REMOTE CONTROL COMMANDER IC

■ GENERAL DESCRIPTION

The NJU6014 is a remote control commander IC, and generates the control code according to the key input of 4 x 8 matrix. It contains auto clear circuit, carrier generator, key input / key scan output circuit, extension code generator, data ROM and operated single power supply.

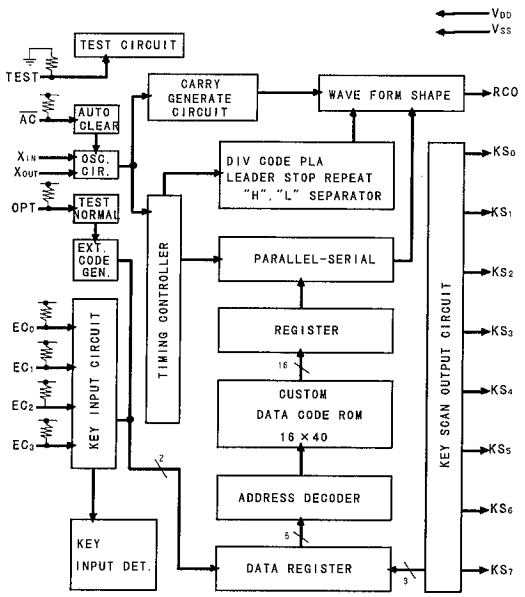
The NJU6014 has the stand-by mode using auto clear function with external capacitance.

The transmission code is using a Pulse Position Modulation (PPM) method and its transmission by the IR-LED. Maximum 40 - pattern output is available by programming the PLA and custom code ROM.

■ FEATURES

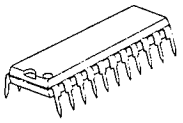
- Transmission Code — Pulse Position Modulation
- Generating Pattern — Fixed by PLA and ROM
- Frame Number Setting — 1 to 8 frame
- Internal Oscillation Circuit
- Power On Initialization
- Stand-by Mode — 1 μA Max.
- Low Power Consumption
- Low Operating Voltage — 1.1 ~ 1.8V
- Package Outline — SSOP 20 / SOP 20 / SDIP 22
- C-MOS Technology

■ BLOCK DIAGRAM



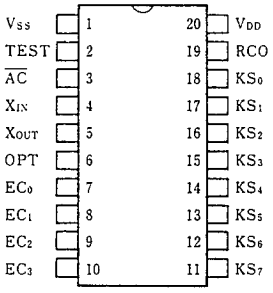
■ PACKAGE OUTLINE

NJU6014G NJU6014V

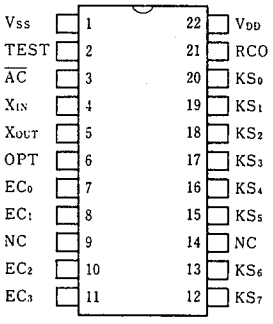


NJU6014L

■ PIN CONFIGURATION



NJU6014G/V



NJU6014L

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■ TERMINAL DESCRIPTION

NO.		SYMBOL	FUNCTION
NJU6014G/V	NJU6014L		
1	1	V_{SS}	GND
2	2	TEST	Testing Terminal (Normally OPEN, Internal Pull-down Resistance)
3	3	$\overline{AC}$	Auto Clear Terminal (Internal Pull-up Resistance) Power on initialization is executed by connecting a capacitance to this.
4, 5	4, 5	X_{IN}, X_{OUT}	Oscillation Inverter Input / Output Terminal (Internal Feedback Resistance) This connects a ceramic resonator.
6	6	OPT	Extension Key Input Terminal (Internal Pull-up Resistance) The keys are extended by connecting with switches between the OPT terminal and the key scan terminals KS_6 and KS_7.
7~10	7, 8, 10, 11	EC_0~EC_3	Key Matrix Input Terminal (Internal Pull-up Resistance) The RCO output is started when this key input is perceived after 36msec period.
11~18	12, 13 15~20	KS_7~KS_0	Key Scan Output Terminal Key scan time is 0.42msec. In case using maximum 32 keys, all scan time is about 36msec in high speed.
19	21	RCO	Remote Control Oscillation Terminal The pulse line of the transmission cord modulated by carrier wave is output. This pulse operates the IR-LED by driving the base of an external NPN transistor.
20	22	V_{DD}	Power Supply Voltage range is wide from 1.1V to 1.8V, therefore it is single battery (1.5V) enough to operate. Except for key operation, operating current (stand-by current) is dropped under 1uA by stopping oscillation.
—	9, 14	NC	Non Connection

■ FUNCTIONAL DESCRIPTION

(1) Oscillation Circuit

The NJU6014 incorporates an internal oscillation circuit, therefore, when a ceramic resonator is connected the terminals X_{IN} and X_{OUT}, carrier wave of a transmission signal is generated inside.

(2) Key Matrix

The key of 4×8 matrix consists the inputs EC_0 to EC_3 and the key scan outputs KS_0 to KS_7. And Keys are extended by combining the OPT terminal and the terminals KS_6 and KS_7.

(3) Transmission Signal

(3-1) Data Format

The NJU6014 has 14 kinds of the data transmission format as shown in Table 1.

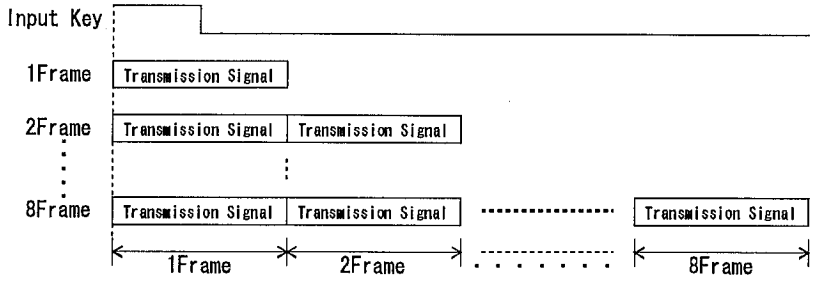
Table 1 Data Transmission Format in NJU6014

Wave Type	Date Line Up
1	Custom Code 8bit / $\overline{\text{Custom Code}}$ 8bit / Data Code 8bit / $\overline{\text{Data Code}}$ 8bit Leader C1 C2 C3 C4 C5 C6 C7 C8 $\overline{C1}$ $\overline{C2}$ $\overline{C3}$ $\overline{C4}$ $\overline{C5}$ $\overline{C6}$ $\overline{C7}$ $\overline{C8}$ D1 D2 D3 D4 D5 D6 D7 D8 $\overline{D1}$ $\overline{D2}$ $\overline{D3}$ $\overline{D4}$ $\overline{D5}$ $\overline{D6}$ $\overline{D7}$ $\overline{D8}$ Stop Repeat
2	Custom Code 8bit / Data Code 8bit Leader C1 C2 C3 C4 C5 C6 C7 C8 D1 D2 D3 D4 D5 D6 D7 D8 Stop
3	Data Code 6bit D1 D2 D3 D4 D5 D6 Stop
4	Data Code 10bit D1 2 3 4 5 6 7 8 9 10 Stop
5	Custom Code 8bit / $\overline{\text{Custom Code}}$ 8bit / Data Code 8bit / $\overline{\text{Data Code}}$ 8bit Leader C1 C2 C3 C4 C5 C6 C7 C8 $\overline{C1}$ $\overline{C2}$ $\overline{C3}$ $\overline{C4}$ $\overline{C5}$ $\overline{C6}$ $\overline{C7}$ $\overline{C8}$ D1 D2 D3 D4 D5 D6 D7 D8 $\overline{D1}$ $\overline{D2}$ $\overline{D3}$ $\overline{D4}$ $\overline{D5}$ $\overline{D6}$ $\overline{D7}$ $\overline{D8}$ Stop
6	Option2 / Mask1 / Check1 / Address5 / Data6 / $\overline{\text{Address5}}$ / $\overline{\text{Data6}}$ / Option2 / Mask1 / Check1 A1 A2 A3 A4 A5 D1 D2 D3 D4 D5 D6 O1 O2 M1 H1 Stop A1 A2 A3 A4 A5 D1 D2 D3 D4 D5 D6 O1 O2 M1 H1 Stop
7	Data Code 12bit D1 2 3 4 5 6 7 8 9 10 11 12 Stop
8	Data Code 12bit Leader D1 2 3 4 5 6 7 8 9 10 11 12 Stop
9	Custom Code 8bit / Data Code 8bit Leader C1 C2 C3 C4 C5 C6 C7 C8 Separator D1 D2 D3 D4 D5 D6 D7 D8 Stop
10	Custom Code 8bit / Custom Code 8bit / Data Code 8bit / $\overline{\text{Data Code}}$ 8bit Leader C1 C2 C3 C4 C5 C6 C7 C8 $\overline{C1}$ $\overline{C2}$ $\overline{C3}$ $\overline{C4}$ $\overline{C5}$ $\overline{C6}$ $\overline{C7}$ $\overline{C8}$ D1 D2 D3 D4 D5 D6 D7 D8 $\overline{D1}$ $\overline{D2}$ $\overline{D3}$ $\overline{D4}$ $\overline{D5}$ $\overline{D6}$ $\overline{D7}$ $\overline{D8}$ Stop Repeat
11	Custom Code 6bit / Data Code 6bit / $\overline{\text{Custom Code}}$ 6bit / $\overline{\text{Data Code}}$ 6bit Leader C1 C2 C3 C4 C5 C6 D1 D2 D3 D4 D5 D6 $\overline{C1}$ $\overline{C2}$ $\overline{C3}$ $\overline{C4}$ $\overline{C5}$ $\overline{C6}$ $\overline{D1}$ $\overline{D2}$ $\overline{D3}$ $\overline{D4}$ $\overline{D5}$ $\overline{D6}$ Stop
12	Custom Code 5bit / Data Code 6bit / $\overline{\text{Custom Code}}$ 5bit / $\overline{\text{Data Code}}$ 6bit Leader C1 C2 C3 C4 C5 D1 D2 D3 D4 D5 D6 $\overline{C1}$ $\overline{C2}$ $\overline{C3}$ $\overline{C4}$ $\overline{C5}$ $\overline{D1}$ $\overline{D2}$ $\overline{D3}$ $\overline{D4}$ $\overline{D5}$ $\overline{D6}$ Stop
13	Custom Code 8bit / Data Code 8bit C1 C2 C3 C4 C5 C6 C7 C8 D1 D2 D3 D4 D5 D6 D7 D8 Stop
14	Custom Code 8bit / Custom Code 8bit / Data Code 8bit / $\overline{\text{Data Code}}$ 8bit Leader C1 C2 C3 C4 C5 C6 C7 C8 $\overline{C1}$ $\overline{C2}$ $\overline{C3}$ $\overline{C4}$ $\overline{C5}$ $\overline{C6}$ $\overline{C7}$ $\overline{C8}$ D1 D2 D3 D4 D5 D6 D7 D8 $\overline{D1}$ $\overline{D2}$ $\overline{D3}$ $\overline{D4}$ $\overline{D5}$ $\overline{D6}$ $\overline{D7}$ $\overline{D8}$ Stop Repeat

Note 1) Each wave form is available as the masked ROM option.

(3-2) The Number of Output Frame

The number of transmission signal frame generated by minimum key input time is available as the masked ROM option. It has from 1 frame to 8 frame.



(4) Key Operation

(4-1) Standard Key Operation

The key board matrix correspond to the ROM code address is shown as follows;

	Standard Key Matrix			
Key Scan	EC_0	EC_1	EC_2	EC_3
KS_0	00 (KY1)	08 (KY9)	16 (KY17)	24 (KY25)
KS_1	01 (KY2)	09 (KY10)	17 (KY18)	25 (KY26)
KS_2	02 (KY3)	10 (KY11)	18 (KY19)	26 (KY27)
KS_3	03 (KY4)	11 (KY12)	19 (KY20)	27 (KY28)
KS_4	04 (KY5)	12 (KY13)	20 (KY21)	28 (KY29)
KS_5	05 (KY6)	13 (KY14)	21 (KY22)	29 (KY30)
KS_6	06 (KY7)	14 (KY15)	22 (KY23)	30 (KY31)
KS_7	07 (KY8)	15 (KY16)	23 (KY24)	31 (KY32)

Note 2) The inside of parentheses means the key number.

Only for standard key operation, when the roll over input occurs, the transmission data in the data register is cleared by the roll over preventive circuit and the transmission is forbad.

(4-2) Extension Key Operation

The extension key is connected between the OPT terminal and the key scan output terminal KS_6 or KS_7, key board matrix correspond to ROM code address is shown as follows;

	Standard Key Matrix				Extension Key Matrix				
Key Scan	EC_0	EC_1	EC_2	EC_3	EC_0	EC_1	EC_2	EC_3	OPT
KS_0	00 (KY1)	08 (KY9)	16 (KY17)	24 (KY25)	No Extension Key				
KS_1	01 (KY2)	09 (KY10)	17 (KY18)	25 (KY26)					
KS_2	02 (KY3)	10 (KY11)	18 (KY19)	26 (KY27)					
KS_3	03 (KY4)	11 (KY12)	19 (KY20)	27 (KY28)					
KS_4	04 (KY5)	12 (KY13)	20 (KY21)	28 (KY29)					
KS_5	05 (KY6)	13 (KY14)	21 (KY22)	29 (KY30)					
KS_6	06 (KY7)	14 (KY15)	22 (KY23)	30 (KY31)	20	21	22	23	KY33
KS_7	07 (KY8)	15 (KY16)	23 (KY24)	31 (KY32)	24	25	26	27	KY34

The extension key is formed by the KY33 and the KY34, and it is generated the extension code by operating with the combination key.

The combination key corresponded to the extension key is as follows;

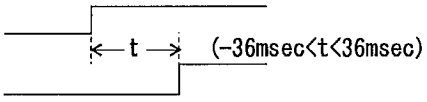
Extension key	Combination Key			
KY33	KY7	KY15	KY23	KY31
KY34	KY8	KY16	KY24	KY32

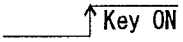
It is correspondence as this table , therefore any other combinations aren't transmitted, besides, only extension key KY33 or KY34 isn't transmitted. The extension key should be pushed with the combination key.

(4-3) Key Timing Prevented Of Two Key Roll Over

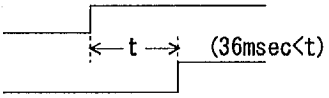
The timing of key scan is 0.42msec. The time to stop scanning is about 36msec. Besides , to prevent chattering of key ON , a data isn't read for 9msec after pressing a key. Therefore the key timing prevented of two key roll over is as follow;

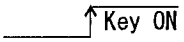
① Pressing At The Same Time Within 36msec → Forbidding Transmission



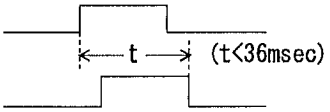


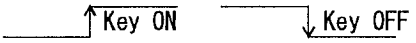
② Pressing Second Key after 36msec → After Transmitting First Key Data, Forbidding Transmission



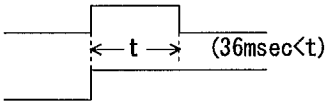


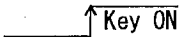
③ Taking Off Both Key Within 36msec → Forbidding Transmission





④ Taking Off The Other Key After 36msec → Transmitting Rest Key Data



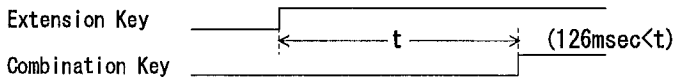


As this, provided an key is kept to press over 36msec, its code is transmitted once.

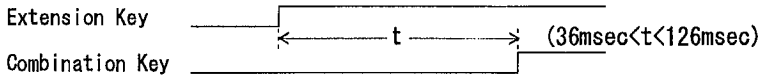
(4-4) Roll Over Timing Of Extension Key

When keys are pressed over two at the same time, transmission is usually forbad by the roll over preventive circuit. However, when the extension key is pressed, it is transmitted by operating with the combination key at input timing as follows;

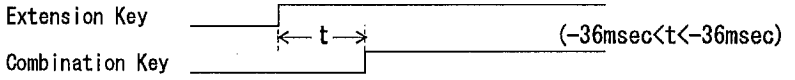
① Extension Key Signal Transmission



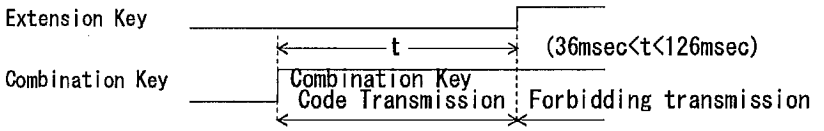
② Forbidding Extension Key Signal Transmission



③ Forbidding Extension Key Signal Transmission



④ Forbidding Extension Key Signal Transmission



For the order of the priority of pressing key, the extension key can operates when only the combination key is pressed after 126msec at the time of pressing the extension key.

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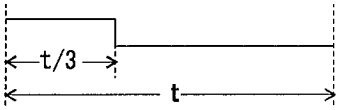
(5) Carrier Frequency Generating Circuit

Each other seramic resonator corresponded to the carrier wave frequency is shown below.

For ROM option, the seramic resonator should be specified.

	Seramics resonator fosc (kHz)				
	393	440	455	480	455
Carrier Frequency fca (kHz)	32.8	36.7	37.9	40.0	56.9
Dividing Frequency Percentage	fosc/12	fosc/12	fosc/12	fosc/12	fosc/8

The carrier frequency is output in 1/3 duty.

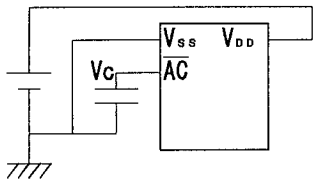


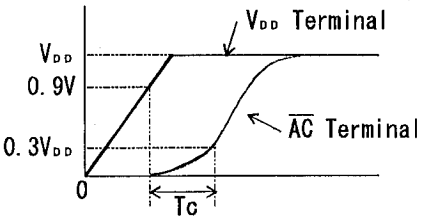
t = 1/fca

In case of using the ceramic resonator 455kHz and set the frequency dividing ratio to fosc/8, the carrier frequency is 1/2 duty.

(6) Auto Clear Circuit

Connecting the capacitor between the $\overline{AC}$ terminal and V_{SS}, auto clear function is executed at the time of power-on. After the V_{DD} terminal voltage is risen to 0.9V, it is required that the period (Tc) which the $\overline{AC}$ terminal voltage (Vc) becomes $Vc>0.3V_{DD}$ is Tc>0.1msec. After auto clear function is executed, this circuit is kept the stand-by mode until a key is input.





An external capacitance should be connected value more than 2nF.
Example expressions are shown below.

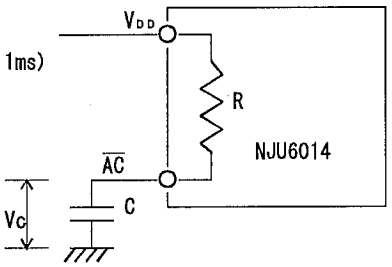
・For example (V_{DD}=1.5V Operating)

V_{min} : Minimum Operating Voltage (1.1V)
Vc : $\overline{AC}$ Terminal Voltage ($0.3V_{DD}$)
Tc : Time Until $\overline{AC}$ Terminal is $Vc>0.3V$ (more than 0.1ms)
R : Internal Pull-Up Resistance (80kΩ)
C : External Capacitance

$$Vc=V_{min}(1-e^{\frac{-Tc}{CR}})$$

$$Tc=-CR\times\log(1-\frac{Vc}{V_{min}})$$

$$0.1(ms)\leqq -C\times 80(k\Omega)\times\log(1-\frac{0.45(V)}{1.1(V)})$$



$\therefore C\geqq 1.83nF$

Therefore, in order to be executed auto clear function exactly , the capacitance more than this numerical value should be connected.

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25℃)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}	-0.3 ~ +3.0	V
Input Voltage	V_{IN}	V_{SS}-0.3 ~ V_{DD}+0.3	V
Operating Temperature	Topr	- 25 ~ + 75	℃
Storage Temperature	Tstg	- 40 ~ + 125	℃

■ ELECTRICAL CHARACTERISTICS

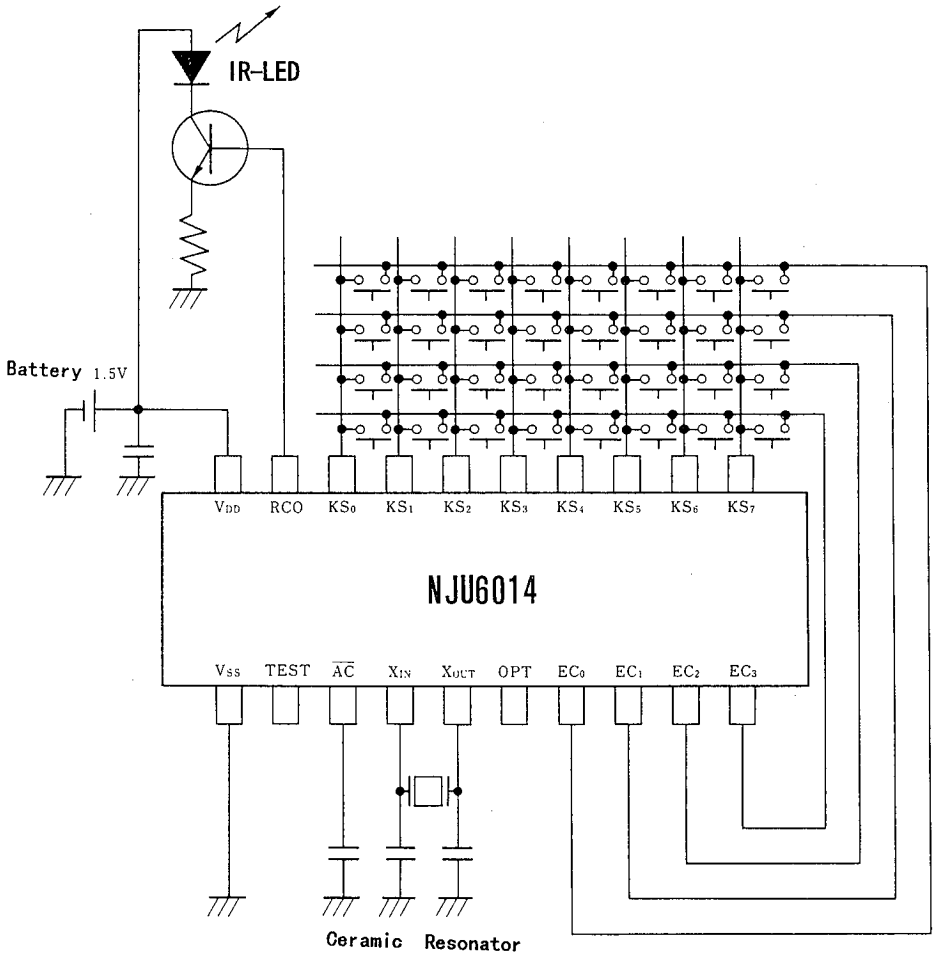
(V_{DD}=1.2V, Ta=25℃)

PARAMETER	SYMBOL	CONDITIONS		MIN.	TYP.	MAX.	UNIT	NOTE
Operating Voltage	V_{DD}	fosc=455kHz		1.1		1.8	V	
Operating Current	I_{DD}	fosc=455kHz				0.6	mA	
Stand-by Current	I_{ST}					1.0	μA	
"H" Input Voltage	V_{IH}	Each EC, OPT Terminal		0.7V_{DD}		V_{DD}	V	
"L" Input Voltage	V_{IL}	Each EC, OPT Terminal				0.3V_{DD}	V	
Oscillation Frequency	fosc	X_{IN}, X_{OUT} Terminal			393 440 455 480		kHz	3
Output Current(1)	I_{OL1}	V_{OL}=0.3V	RCO Terminal	0.1	0.3		mA	
	I_{OH1}	V_{OH}=0.9V		- 2	- 4			
Output Current(2)	I_{OL2}	V_{OL}=0.9V	Each KS Terminal	0.5	1.0		mA	
Feedback Resistance	Rf	X_{IN}=V_{DD}			1		MΩ	
Pull-up Resistance	R_{I1}	OPT Terminal			100		kΩ	
	R_{I2}	Each EC Terminal			100			
	R_{I3}	$\overline{AC}$ Terminal			80			
Pull-down Resistance	R_{I4}	TEST Terminal			200		kΩ	

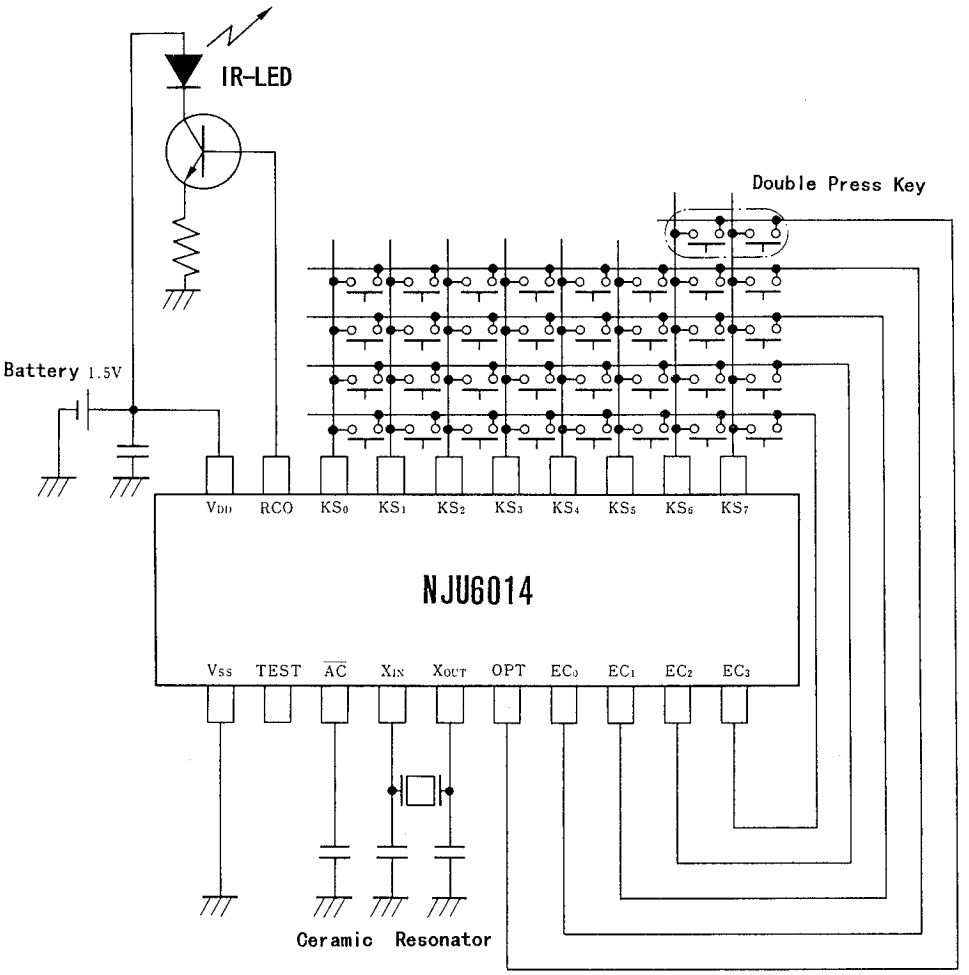
Note 3) The oscillation frequency is turned by depending the ceramic resonator. The carrier frequency is the masked ROM option , therefore the ceramic resonator should be designated.

■APPLICATION CIRCUIT

(1) Normal Key



(2) Double Press Key



MEMO