Ordering number:ENN *3590

CMOS IC

LC7465M

Infrared Remote Control Transmitter IC

Preliminary

Overview

The LC7465M is a 64-key infrared remote controller transmitter IC that incorporates key-scanning, oscillator and timing circuits on-chip, resulting in a very low external component count.

The LC7465M generates 256 function codes using the 64 function keys. The output data format comprises the mask-programmed custom code, the parity field, the mask-programmed system code, the product code, the function code and the data check code.

The LC7465M operates from a 2.0 to 3.6 V supply and is available in 30-pin MFPs.

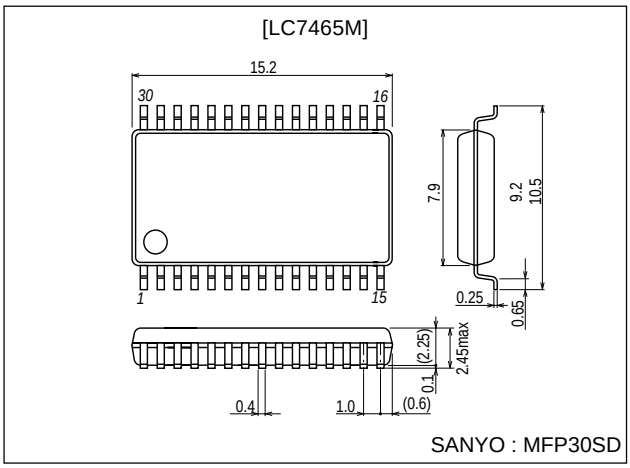
Features

- Low external component count.
- 64 function keys.
- 256 function codes.
- Mask-programmable custom and system codes.
- 64 product codes.
- Output conforms to Japan's Association for Electric Home Appliances recommended standards for infrared remote controls.
- On-chip input pull-down resistors.
- 2.0 to 3.6 V supply.
- 30-pin MFP.

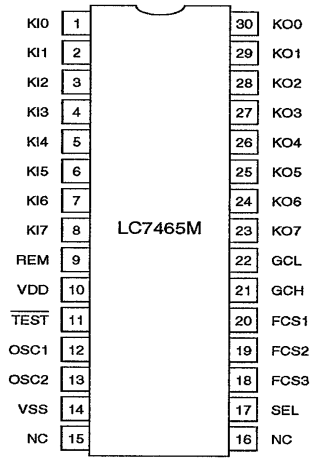
Package Dimensions

unit:mm

3073B-MFP30SD

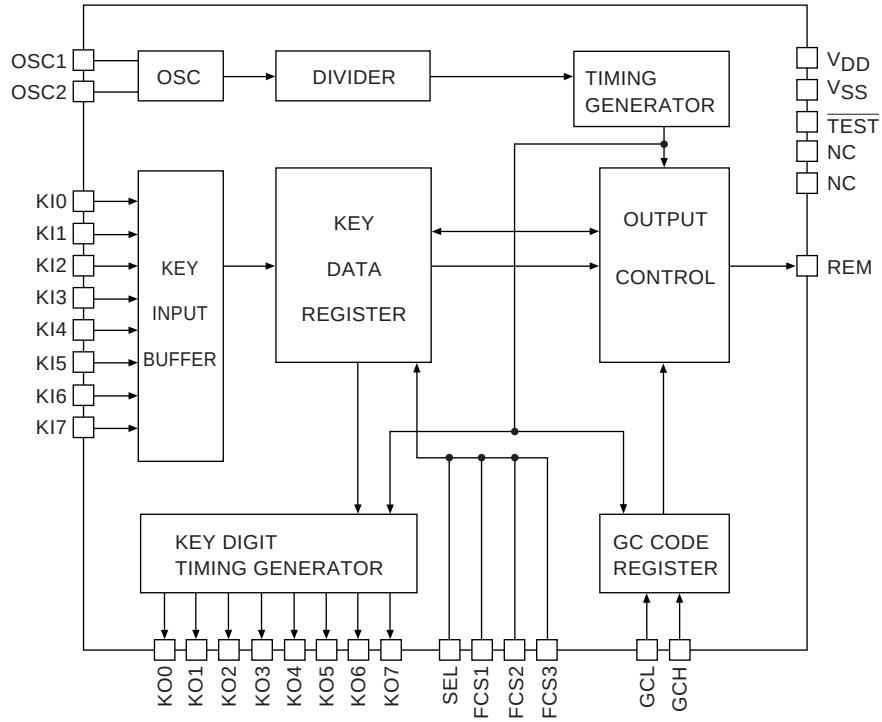


Pin Assignment

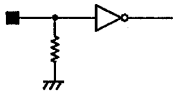
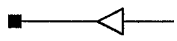
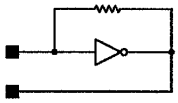
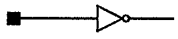
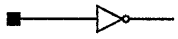
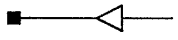


Top view

Block Diagram



Pin Description

Number	Name	Equivalent circuit	Description
1 to 8	KI0 to KI7		Keyswitch scanning inputs
9	REM		LED driver output
10	V_{DD}		Supply voltage
11	$\overline{TEST}$		Test input. $\overline{TEST}$ should be tied HIGH or left open for normal operation
12	OSC1		Ceramic oscillator input connection
13	OSC2		Ceramic oscillator output connection
14	V_{SS}		Ground
15, 16	NC		No connection. Should be left open
17	SEL		Function code mode select inputs
18 to 20	FCS1 to FCS3		Function code select inputs
21	GCH		Product code select inputs
22	GCL		
23 to 30	KO0 to KO7		Keyswitch scanning outputs

Specifications

Absolute Maximum Ratings at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{DD} max		V_{SS}−0.3 to+5.5	V
Input voltage	V_I		V_{SS}−0.3 to V_{DD}+0.3	V
Output voltage	V_O		V_{SS}−0.3 to V_{DD}+0.3	V
Output current	I_O		−35	mA
Allowable power dissipation	Pd max	Ta≤85˚C	150	mW
Operating temperature	Topr		−40 to +85	˚C
Storage temperature	Tstg		−50 to +125	˚C

Recommended Operating Conditions at Ta = –40 to +85˚C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage range	V_{DD}		2.0	3.0	3.6	V
KI0 to KI7, GCL, GCH, FCS1 to FCS3 and SEL input high-level voltage	V_{IH}		$0.7V_{DD}$		V_{DD}	V
KI0 to KI7, GCL, GCH, FCS1 to FCS3 and SEL input low-level voltage	V_{IL}		V_{SS}		$0.3V_{DD}$	V
Oscillator frequency	f_{OSC}		433	455	477	kHz

Electrical Characteristics at Ta = –40 to +85˚C, V_{DD} = 2.0 to 3.6 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Operating supply current	I_{DD}	Key pressed, no load			1	mA
Standby supply current	I_{DS}	No key pressed, oscillator stopped			1	µA
REM output high-level current	I_{OH}	V_{DD}=2V, V_{OH}=V_{DD}−1V		−2.5		mA
		V_{DD}=3V, V_{OH}=V_{DD}−1V		−11		
KO0 to KO7 output high-level voltage	V_{OH}	I_{OH}=−0.1mA	V_{DD}−0.3			V
KO0 to KO7 and REM output low-level voltage	V_{OL}	I_{OL}=0.1mA			0.3	V
GCL, GCH and FCS1 to FCS3 input high-level current	I_{IH}	V_I=V_{DD}			1	µA
GCL, GCH and FCS1 to FCS3 input low-level current	I_{IL}	V_I=V_{SS}	−1			µA
KI0 to KI7 input floating voltage	V_{IF}				$0.1V_{DD}$	V
KI0 to KI7 input pull-down resistance	R_{IN}		75	100	125	kΩ

Functional Description

Key Inputs

An eight-by-eight matrix is formed with the keyswitch scanning outputs KO0 to KO7 and the keyswitch scanning inputs KI0 to KI7 as shown in the following figure. When a key is held down, either the normal or abbreviated continuation code is output continously, depending on the mask option selected.

Normally, only one key can be pressed at a time. If more than one key is pressed, all keys are ignored and no output is generated. However, when the appropriate mask option is selected, seven function codes can be generated by holding down key 8 and one of keys 16, 24, 32, 40, 48, 56 and 64 as shown in table 1.

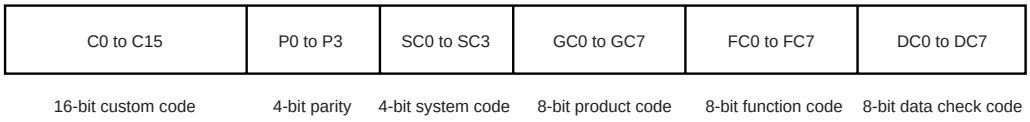
	KI0	KI1	KI2	KI3	KI4	KI5	KI6	KI7
KO0	1	9	17	25	33	41	49	57
KO1	2	10	18	26	34	42	50	58
KO2	3	11	19	27	35	43	51	59
KO3	4	12	20	28	36	44	52	60
KO4	5	13	21	29	37	45	53	61
KO5	6	14	22	30	38	46	54	62
KO6	7	15	23	31	39	47	55	63
KO7	8	16	24	32	40	48	56	64

Table 1. Function code generation

Key combination	Function code							
	FC0	FC1	FC2	FC3	FC4	FC5	FC6	FC7
8, 16	1	1	1	0	1	0	0	1
8, 24	1	1	1	0	0	1	0	1
8, 32	1	1	1	0	1	1	0	1
8, 40	1	1	1	0	0	0	1	1
8, 48	1	1	1	0	1	0	1	1
8, 56	1	1	1	0	0	1	1	1
8, 64	1	1	1	0	1	1	1	1

Output Data Configuration

The 48-bit output data configuration is shown in the following figure. Note that the data is sent least-significant bit first.



Custom code

The 16-bit mask-programmable custom code (C0 to C15) is a unique code registered with the Association for Electric Home Appliances.

Parity bits

The four parity bits (P0 to P3) are used for error detection. Their value is given by the following equation.

$$Pn=Cn \oplus C(n+4) \oplus C(n+8) \oplus (n+12)$$

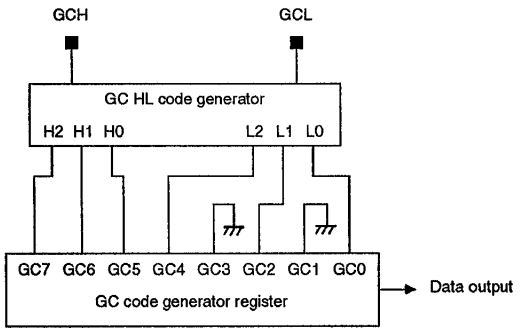
where n=0 to 3.

System code

The four-bit system code (SC0 to SC3) is mask-programmed into the LC7465M during fabrication.

Product code

The eight-bit product code (GC0 to GC7) consists of two mask-programmable bits and six bits that are set by connecting each of GCL and GCH to one of KO0 to KO7. The block diagram of the product code generator is shown in the following figure. GC1 and GC3 are the mask-programmable bits, shown set to zero.



Tables 2 and 3 show the relationships between GCL and L0 to L2, and between GCH and H0 to H2, respectively.

Table 2. GCL product codes

Pin	Code generated		
	L0	L1	L2
KO0	0	0	0
KO1	1	0	0
KO2	0	1	0
KO3	1	1	0
KO4	0	0	1
KO5	1	0	1
KO6	0	1	1
KO7	1	1	1

Table 3. GCH product codes

Pin	Code generated		
	H0	H1	H2
KO0	0	0	0
KO1	1	0	0
KO2	0	1	0
KO3	1	1	0
KO4	0	0	1
KO5	1	0	1
KO6	0	1	1
KO7	1	1	1

Function code

The eight-bit function code (FC0 to FC7) is determined by the number of the key pressed and the SEL and FCS1 to FCS3 inputs.

When SEL is LOW, bits FC3 and FC7 of the function codes for the 64 keys are determined by FCS1 and FCS3, respectively, as shown in tabel 4 and the following figure.

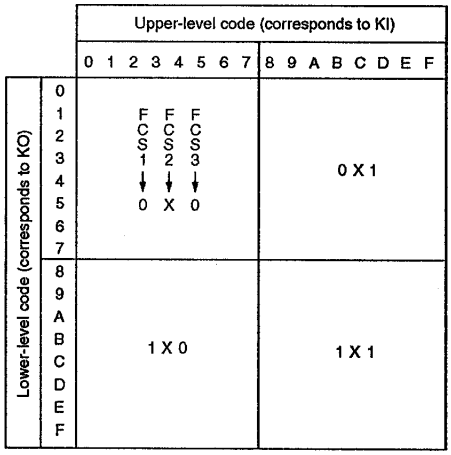


Table 4. Function code generation when SEL is LOW

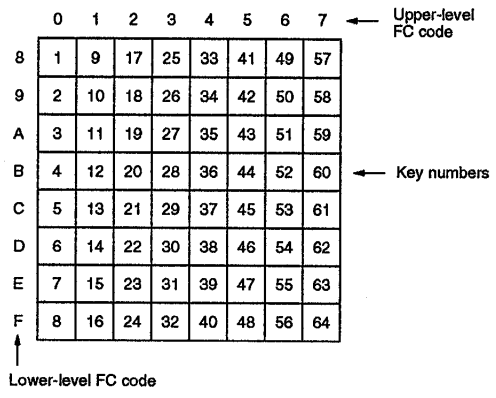
FCS1	FCS2	FCS3	Function code							
			FC0	FC1	FC2	FC3	FC4	FC5	FC6	FC7
LOW	×	LOW	–	–	–	0	–	–	–	0
HIGH	×	LOW	–	–	–	1	–	–	–	0
LOW	×	HIGH	–	–	–	0	–	–	–	1
HIGH	×	HIGH	–	–	–	1	–	–	–	1

Note

× = don't care

– = key press code

The function codes when SEL is LOW, FCS1 is HIGH and FCS3 is LOW are shown in the following figure. For example, when key 23 is pressed, the generated function code is 2EH.



When SEL is HIGH, the function codes for keys 1 to 32 are fixed, and bits FC3, FC6 and FC7 of the function codes for keys 33 to 64 are determined by FCS1 to FCS3 as shown in table 5 and the following figure.

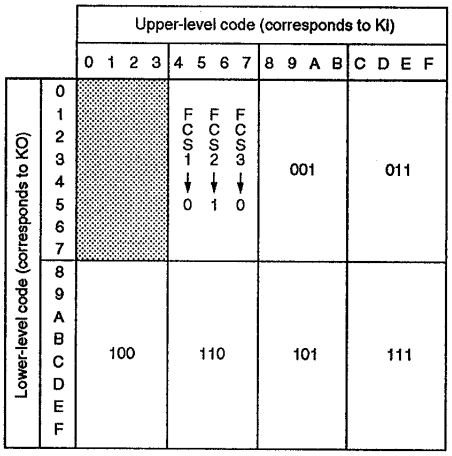


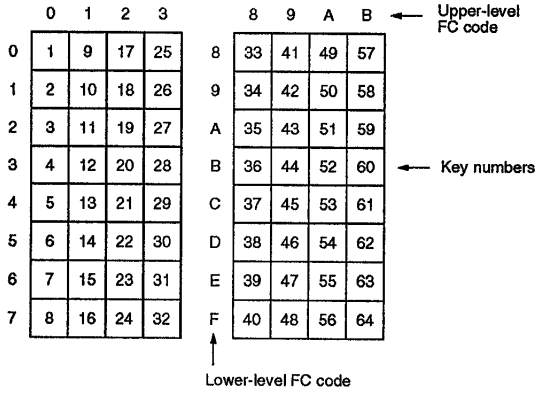
Table 5. Function code generation when SEL is HIGH

FCS1	FCS2	FCS3	Function code							
			FC0	FC1	FC2	FC3	FC4	FC5	FC6	FC7
LOW	LOW	LOW	–	–	–	0	–	–	1	0
HIGH	LOW	LOW	–	–	–	1	–	–	0	0
LOW	HIGH	LOW	–	–	–	0	–	–	1	0
HIGH	HIGH	LOW	–	–	–	1	–	–	1	0
LOW	LOW	HIGH	–	–	–	0	–	–	0	1
HIGH	LOW	HIGH	–	–	–	1	–	–	0	1
LOW	HIGH	HIGH	–	–	–	0	–	–	1	1
HIGH	HIGH	HIGH	–	–	–	1	–	–	1	1

Note

– = key press code

The function codes when SEL is HIGH, FCS1 is HIGH, FCS2 is LOW and FCS3 is HIGH are shown in the following figure. For example, when key 45 is pressed, the generated function code is 9CH.



Note that when the appropriate mask option is selected, function codes 97H, A7H, B7H, C7H, D7H, E7H and F7H can also be generated by holding down key 8 and one of keys 16, 24, 32, 40, 48, 56 and 64.

Data check code

The eight-bit data check code (DC0 to DC7) is generated by adding the carry bits from the system code to the product and function code bits. This code is used for error detection. The data check code is calculated using the following equation.

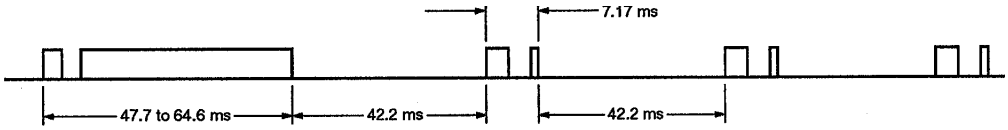
DC=SC+GC0 to GC3+GC4 to GC7+FC0 to
FC3+FC4 to FC7

For example, when

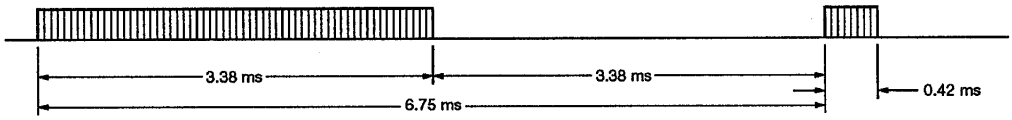
SC=0H, GC=0B1H, FC=35H
DC=0H+1H+0BH+5H+3H=14H

Data Transmission Waveforms

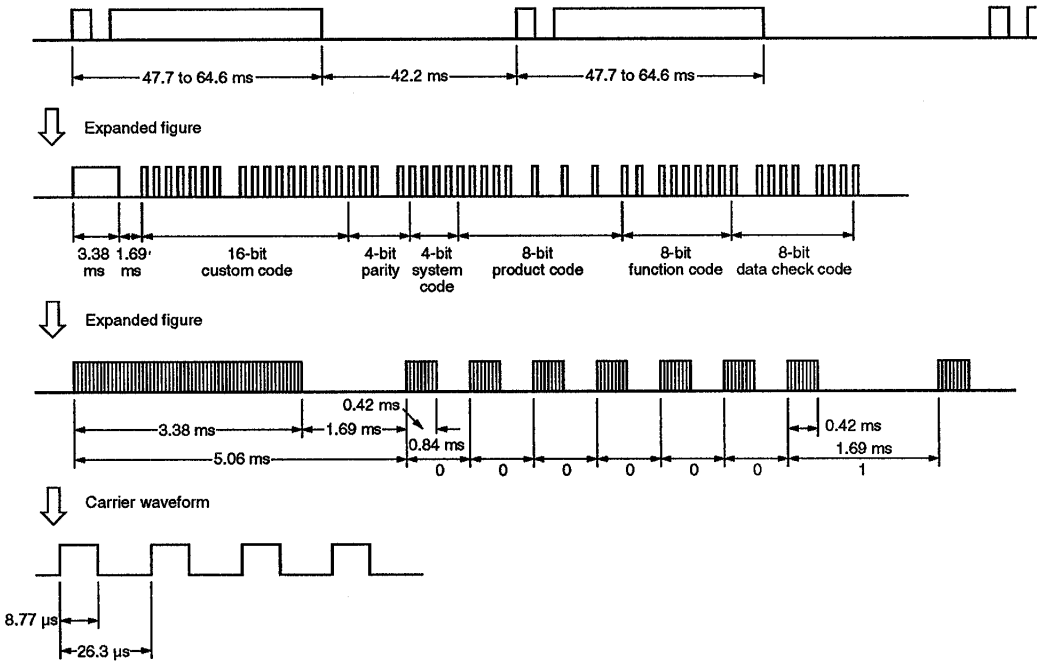
Abbreviated transmission mode



Abbreviated mode detail

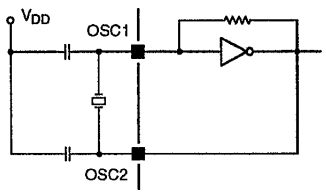


Normal transmission mode



Oscillator

The LC7465M contains a self-biased CMOS inverter that is used as an oscillator when connected to a ceramic resonator as shown in the following figure. To reduce power cunsumption, the oscillator operates only when a key is pressed.



Typical Application