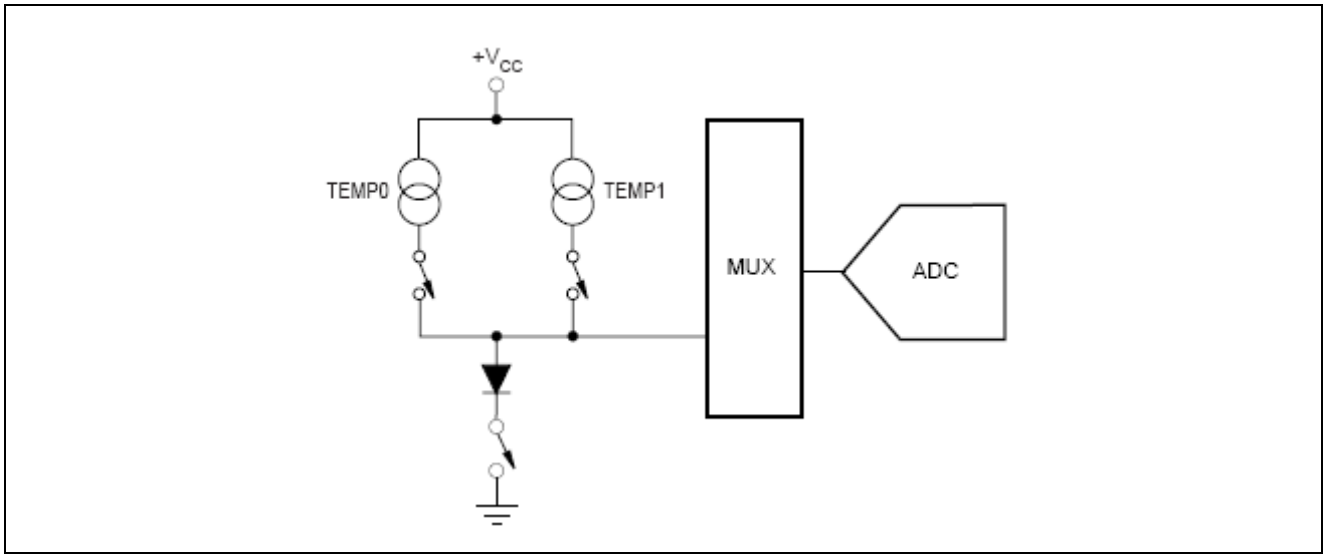
Build the touch screen

In some cases, it may be necessary to connect a capacitor across the touch screen to eliminate noise generated by the touch screen operation (such as from the backlight circuit or LCDNoise generated on the panel) . These capacitors provide a low-pass filter to reduce noise, but cause settling time when the screen is touched The problem will usually manifest itself as a gain error. There are several ways to eliminate or mitigate this effect. The crux of the matter is that the input and/or reference source isADCThe input is sampled and the digital output is provided without reaching a final stable value. In addition, the reference source may also be

is changing. The first option is to stop or slow down for the required touchscreen build-up timeET2046ofDCLKSignal. This causes the input and reference sources to be in acknowledgment cycle (ET2046Zhongwei3clock cycle, see Fig.8) can reach a stable value. This works in both single-ended and differential modes. The second option is to useET2046Only work in differential mode and configure when measuring touch screensET2046Make it always in working condition (touch screen driver is on) without enteringPower-Downstate(PD0=1). According to the requirements of the establishment time andET20460Convert several times at a certain rate. Once the required number of conversions is reached, the processor commandsET2046Enter after last conversionPower-Down state. This process can be done inxdirection,Ydirection andZ Implemented in direction measurement. A third option is to operate the device at15clock per conversion cycle mode, this allowsADCTo maintain continuous working status, keep the touch screen driver always open until a stop command is received from the processor.

temperature measurement

In some applications, such as when charging a battery, it is necessary to measure absolute temperature.ET2046The temperature measurement technique is derived from the properties of a semiconductor junction operating at a fixed current. The forward voltage of the diode junction (V_{BE}) has a good correlation with temperature. In practical applications, it can be known25°CV_{BE}value and monitorV_{BE}The absolute temperature at this time can be obtained by the offset value as the temperature changes. ET2046Two working methods are provided. The first mode requires a voltage value at a known temperature as a standard, but only requires one measurement to obtain the absolute temperature value. A diode is used (turned on) during this measurement. exist20℃ and have20μAWhen a current flows through the diode, the typical value of this voltage is600mV. The absolute value of this diode voltage will bemVlevel deviation. However, the temperature coefficient of this voltage (TC) is very fixed, for 2.1mV/℃. During final product testing, the device will be stored in a room with a known room temperature in order to memorize this specific voltage used as a standard. In this way, the accuracy of the measurement results can reach0.3℃/LSB(exist12-Bitmode).



picture5Schematic diagram of temperature test mode

The second measurement method does not require a temperature standard to be tested, but it requires two temperature measurement processes to eliminate the influence of no temperature standard, which can be achieved2℃ accuracy. A second conversion is required in this mode, and the current flowing through the diode will be the first91times. The pressure difference between the first and second conversion is given by the following formula (1)Represents:

$$\frac{KT}{q}\cdot\ln(N) \qquad (1)$$

in:

Nis the current ratio =91

K=Boltzmann constant (1.38054·10^{-23}Electron volts/Kelvin temperature)

q=Electron power (1.602189·10^{-19}C) T=Kelvin temperature

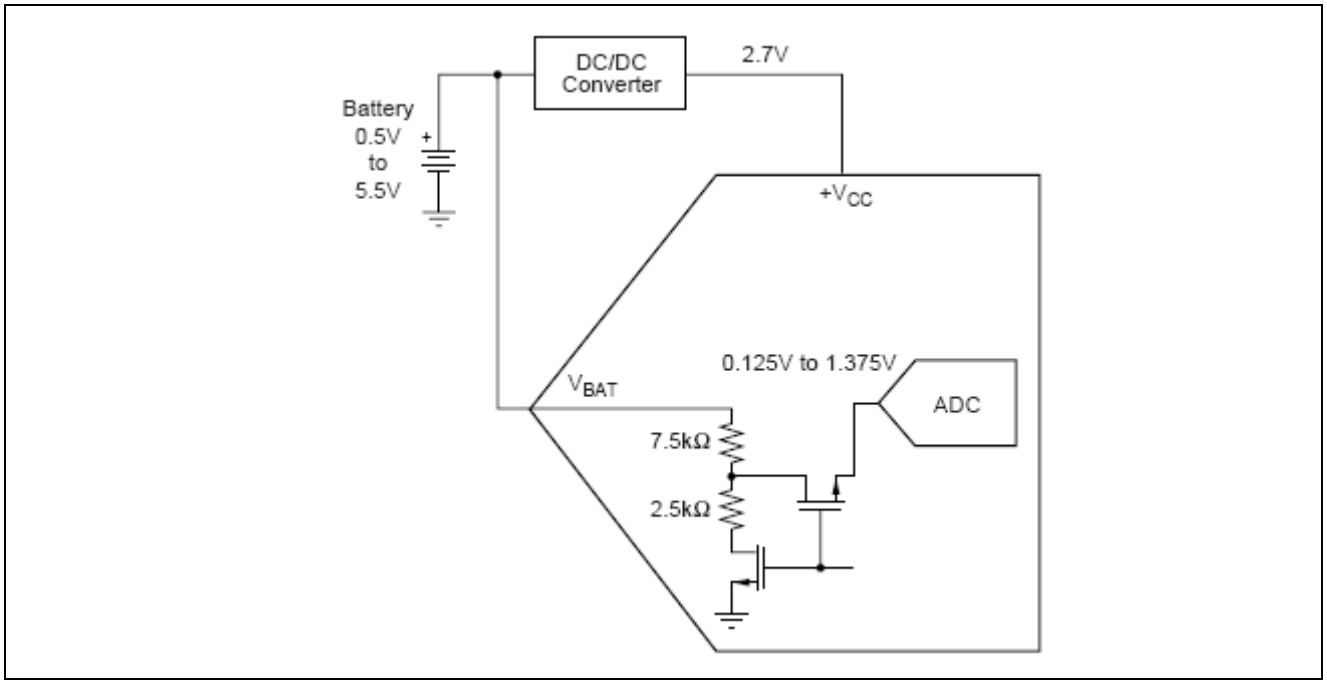
This mode provides an improved method of measuring temperature at the expense of reduced accuracy. The equation for solving the Kelvin temperature is:

$$\text{Kelvin temperature} = q \cdot \frac{\Delta V}{(k * \ln(N))} \qquad (2)$$

in:

△V=V(I91)-V(I1)(Unit ismV) Kelvin temperature =2.573Kelvin/mV·△V ℃= 2.573·△V(mV)-273Kelvin **Measurement of battery voltage**

ET2046with the voltage regulator (DC/DCconverter) side to monitor the battery voltage, see figure6. Battery voltage can be obtained from0Vchange to 6V, while maintaining the supplyET2046The voltage is2.7Vor3.3Vwait. The input voltage is divided by4Therefore5.5VThe battery voltage input to theADC middle is1.375V. This simplifies the multiplexer and control logic. To minimize power dissipation, this voltage divider is onlyA2=0,A1=1 andA0=0It only works during the sampling period.



picture6Battery monitoring function block diagram

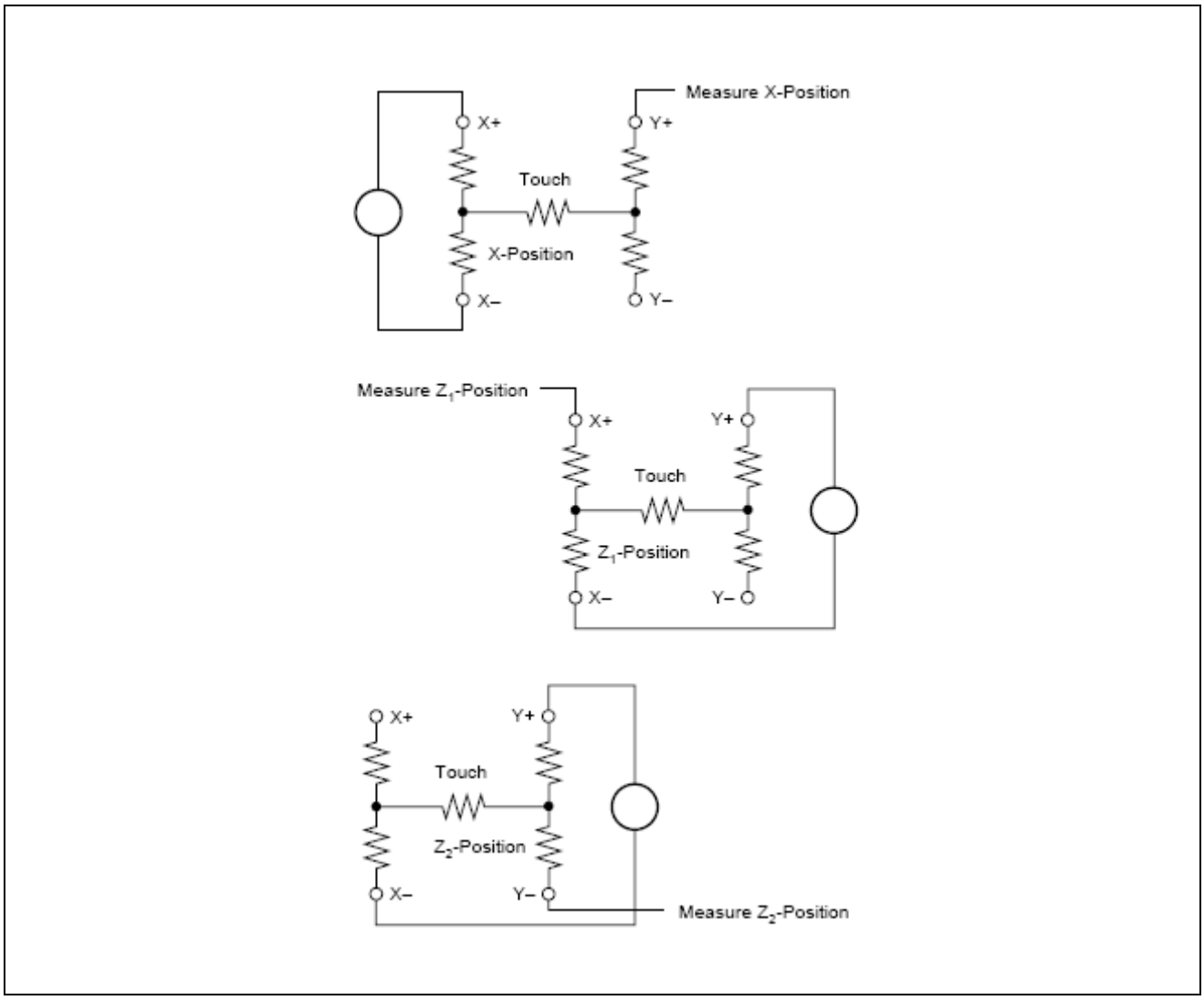
pressure monitoring

useET2046Touch pressure can also be monitored. In order to distinguish whether the screen is touched by hand or pen, the strength of the touch needs to be measured. In general, this measurement does not require high accuracy, so it is recommended to use8-bitprecision mode (but the calculations shown are12-BitPrecision mode as an example). There are several ways to measure pressure.ET2046Two of these methods are supported. The first method requires knownxPlane resistance, measurementxposition and add two additional flat positions on the touch screen (Z1andZ2), as shown in the figure7shown. Using the equation (3)You can calculate the touch resistance:

$$R_{TOUCH} = R_{X-Plat} \quad e \cdot \frac{X - Position}{4096}\left(\frac{Z_2}{Z_1} - 1\right) \qquad (3)$$

The second method requires knownxPlane andYPlane resistance, measurementxdirection,Ydirection position andZ1. Using the equation (4)You can also get touch resistors:

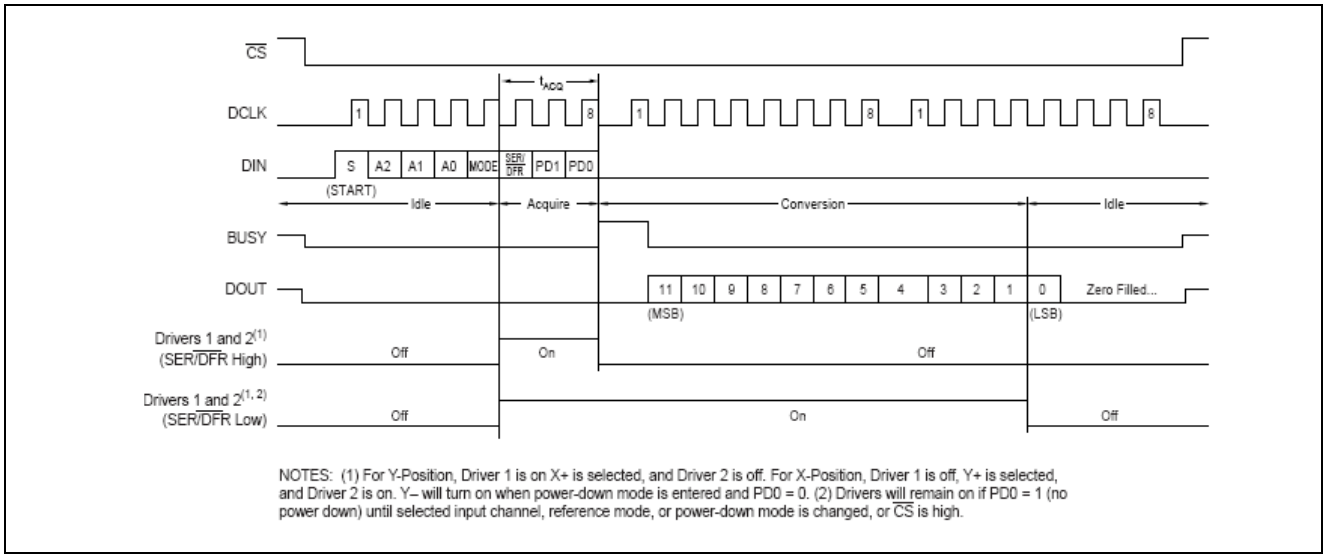
$$R_{TOUCH} = \frac{R_{X-Plate} \cdot X - Position}{4096}\left(\frac{4096}{Z_1} - 1\right) - R_{Y-Plate}\left(1 - \frac{Y - Position}{4096}\right) \qquad (4)$$



picture7Block diagram of pressure measurement

digital interface

ET2046The typical working mode of the digital interface is shown in the figure.8.



NOTES: (1) For Y-Position, Driver 1 is on X+ is selected, and Driver 2 is off. For X-Position, Driver 1 is off, Y+ is selected, and Driver 2 is on. Y– will turn on when power-down mode is entered and PD0 = 0. (2) Drivers will remain on if PD0 = 1 (no power down) until selected input channel, reference mode, or power-down mode is changed, or $\overline{CS}$ is high.

picture8Conversion timing diagram, per conversion cycletwenty fourclock,8bit bus interface.

This diagram assumes that the digital signal originates from a microcontroller or digital signal processor with a serial port. Every communication between the processor and the converter, e.g.SPI,SSIorMicrowire™Synchronous serial interfaces, both consisting of8consists of clock cycles. A complete conversion can be done by3Secondary serial communication is completed, inDCLKTotal inputtwenty fourclock cycles.

forward8clock cycles for passingDINThe port provides control words. After the converter has received enough information to configure the multiplexer and reference source inputs, the device enters confirmation (sampling) mode and opens the touch screen driver port if necessary. Again3After clock cycles, the transmission of the control word is completed and the converter enters conversion mode. At this time, the input sample-hold enters hold mode and the touch screen driver port is closed (in single-ended mode). Next12cycle to complete the actual analog-to-digital conversion. If converted to ratio mode (SER/$\overline{\text{DFR}}$=0), the driver port remains open during the conversion process and requires the first13clock cycles to complete the final1Bitconversion. need extra3cycles to complete the last byte (DOUT will be low), these three cycles are ignored by the converter.

control word

control word (added toDINport) providedET2046The following information: start conversion flag, address,ADCThe accuracy, configuration method andPower-DownMode selection, see table3. picture8,surface3and table4Details are given.

Starting bit—the first bit (i.e.Sbit) must be held high to indicate the start of a control word transfer. When the start bit is not detectedET2046will ignore DINAll inputs on the feet.

Address bits—next3bit(A2,A1,A0) determines the input multiplexer (see table1,surface2and diagram2) input channel, touch screen driver and reference source input.

Mode bit—The mode bit is setADCaccuracy. When this bit is low, subsequent conversions end with12-Bitmode; if this bit is high, the next conversion will be8-bitmode proceeds.

SER/$\overline{\text{DFR}}$bit—SER/$\overline{\text{DFR}}$This bit controls the mode of the reference source, whether to use single-ended mode (this bit is high) or differential mode (this bit is low). Differential mode is also called ratiometric mode when used to measurexdirection,YDirection and touch pressure will be better than single-ended mode. The reference source voltage comes from the switch driver voltage, which is almost as large as the voltage applied to the touch screen. In this situation,ADCThe reference voltage is the voltage across the touch screen, so there is no need for an independent reference source voltage. In single-ended mode, the converter reference voltage is always equal toV_{REF}

feet andGNDThe voltage difference between the pins (see table for details1-2,picture1-4). If measuring in single-ended modexdirection,YDirection and touch pressure require an external reference source.ET2046It must also be powered by an external reference source. Care must be taken when using single-ended modeADCThe input voltage cannot exceed the voltage value of the internal reference source. Especially when the supply voltage is greater than2.7Vhour.

Note: Differential measurement mode is only available forxdirection,YMeasurement of orientation and touch pressure. Measuring other values requires single-ended mode.

Bit7(MSB)	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0(LSB)
S	A2	A1	A0	MODE	SER/$\overline{\text{DFR}}$	PD1	PD0

surface3Sequence of control bits in control word

Bit	name	describe
7	S	Start bit. Control byte starts with first high bit on DIN.A new control byte can start every 15th clock cycle in 12-bit conversion mode or every 11th clock cycle in 8-bit conversion mode (see Figure 13).
6-4	A2-A0	Channel Select bits. Along with the SER/DFR bit, these bits control the setting of the multiplexer input, touch drivers witches, and reference inputs (see Tables I and II).
3	MODE	12-Bit/8-Bit Conversion Select bit. This bit controls the number of bits for the next conversion: 12-bits(low) or 8-bits (high).
2	SER/$\overline{\text{DFR}}$	Single-Ended/Differential Reference Select bit. Along with bits A2-A0, this bit controls the setting of the multiplexer input, touch driver switches, and reference inputs (see Tables I and II).
1-0	PD1-PD0	Power-Down Mode Select bits. Refer to Table V for details.

surface4Description of the control bits in the control word

PD0andPD1bit-table5Describedpower-downMode and how the internal reference source is configured. The internal reference source can be used without affecting theADCOn and off. This gives the internal reference additional time to establish its voltage value before a conversion occurs.ADCWorks immediately with no additional setup time required. In order to turn off the internal reference source, after channel conversion is completed, you need toET2046Write an additional instruction.

PD1	PD0	$\overline{\text{PENIRQ}}$	describe
0	0	Enabled	Power-Down Between Conversions. When each conversion is finished, the converter enters a low-power mode. At the start of the next conversion, the device instantly powers up to full power. There is no need for additional delays to ensure full operation, and the very first conversion is valid. The Y– switch is on when in power-down.
0	1	Disabled	Reference is off and ADC is on.
1	0	Enabled	Reference is on and ADC is off.
1	1	Disabled	Device is always powered. Reference is on and ADC is ON.

surface5 Power-DownSelection of modes and internal reference sources

$\overline{\text{PENIRQ}}$output

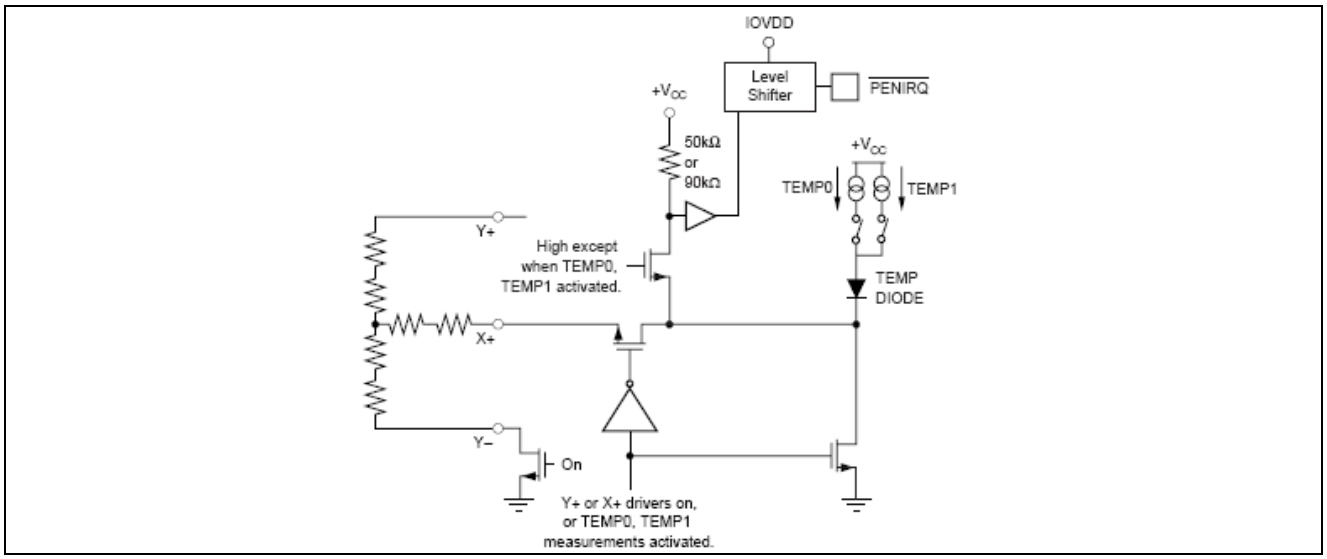
picture9The output function of the pen interrupt is illustrated. DangzaiPower-Downmode andPD0=0hour,YThe driver conduction turns the touch screen'sYdirection to ground.$\overline{\text{PENIRQ}}$The output is connected via two transmission gates toX+enter. When the screen is touched,X+Input is pulled to the ground via the touch screen.

existET2046, the internal pull-up resistor is typically50kΩ, but this value will change with temperature and process changes.36kΩand67kΩchange between. to make sure$\overline{\text{PENIRQ}}$able to achieve0.35*(+Vcc)logic low level, connected to theX+andY-The total resistance between21kΩ.

$\overline{\text{PENIRQ}}$It reaches a low level by draining current from the touch screen to ground, thereby generating an interrupt to the processor. existX+, Y+andZdirection measurement period,X+Enter with$\overline{\text{PENIRQ}}$The internal pull-up resistor on is disconnected. This eliminates leakage current from the internal pull-up resistor through the touch screen to ground (this current can cause measurement errors) .

in addition,$\overline{\text{PENIRQ}}$Signal is measuringX+,Y+andZdirection is disabled and held low.$\overline{\text{PENIRQ}}$Signal is disabled and held high when measuring battery, auxiliary input and temperature. If writtenET2046in the last byte of the instructionPD0=1, the pen interrupt output function is disabled, so it cannot detect whether the touch screen is touched. In this case, in order to re-enable this signal theET2046write to a band PD0=0control word. If writtenET2046The last control word containsPD0=0, then the pen interrupt function is enabled after this conversion is completed. The end of the conversion is in the converted dataBit1send outET2046clockDCLKafter the falling edge occurs.

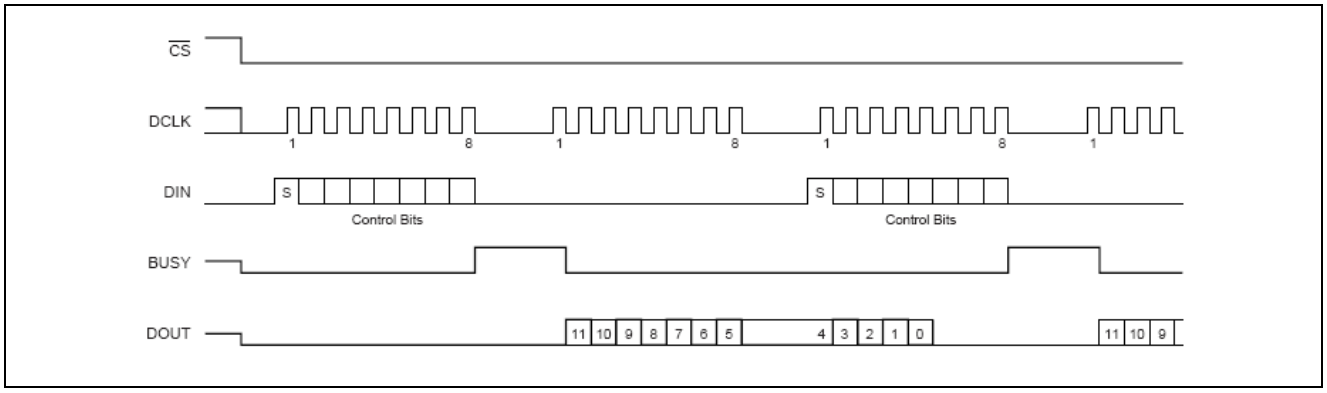
We recommend sending control words in the processor toET2046time shield$\overline{\text{PENIRQ}}$Interrupt. This can be used in the situations discussed in this section$\overline{\text{PENIRQ}}$ The output will not trigger accidentally.



picture9 $\overline{\text{PENIRQ}}$Functional block diagram

16clocks per conversion cycle

As shown in the picture10As shown, convertn+1The control word can be converted immediately afterninput to achieve16clocks per conversion cycle. This figure also shows the format of the serial communication between the processor and the converter. This diagram shows that each conversion can be started after1.6msFinish. Otherwise, the voltage on the sample and hold capacitor will drop significantly and affect the conversion result.

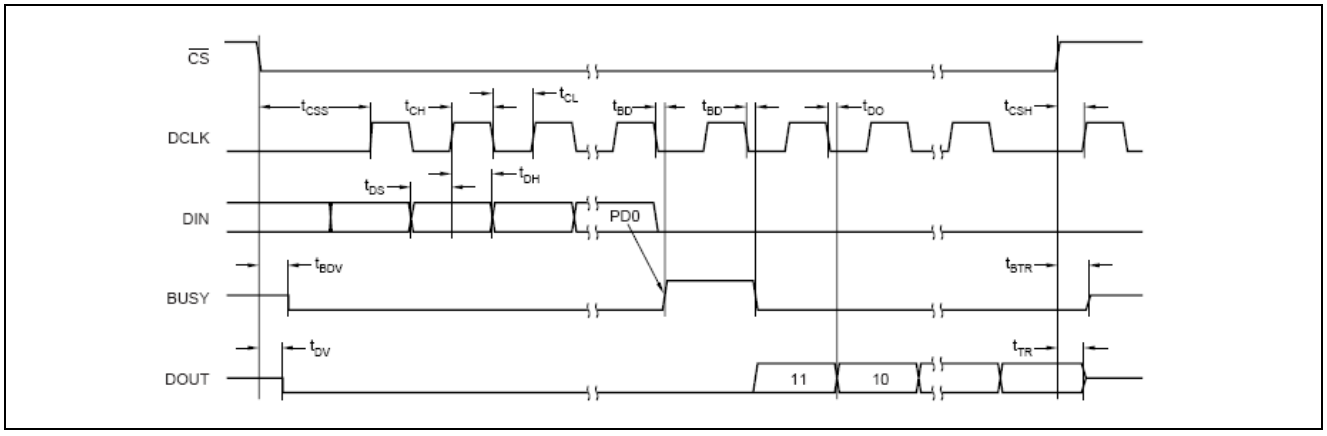


picture10Conversion timing diagram,16clocks per conversion cycle,8bit bus mode.

No need for specific serial portDCLKDelay

digital timing

picture8,picture11and table6providedET2046Detailed timing for digital interfaces.



picture11Detailed Timing Diagram

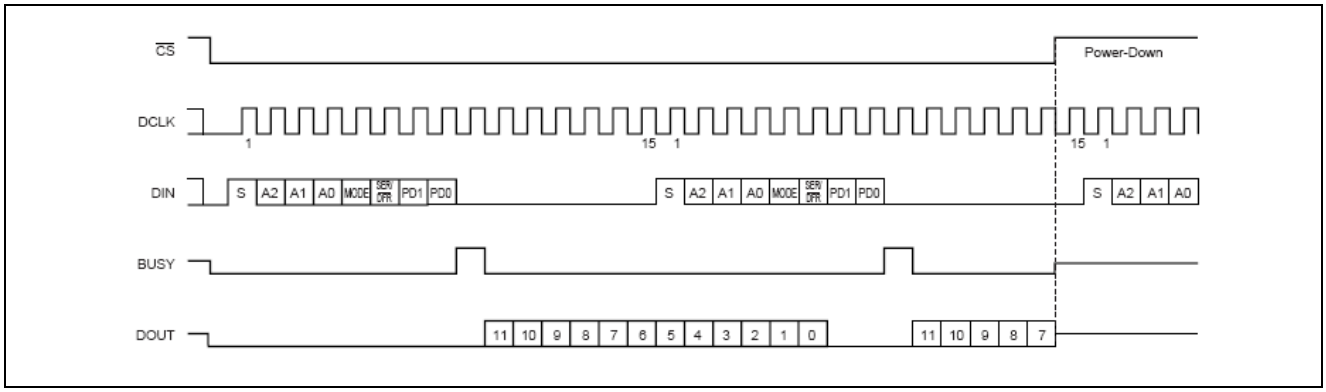
symbol	describe	+V_{CC}*2.7V, +V_{CC}*IOV_{DD}*1.5V,C_{LOAD}=50pF			unit
		minimum value	Typical value	maximum value	
t_{ACQ}	Acquisition Time	1.5			μs
t_{DS}	DIN Valid Prior to DCLK Rising	100			ns
t_{DH}	DIN Hold After DCLK High	50			ns
t_{DO}	DCLK Falling to DOUT Valid			200	ns
t_{DV}	$\overline{CS}$ Falling to DOUT Enabled			200	ns
t_{TR}	$\overline{CS}$ Rising to DOUT Disabled			200	ns
t_{CSS}	$\overline{CS}$ Falling to First DCLK Rising	100			ns
t_{CSH}	$\overline{CS}$ Rising to DCLK Ignored	10			ns
t_{CH}	DCLK High	200			ns
t_{CL}	DCLK Low	200			ns
t_{BD}	DCLK Falling to BUSY Rising/Falling			200	ns

t_{BDV}	$\overline{CS}$ Falling to BUSY Enabled			200	ns
t_{BTR}	$\overline{CS}$ Rising to BUSY Disabled			200	ns

surface6timing value,Ta=-40℃ to +85℃

15clocks per conversion cycle

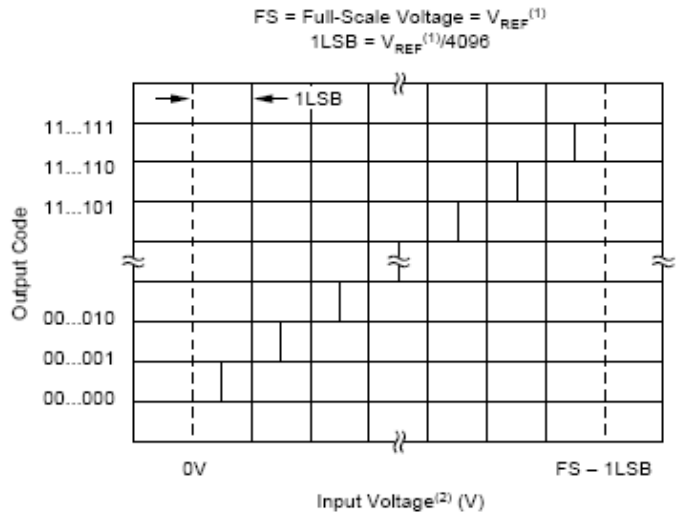
picture11providedET2046Fastest way to clock. This method is not suitable for most microcontrollers and digital signal processors because they do not have the capability to provide every signal transmission cycle15clock capability. However, this approach can be applied to field programmable gate arrays (FPGAs) or application specific integrated circuit (ASICs). Note that this approach greatly increases the maximum conversion rate of the converter.



picture12Maximum transfer rate,15clocks per conversion cycle

Data Format

ET2046Output data directly in binary format, as shown in the figure13shown. This graph shows the ideal output encoding relative to a given input voltage, excluding the effects of offset, gain error, and noise.



NOTES: (1) Reference voltage at converter: +REF – (–REF), see Figure 2.
(2) Input voltage at converter, after multiplexer: +IN – (–IN), see Figure 2

picture13Ideal input voltage and output coding

conversion mode

ET2046provides a8bitConversion mode is used in situations where high-speed conversion is required but the accuracy of digital results is not high. switch to8bitAfter mode, each conversion can be advanced4clock cycle is completed. This not only reduces the number of conversions per conversion4bit (speed up25%), while each conversion can occur faster. This is becauseET2046The internal setup time of8 The precision value in digits. Clock rates can be accelerated up to50%. Faster clocks and fewer clock cycles will increase conversion rates by up to1times.

Limit parameters

parameter	scope	unit
+ VccandIOVDDarriveGND	- 0.3~+6	V
Analog input to ground	- 0.3~+VCC+0.3	V
digital input to ground	- 0.3~IOVDD+0.3	V
Power consumption	250	mW
maximum junction temperature	+150	℃
range of working temperature	- 40~+85	℃
Storage temperature range	- 65~+150	℃
Wire temperature (soldering,10s)	+300	℃

Electrical parameters(If not specified, the test conditions are:T_A=-40℃~+85℃, +V_{CC}=+2.7V,V_{REF}=2.5Vinternal voltage,f_{SAMPLE}=125kHz, f_{CLK}=16*f_{SAMPLE}=2MHz,12-bitmode,numeric input =GNDorIOVDD, +VCCmust be*IOVDD)

parameter	condition	minimum value	Typical value	maximum value	unit
Analog input					
full scale input	Positive input - negative input	0		V_{REF}	V
absolute input range	positive input	- 0.2		+V_{CC}+0.2	V
	negative input	- 0.2		+ 0.2	V
capacitance			25		pF
leakage current			0.1		μA
system performance					
resolution			12		Bits
missing code		11			Bits
Cumulative Linearity Error				±2	LSB(1)
Offset error				±6	LSB
gain error	externalV_{REF}			±4	LSB
noise	including internalV_{REF}		70		μVrms
Power Supply Rejection Ratio			70		dB
dynamic sampling					
conversion time				12	CLK Cycles
confirm the time		3			CLK Cycles
channel throughput				125	kHz
Multiplexer setup time			500		ns
Aperture delay			30		ns
Aperture jitter			100		PS
Channel-to-channel isolation	V_{IN}=2.5Vpp(50KHz)		100		dB
switch driver					
On-resistance					
Y+, X+			5		Ω
Y-, X-			6		Ω
Drive current(2)	duration100ms			50	mA

Reference source output					
Internal reference voltage		2.45	2.50	2.55	V
Internal reference source drift			15		ppm/℃
Quiescent Current			500		μA
Reference source input					
scope		1.0		$+V_{CC}$	V
input resistance	SER/ $\overline{DFR}$ =0, PD1=0		1		GΩ
	internal source closed				
	internal source on		250		Ω
battery monitoring					
Input voltage range		0.5		6.0	V
input resistance					
Sampling battery			10		kΩ
Battery monitoring off			1		GΩ
Accuracy	V_{BAT}=0.5V~5.5V,external V_{REF}=2.5V	- 2		+ 2	%
	V_{BAT}=0.5V~5.5V, internal source	- 3		+ 3	%
temperature measurement					
temperature range		- 40		+85	℃
resolution	Differential mode(3)		1.6		℃
	TEMP0(4)		0.3		℃
Accuracy	Differential mode(3)		±2		℃
	TEMP0(4)		±3		℃
Digital input/output					
digital logic interface			CMOS		
capacitance	All digital control input pins		5	15	pF
V_{IH}	$\|I_{IH}\| \leqslant +5\mu A$	IOVDD*0.7		IOVDD+0.3	V
V_{IL}	$\|I_{IL}\| \leqslant +5\mu A$	- 0.3		0.3*IOVDD	V
V_{Oh}	I_{Oh}=-250μA	IOVDD*0.8			V
V_{OL}	I_{OL}=250μA			0.4	V
Data Format			binary		
Power supply requirements					
$+V_{CC}$(5)	Recommended scope of work	2.7		3.6	V
	The scope of work	2.2		5.25	V
IOVDD(6)		1.5		$+V_{CC}$	V
Quiescent Current(7)	internal source closed		280	650	μA
	internal source on		780		μA
	f_{SAMPLE}=12.5kHz		220		μA
	Power-Downmodel $\overline{CS}$=DCLK=DIN= IOV_{DD}			3	μA

Power consumption	+V_{CC}=+2.7V			1.8	mW
temperature range					
under given working conditions		- 40		+85	℃

Note:

(1) LSBIndicates the least significant digit. existV_{REF}=2.5Vhour,1indivualLSB=610μV. Determined by design, but not

(2) tested. Exceed50mAcurrent may cause device failure. MeasurementTEMP0andTEMP1The difference does not

(3) require a standard value. The temperature drift is -2.1mV/℃.

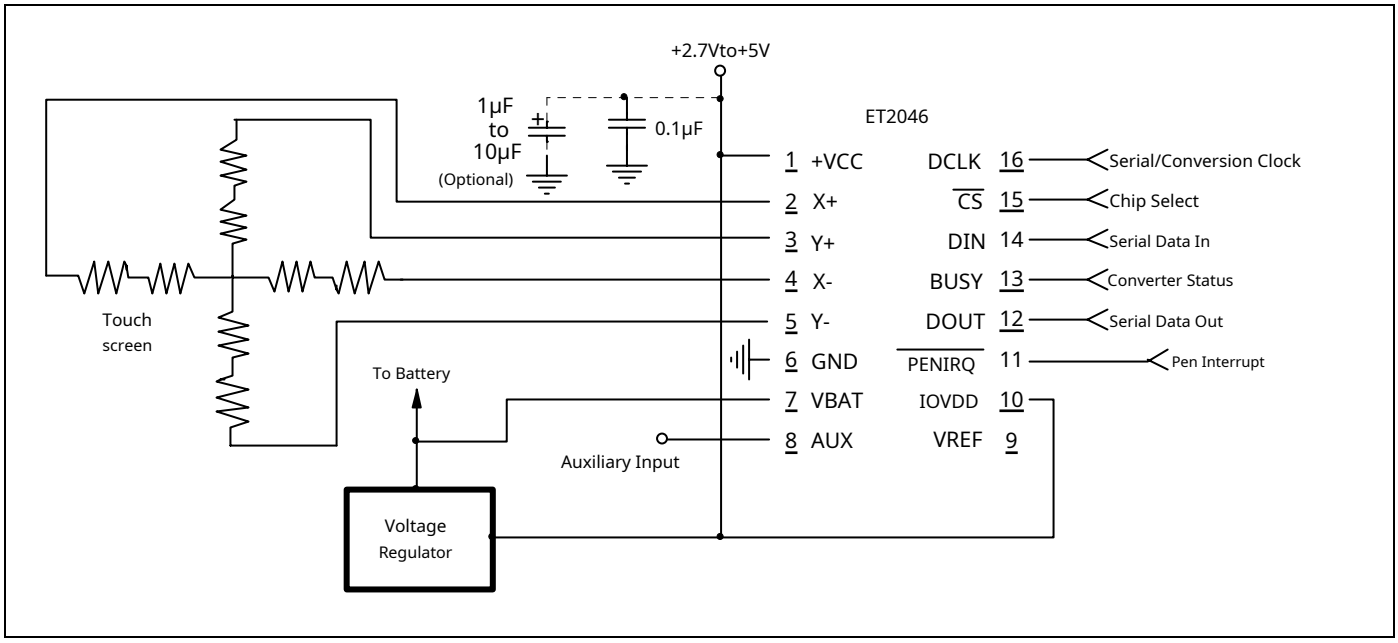
(4)

(5) ET2046Operating voltage can be as low as2.2V.

(6) IOV_{DD}Must be -(+V_{CC}).

(7) include+V_{CC}andIOV_{DD}current, typical values are fromPD0=0hourAUXObtained from the conversion of oral input.

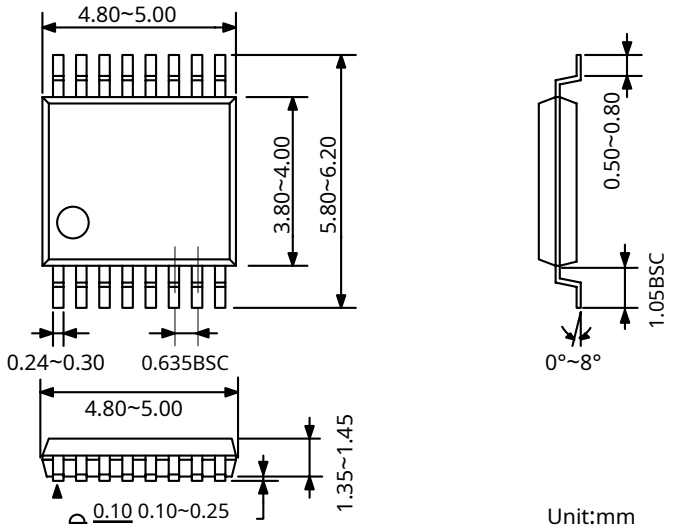
Reference application circuit diagram



*: This circuit is for reference only.

Package size

SSOP16



QFN16