A46. 3 x 8 CHANNEL REMOTE CONTROL ENCODER/DECODER IC's

In Hong Kong, where DIY Electronics is based, there are alot of IC's available for local manfacturers to use in their toys & consumer items which are made by small, relatively unknown IC manufacturers. They are poorly documented, if at all, in english, and they are not available for individual sale to the hobbyist. We are trying to make some of these IC's available.

We have just developed a 3 x 8 channel IR Transmitter & Decoder using a pair of these chips. The code numbers of the chips are: encoder SM5021B, and decoder SM5032B. **NOTE**: this **was** a 4 channel pair originally but in 1997 the manufacturer changed it to 3 channel.

Various options of the chip set are available. We have decided on the B series which allows multi-key operation. The IC's have been readily available for several years and we understand they are very popular in remote control devices. Certainly after trial & error to correct documentation problems we had we found the chip set to be robust & reliable with a high noise immunity.
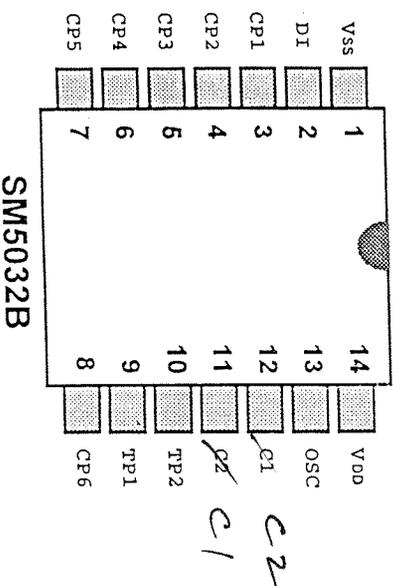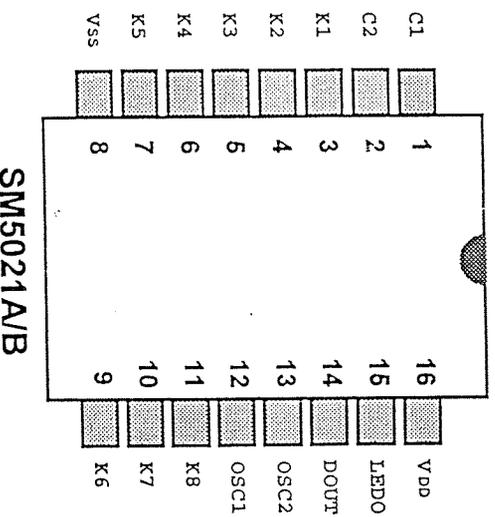
We have developed Kit 72 using these ICs.

The features of the chips are given here together with some of our own findings. Some of the documentation is photocopied. We cannot guarantee it is correct. Prototypes must be thoroughly tested.

Features:

— wide range of operating voltage 2.5V to 6V

— auto power off

— LED output to indicate transmission

— direct IR LED 38KHz modulated output

— 3 ranges of 8 channel output. (one channel was discontinued about 1997.)

— in each range, keys 1 through 6 operate on/off outputs in the decoder. Multi-key operation of these keys is supported. That is, more than one key can be pressed at a time and it will be decoded.

— Keys 7 & 8 are decoded as toggles outputs. The first keypress will toggle the output on. It needs another keypress to toggle the output off. Multi key operation between the toggle keys 7 & 8 and with keys 1 to 6 does not work. However, there is an interaction. But the interaction depends on which key was actually pressed first, and whether it is key 7 or key 8 which is pressed. Rather than being a design feature the multi-key operation between keys 1 to 6, and keys 7 & 8 should not be used as being unpredictable.

Note that the C1 and C2 outputs, pins 11 and 12 on the SM5032B were interchanged at the end of 1998. Why I do not know. So when testing prototypes remember that these two pins may be interchanged.

SM5021A/B

C1	1
C2	2
K1	3
K2	4
K3	5
K4	6
K5	7
Vss	8

16	VDD
15	LEDO
14	DOUT
13	OSC2
12	OSC1
11	K8
10	K7
9	K6

SM5032B

Vss	1
DI	2
CP1	3
CP2	4
CP3	5
CP4	6
CP5	7

|	
14	VDD
13	OSC
12	C1
11	C2
10	TP2
9	TP1
8	CP6

SM5021

ENCODER

GENERAL DESCRIPTION

The SM5021A/B is a high performance infrared remote control encoder utilizing CMOS technology. Mode A is a single-key control and mode B is a multi-key control during data transmission, supports eight data key inputs and a LED output to indicate the status during transmission.

Auto power off function when key is not pressed to save power, custom codes to distinguish different products. SM5021 encoder is paired with SM5031/ SM5032 decoder for more data control applications.

PIN DIAGRAM
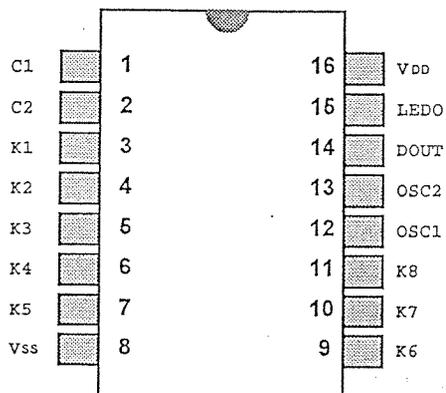
SM5021A/B

## FEATURES

* Wind operation voltage range, 2.5V to 6V
* Eight data key control
* Option of single-key or multi-key control
* Two custom codes to separate products
* Auto power off for saving power
* LED output to indicate transmission status
* Direct infrared LED 38KHz modulation output
* Low power consumption
* Paired with SM5031/SM5032 decoder
* 16 pin DIP or SO package

APPLICATIONS

* SM3011/SM3012 Fan Remote Control
* Audio Remote Control
* Toy Remote Control
* Consumer Products Remote Control

BLOCK DIAGRAM
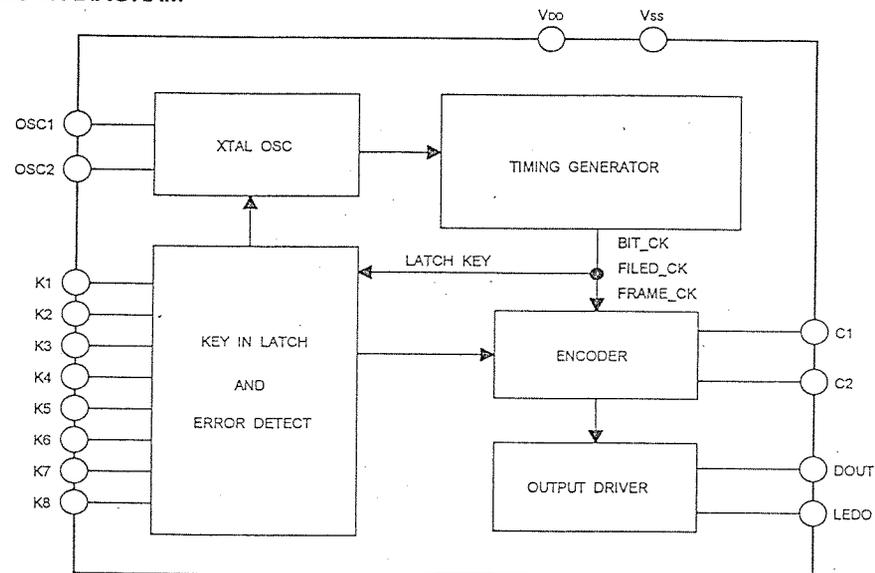
PIN DESCRIPTION

PIN NAME	I/O	FUNCTION
C1,C2	I	CUSTOM CODE
K1 ~ K8	I	REMOTE CONTROL KEY INPUTS (BUILT-IN PULL-LOW RESISTOR)
Vss	POWER	NEGATIVE POWER SUPPLY
OSC1	I	455K Hz XTAL OSC PIN
OSC2	O	455K Hz XTAL OSC PIN
DOUT	I/O	SIGNAL OUTPUT
LEDO	I/O	TRANSMISSION INDICATOR
VDD	POWER	POSITIVE POWER SUPPLY

FUNCTION DESCRIPTION

A. Decoder Signal Input Format

Bit Format

455KHz / 192

Logic 1 is

Logic 0 is
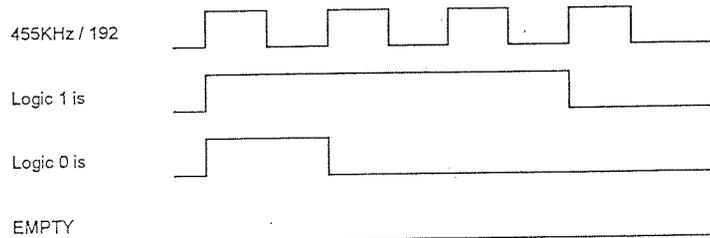
EMPTY

Frame Format

There are four frames, each frame contains four fields while receiving:

a) Frame Head / Three-Bits   1   1   0   (Metal Option)

b) Custom Code / Two-Bits   C1   C2

c) Control Word / Seven-Bits   0 0 0 0 0 0 1 ~ 1 0 0 0 1 1 0

d) Synch Filed / Four-Bits of Empty

B. Receiver Code Table

| START WORD	CUSTOM CODE	B1	B2	B3	B4	B5	B6	B7	RECEIVER
1 1 0	C1 C2	0	0	0	0	0	0	1	CP1
1 1 0	C1 C2	0	0	0	0	0	1	0	CP2
1 1 0	C1 C2	0	0	0	0	1	0	0	CP3
1 1 0	C1 C2	0	0	0	1	0	0	0	CP4
1 1 0	C1 C2	0	0	1	0	0	0	0	CP5
1 1 0	C1 C2	0	1	0	0	0	0	0	CP6
1 1 0	C1 C2	1	0	0	0	0	1	1	CP7/TP1
1 1 0	C1 C2	1	0	0	0	1	1	0	CP8/TP2

C. Receiver Waveform

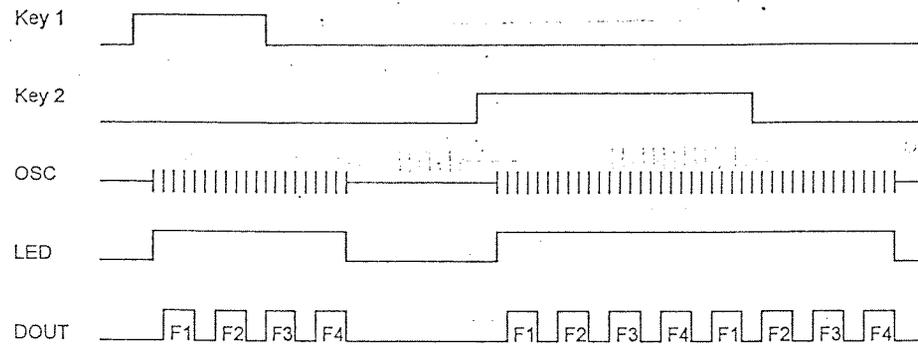### Normal Condition (Paired With SM5021A)
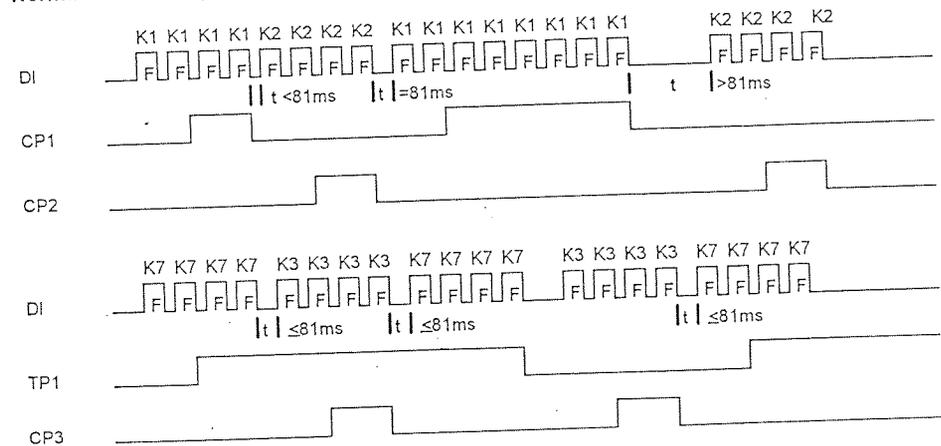
Overlap Condition (Paired With SM5021B)

If more than one data is received , multi-key decode available.(Except for CP7/CP8 or TP1/TP2)
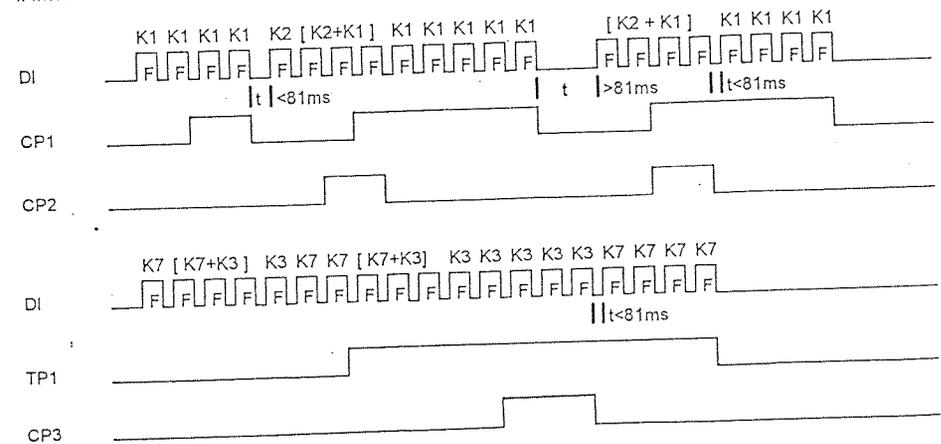
D. SM5021A Transmission Waveform

Normal Condition

Key 1

Key 2

OSC

LED

DOUT

F1 F2 F3 F4   F1 F2 F3 F4 F1 F2 F3 F4

Overlap Condition

If more than one key is pressed , transmission stops.

Key 1

Key 2

t > 32ms

OSC

LED

DOUT

F1 F2   F1 F2 F3 F4
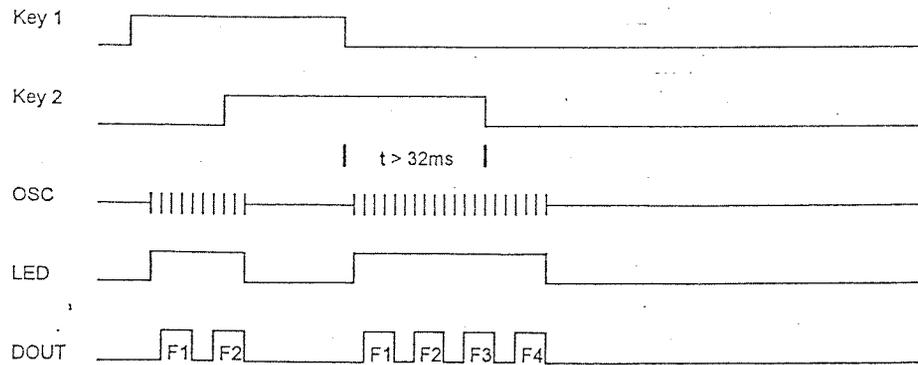
E. SM5021B Transmission Waveform

Normal Condition

Key 1

Key 2

OSC

LED

DOUT

F1 F2 F3 F4   F1 F2 F3 F4 F1 F2 F3 F4
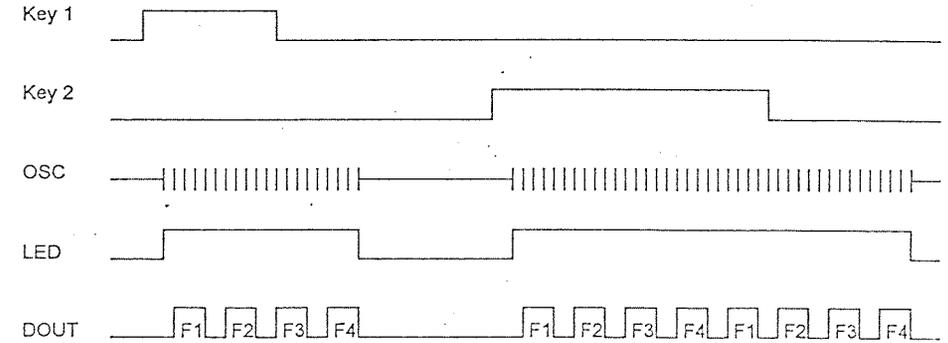
Overlap Condition

If more than one key is pressed , multi-key data transmission.

Key 1

t > 32ms

Key 2

t > t3+108ms

OSC

LED

DOUT

K1 K1 [K1+K2] K2 K2 K2 K2 K2 K2

F F F F F F F F F

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Test Conditions	Ratings	Unit
Supply Voltage	$V_{DD} - V_{SS}$		-0.3~6	V
Input Voltage	V_I		V_{SS}-0.3~V_{DD}+0.3	V
Output Voltage	V_O		V_{SS}-0.3~V_{DD}+0.3	V
Maximum Power Consumption	P_d	$V_{DD} - V_{SS}$ = 5V	500	mW
Operating Temperature	Topr		-10~70	°C
Storage Temperature	Tstg		-40~125	°C

DC ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}		2.2	3	6	V
Stand-by Current	Iss	$V_{DD} - V_{SS}$ = 3V OSC stop all output pins open		1		uA
Input High Level	Vih		1.5	2.1	3.5	V
Input Low Level	Vil		0.7	1	1.5	V
DOUT Source Current	Ioh	V_{OH} =+2.4V	5			mA
LEDO Source Current	Ioh	V_{OH} =+2.4V	10			mA
DOUT Sink Current	Iol	V_{OL} =+0.4V	5			mA

APPLICATION CIRCUIT

SM5032

DECODER

GENERAL DESCRIPTION

SM5032A/B is an infrared remote control decoder utilizing CMOS technology, paired with SM5021 for transmitter. The remote control system is capable of controlling eight functions and CP1 to CP6 can multi -decode. There is an option for two toggle signal outputs in these data control functions.
Also there are two custom codes for user to separate different products.
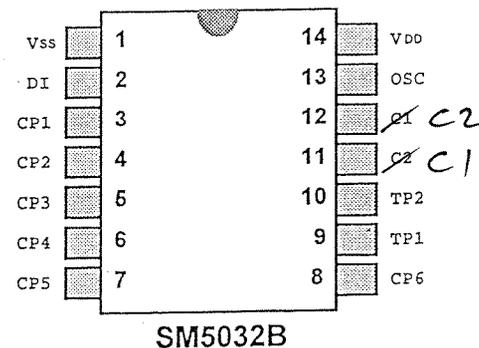
APPLICATIONS

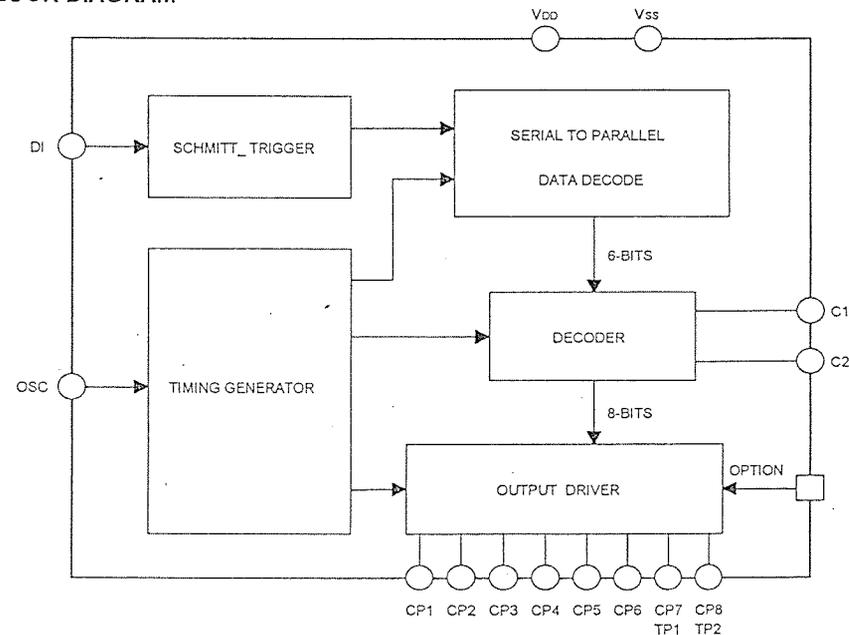* Consumer Products Remote Control
* Toy Remote Control
* Audio Remote Control
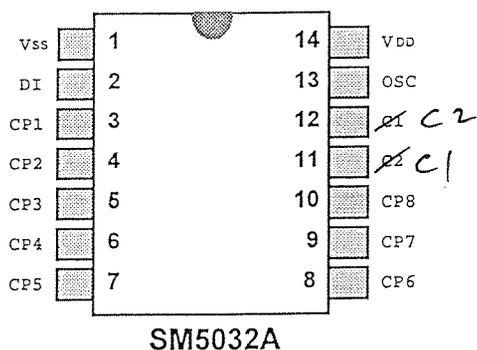
FEATURES

* Wind operation voltage range, 2.5V to 6V
* Infrared remote control receiver
* Two custom code to separate products
* Eight control functions for continuous signal
* Mulit-key control outputs
* Two toggle signal can be optioned in outputs
* A single terminal type oscillator by means of RC is provided
* Low power consumption
* High noise immunity
* 14 pin DIP or SO package

PIN DIAGRAM

| Vss	1	14	V DD
DI	2	13	OSC
CP1	3	12	C2
CP2	4	11	C1
CP3	5	10	CP8
CP4	6	9	CP7
CP5	7	8	CP6

SM5032A

Vss	1	14	V DD
DI	2	13	OSC
CP1	3	12	C2
CP2	4	11	C1
CP3	5	10	TP2
CP4	6	9	TP1
CP5	7	8	CP6

SM5032B

BLOCK DIAGRAM

PIN DESCRIPTION

PIN NAME	I/O	FUNCTION
VSS	POWER	NEGATIVE POWER SUPPLY
DI	I	SIGNAL INPUT
CP1 ~ CP6	O	MULTI-KEY CONTROL OUTPUTS
CP7,CP8 (TP1/TP2)		SINGLE-KEY CONTROL OUTPUTS (TOGGLE FUNCTION OPTION)
C1,C2	I	CUSTOM CODE
OSC	I	38K Hz OSC PIN
VDD	POWER	POSITIVE POWER SUPPLY

FUNCTION DESCRIPTION

A. Encoder Signal Output Format

Bit Format

SYSCK / 192

Logic 1 is

Logic 0 is
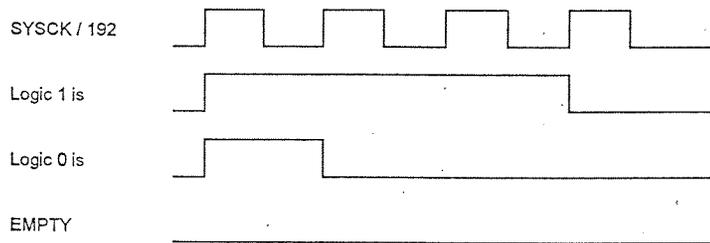
EMPTY

Frame Format

There are four frames, encoder generates during sending. Each frame contains four field:

a) Frame Head / Three-Bits   1 1 0 (Metal Option)

b) Custom Code / Two-Bits   C1 C2

c) Control Word / Seven-Bits   0 0 0 0 0 0 1 ~ 1 0 0 0 1 1 0

d) Synch Filed / Four-Bits of Empty

B. Transmission Code Table

START WORD	CUSTOM CODE	B1	B2	B3	B4	B5	B6	B7	TRANSMIT
1 1 0	C1 C2	0	0	0	0	0	0	1	K1
1 1 0	C1 C2	0	0	0	0	0	1	0	K2
1 1 0	C1 C2	0	0	0	0	1	0	0	K3
1 1 0	C1 C2	0	0	0	1	0	0	0	K4
1 1 0	C1 C2	0	0	1	0	0	0	0	K5
1 1 0	C1 C2	0	1	0	0	0	0	0	K6
1 1 0	C1 C2	1	0	0	0	0	1	1	K7
1 1 0	C1 C2	1	0	0	0	1	1	0	K8

C. Transmission Timing

Key In

OSC

LED

DOUT   Frame 1 Frame 2 Frame 3 Frame 4
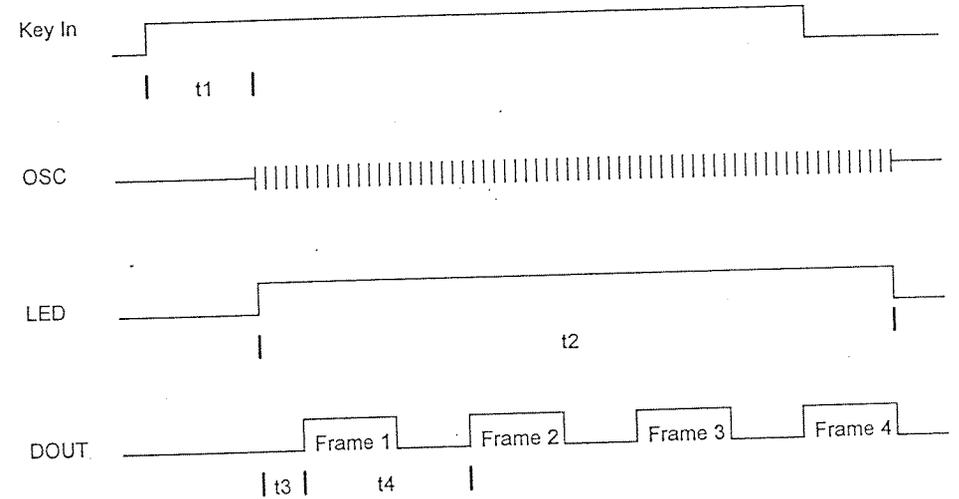
* t1: Key pressing > 32ms

* t2: Transmission time t3 + 108ms (Four Frame)
  If t1 is over t3 + 108ms, DOUT will be transmitted again.
  [(Pressing Time) MOD (t3+108ms) + 1] * 108ms + t3

* t3: Oscillator stable time.   OSC / 384 = 0.8ms

* t4: 3-Bits (Head) + 7-Bits (Data) + 6-Bits (Empty) = 16-Bits (27ms)

* OSC: 455KHz XTAL

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Test Conditions	Ratings	Unit
Supply Voltage	V_{DD} - Vss		-0.3~6	V
Input Voltage	V_I		Vss-0.3~ V_{DD}+0.3	V
Output Voltage	Vo		Vss-0.3~ V_{DD}+0.3	V
Maximum Power Consumption	Pa	V_{DD} - Vss = 5V	500	mW
Operating Temperature	Topr		-10~70	°C
Storage Temperature	Tstg		-40~125	°C

DC ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Test Conditions	Limits			Unit
			Min.	Typ.	Max.	
Supply Voltage	V_{DD}		2.2	3	6	V
Stand-by Current	I_{SB}	V_{DD} - Vss = 3V OSC stop all output pins open		1		uA
		OSC operation non-loading			300	
Input High Level	V_{IH}		1.5	2.1	3.5	V
Input Low Level	V_{IL}		0.7	1	1.5	V
CP1~CP8 Source Current	I_{OH}	V_{OH} =+2.4V			1	mA
CP1~CP8 Sink Current	I_{OL}	V_{OL} =+0.8V			1	mA

APPLICATION CIRCUIT

SM5032A/B