DATA SHEET

GPC74XXXC

4-bit Speech with SPU

May 31, 2022

Version 1.5

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4-BIT SPEECH WITH SPU

1 GPC74XXXC SERIES

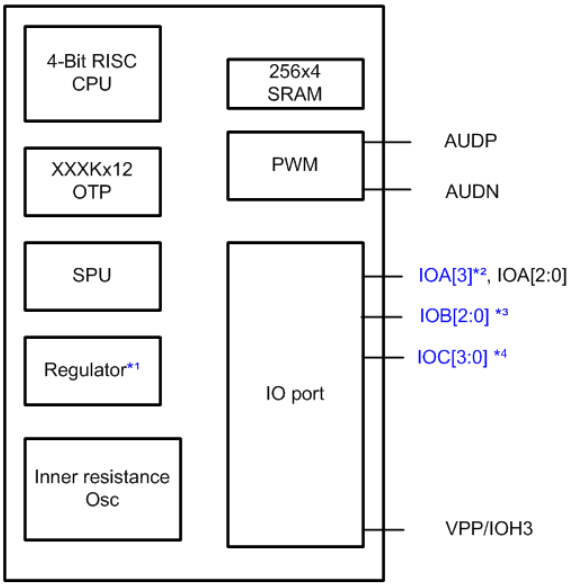
Product No.	GPC74340C	GPC74170C	GPC74081C	GPC74080C	GPC74049C	GPC74048C
OTP density (KWord)	680	340	160	160	96	96
Dedicated IOs	eleven IOs + one input (with pull low resistor)	seven IOs + one input (with pull low resistor)	seven IOs + one input (with pull low resistor)	seven IOs + one input (with pull low resistor)	seven IOs + one input (with pull low resistor)	seven IOs + one input (with pull low resistor)

Product No.	GPC74032C	GPC74016C	GPC74008C
OTP density (KWord)	64	32	16
Dedicated IOs	three IOs + one input (with pull low resistor)	three IOs + one input (with pull low resistor)	three IOs + one input (with pull low resistor)

2 GENERAL DESCRIPTION

GPC74XXXC, a 4-bit sound controller, is architected with a four-channel SPU for MIDI playback, a 4-bit RISC CPU, a 14-bit PWM, three or seven or eleven IOs, one input (with pull low resistor), 256-nibble RAM, and OTP with density of 680K/340K/160K/96K/64K/32K/16K x 12-bit of memory space. The operating voltage ranges from 2.0V through 5.5V and operating speed is 1M/2MHz, configurable through inner oscillator. Other features include Low Voltage Reset, IR carry output, Watchdog, five interrupt sources with two Time-bases, etc.

3 BLOCK DIAGRAM



***1. No regulator available in GPC74080C/GPC74048C**

***2.*3 IOA[3] and IOB[2:0] are for GPC74340C/ GPC74170C/ GPC74081C/ GPC74080C/ GPC74049C / GPC74048C only**

***4 IOC[3:0] is for GPC74340C only.**

4 FEATURES

- 4-bit RISC CPU
- CPU Clock: 1M/2M Hz.
- Operating Voltage: 2.0V - 5.5V
- Regulator built-in with input voltage: 2.0~5.5V, output voltage: 2.0~3.0V
- IO: IOA, IOB, IOC, IOH3 Operating Voltage: 2.0V - 5.5V
- 256 nibbles SRAM
- 14-bit PWM driver for driving speaker directly
- 680K/ 340K/ 160K/ 96K/ 64K/ 32K/ 16K x12-bit OTP
- Standby mode for power savings
- Five interrupt sources with two Time-bases
- Four-channel Sound Processing Unit (SPU) supports MIDI playback
- Three/Seven/Eleven general IOs (bit programmable), one input pin with pull low resistor
- Key wakeup function
- Low voltage reset
- Watchdog

5 APPLICATION FIELD

- Talking instrument controller
- General Music Synthesizer
- Toy controller
- Intelligent toy controller
- And more

6 SIGNAL DESCRIPTION

PIN Name	Pin Number		Type	Description
	SOP8	SOP16		
IO Port				
IOA[3]	NC	12	I/O	IOA[3 : 0] is a bi-directional I/O port, can be wakeup I/O (Body Option). 1Mohm || 200K feedback Pull Low resistor IOA2 shares pad with External Interrupt Input (Body Option) and also shares with SDA of serial interface. IOA1 shares pad with IR Output (Body Option) and also shares with SCK of serial interface. IOA0 shares pad with Reset Input. (Body Option)
IOA[2]	8	7		
IOA[1]	7	6		
IOA[0]	6	5		
IOB[2]	NC	15	I/O	IOB[2 : 0] is a bi-directional I/O port, can be wakeup I/O (Body Option). 1Mohm || 200K feedback Pull Low resistor IOB2 shares pad with External Interrupt Input. (Body Option) IOB1 shares pad with IR Output. (Body Option) IOB0 shares pad with Reset Input. (Body Option)
IOB[1]	NC	14		
IOB[0]	NC	13		
IOC[3]	NC	3	I/O	IOC[3 : 0] is a bi-directional I/O port, can be wakeup I/O (Body Option). 1Mohm || 200K feedback Pull Low resistor IOC2 shares pad with External Interrupt Input(Body Option) IOC1 shares pad with IR Output(Body Option) IOC0 shares pad with Reset Input, (Body Option)
IOC[2]	NC	2		
IOC[1]	NC	1		
IOC[0]	NC	16		
others				
AUDP	4	9	O	PWM audio output
AUDN	2	10		
Power & Ground Pad				
VDDIO	3	8	P	Power supply voltage input
VSS	1	11	G	Ground reference
VPP/IOH3	5	4	P/I	IOH3: input port with pull low resistor & wakeup capability (body option) VPP: OTP program power input
REGOUT	NC	NC	P	3.3V regulator output for core power, this pad only available on GPC74032C/GPC74016C//GPC74008C 1.95V regulator output for core power, this pad only available in GPC74340C/GPC74170C

Note:

1. No regulator available in GPC74080C/GPC74048C

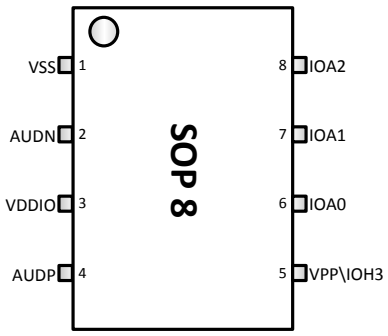
2. IOA[3] and IOB[2:0] are for GPC74340C/ GPC74170C/ GPC74081C/ GPC74080C/ GPC74049C / GPC74048C only.

3. IOC[3:0] is for GPC74340C only.

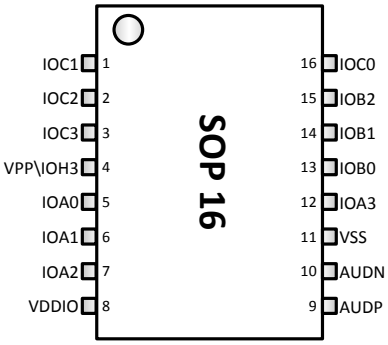
4. SOP 16 is for GPC74340C/ GPC74170C/ GPC74080C/ GPC74048C only.

6.1 Package Pad Assignment

8-PIN SOP（150 mil）



16-PIN SOP（150 mil）



Note:

1. **IOC[3:0] is for GPC74340C only.**
2. **SOP 16 is for GPC74340C/ GPC74170C/ GPC74080C/ GPC74048C only.**

7 FUNCTION DESCRIPTION

7.1 CPU

GPC74XXXC features a 4-bit RISC CPU which executes the 12-bit instruction set with total of 72 instructions, 7 stacks managed by 3-bit stack pointer, three DPRs(Data Pointer to read ROM) sharing stack 4 ~ 6, and 8 VPRs(Voice Data Pointer) for SPU.

7.2 Memory

7.2.1 SRAM

There are 256 nibbles of SRAM, grouped into 4 banks. Each bank has 64 nibbles and supports index mode to read/write its content addressed by TXR.

7.2.2 OTP

One Time Programming (OTP) memory is featured in GPC74XXXC with memory density of 680K/ 340K/ 160K/ 96K/ 64K/ 32K/ 16K x 12-bit.

7.3 Clock Source

Clock source is an inner resistance oscillator with CPU clock options of 1MHz or 2MHz

7.4 Low Voltage Reset

With the LVR function, a reset signal is generated to reset system when the operating voltage drops below LVR level.

7.5 Interrupt

An interrupt is a special event request to microcontroller. When it occurs, the corresponding interrupt will activate and direct the program code to execute the respective functions. The GPC74XXXC has five interrupt sources. Please refer to programming guide for more details.

7.5.1 Timebase

There are two Time-base, TB1/TB2, generated by system clock. The interval of TB1 is allowed up to 1ms and TB2 is up to 2ms.

7.6 SPU

Four-channel SPU supports MIDI playback with A3400Pro-like decode or PCM format and each channel has an 8-bit envelop control.

7.7 PWM

The PWM module is a 14-bit PWM driver to drive speaker directly.

7.8 Sleep Mode, Wakeup and Watchdog

7.8.1 Sleep mode and wakeup

Sleep mode or known as power down mode is an operating state that requires an extremely low power consumption to maintain the system in active. The sleep mode is particularly useful for the application areas where the system is required to constantly maintain its basic functionality and where the power capacity is limited. GPC74XXXC will enter sleep mode when SLEEP instruction is executed and can be waked up by interrupt or key change. CPU will continue to execute the program from where it entered sleep mode.

7.8.2 Watchdog Reset

A watchdog reset is a reset signal that is generated to reset the entire system when watchdog counter is overflow. In case when the program code has been running into an unknown state and without the watchdog signal being cleared for a certain period of time, watchdog function automatically generates a reset signal pulling the system back from unknown state.

7.9 I/O

GPC74XXXC features 3-bit or 7-bit or 11-bit programmable IOs with wakeup capability and 1-bit input port with pull low resistor & wakeup capability. These IOs normally support input with floating or pull-low and output options. In addition to the ordinary I/O function, some IO ports have special functions. The following table summarizes the special functions for these IOs.

Special Function in Port

Port	Special Function	Function Description	Note
IOA0/IOB0/IOC0	Key Reset	Key reset pin selected by code option	
IOA1/IOB1/IOC1	IROUT	IR carry output selected by code option	
IOA2/IOB2/IOC2	EXT INT	External interrupt input selected by code option	

8 ELECTRICAL SPECIFICATIONS

Characteristics	Symbol	Ratings
DC Supply Voltage	V_+	< 7.0V
Input Voltage Range	V_{IN}	(VSS-0.3V) to (V_+ + 0.3V)
Operating Temperature	T_A	0℃ to +70℃
Storage Temperature	T_{STO}	-50℃ to +150℃

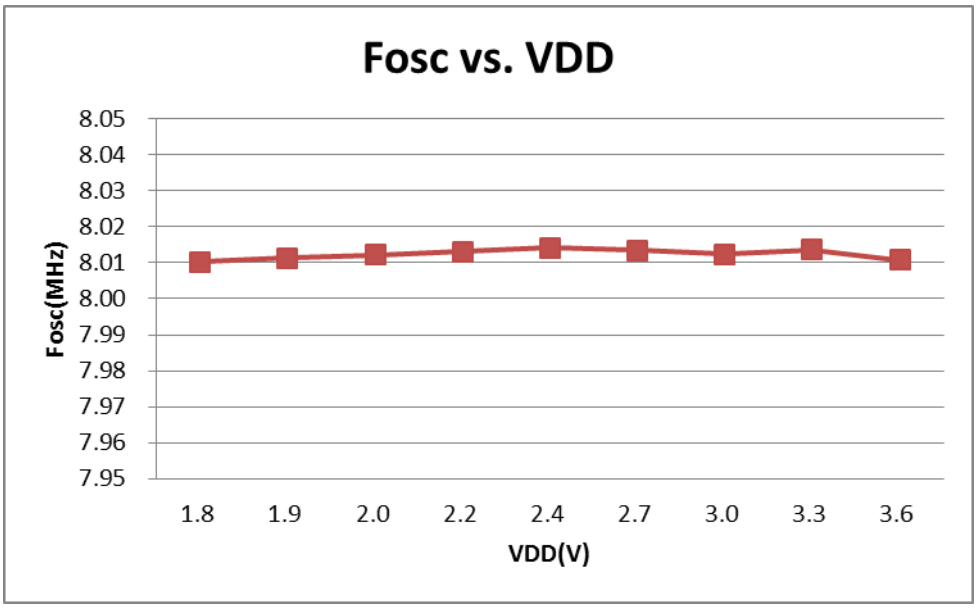
Note: Stresses beyond those given in the Absolute Maximum Rating table may cause permanent damage to the device. For normal operational conditions, see DC Electrical Characteristics.

8.1 DC Characteristics (VDD = 3/4.5V, TA = 25℃)

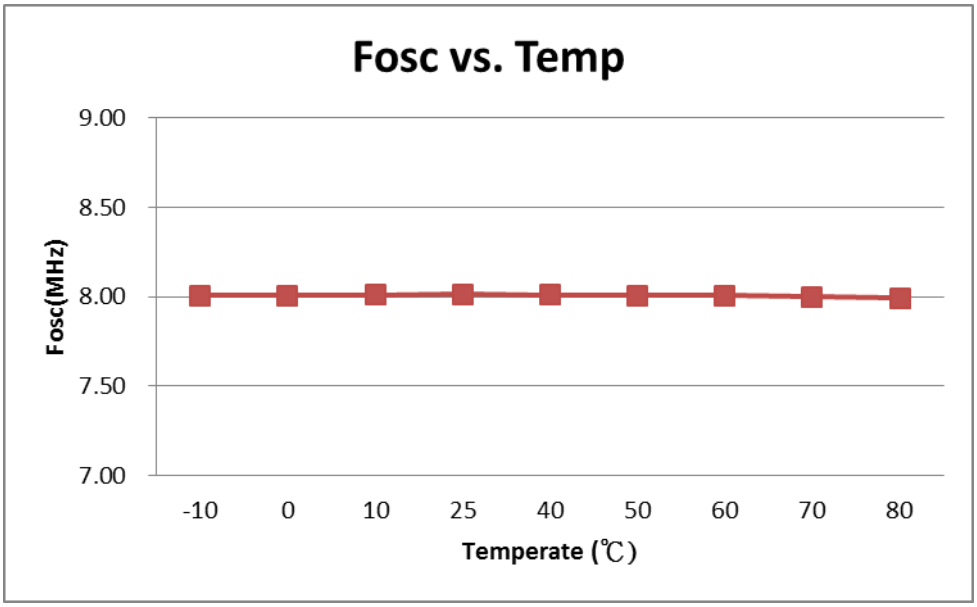
Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
Operating Voltage	VDD	2.0	-	5.5	V	
Operating Current	I_{OP}	-	0.8	1.2	mA	F_{CPU} = 2MHz @ 3.0V, PWM output off For GPC74008C/ GPC74016C/GPC74032C
		-	3	5	mA	F_{CPU} = 2MHz @ 3.0V, PWM output off For GPC74048C/GPC74080C
		-	1.5	2	mA	F_{CPU} = 2MHz @ 3.0V, PWM output off For GPC74049C/GPC74081C /GPC74170C/GPC74340C
		-	1	1.5	mA	F_{CPU} = 2MHz @ 4.5V, PWM output off For GPC74008C/ GPC74016C/GPC74032C
		-	3.0	5	mA	F_{CPU} = 2MHz @ 4.5V, PWM output off For GPC74048C/GPC74080C
		-	1.7	2.5	mA	F_{CPU} = 2MHz @ 4.5V, PWM output off For GPC74049C/GPC74081C /GPC74170C/GPC74340C
Standby Current	I_{STBY}	-	-	5	uA	VDD = 3.0V
		-	-	5	uA	VDD = 4.5V
GPIO Input High Level (IOA, IOB, IOH3)	V_{IH}	0.7*VDD	-	-	V	VDD = 4.5V
GPIO Input Low Level (IOA, IOB, IOH3)	V_{IL}	-	-	0.3*VDD	V	VDD = 4.5V
Output High Current (IOA, IOB)	I_{OH}	-	10	-	mA	VDD = 3.0V, V_{OH} = 0.7*VDD
		-	20	-	mA	VDD = 4.5V, V_{OH} = 0.7*VDD
Output Low Current (Normal)	I_{OL1}	-	10	-	mA	VDD = 3.0V, V_{OL} = 0.3*VDD
		-	20	-	mA	VDD = 4.5V, V_{OL} = 0.3*VDD
Output Low Current (High sink , by Body Option)	I_{OL2}	-	20	-	mA	VDD = 3.0V, V_{OL} = 0.3*VDD
		-	40	-	mA	VDD =4.5V, V_{OL} = 0.3*VDD
Input Pull Low Resistor (IOA, IOB, IOH3)	R_{L1}	-	200	-	Kohm	VDD = 3.0V, IO = 0V
		-	100	-	Kohm	VDD = 4.5V, IO = 0V
Input Pull Low Resistor (IOA, IOB, IOH3)	R_{L2}	-	1000	-	Kohm	VDD = 3.0V, IO = 3.0V
		-	500	-	Kohm	VDD = 4.5V, IO = 4.5V
PWM Driver Current	I_{PWM}	-	180	-	mA	VDD = 3.0V, 8 Ohms load
		-	280	-	mA	VDD = 4.5V, 8 Ohms load

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
Frequency deviation by voltage drop	△F/F	-1	-	+1	%	$\frac{Fosc(5.5v)-Fosc(2.4v)}{Fosc(3.0v)}$ F_{CPU} = 2MHz
Frequency lot deviation	△F/F	-1	-	1	%	$\frac{Fmax(3.0v)-Fmin(3.0v)}{Fmax(3.0v)}$ F_{CPU} = 2MHz @ 3.0V (tentative)
		-1	-	1	%	$\frac{Fmax(4.5v)-Fmin(4.5v)}{Fmax(4.5v)}$ F_{CPU} = 2MHz @ 4.5V (tentative)

8.2 Internal Frequency (Fosc) and VDD

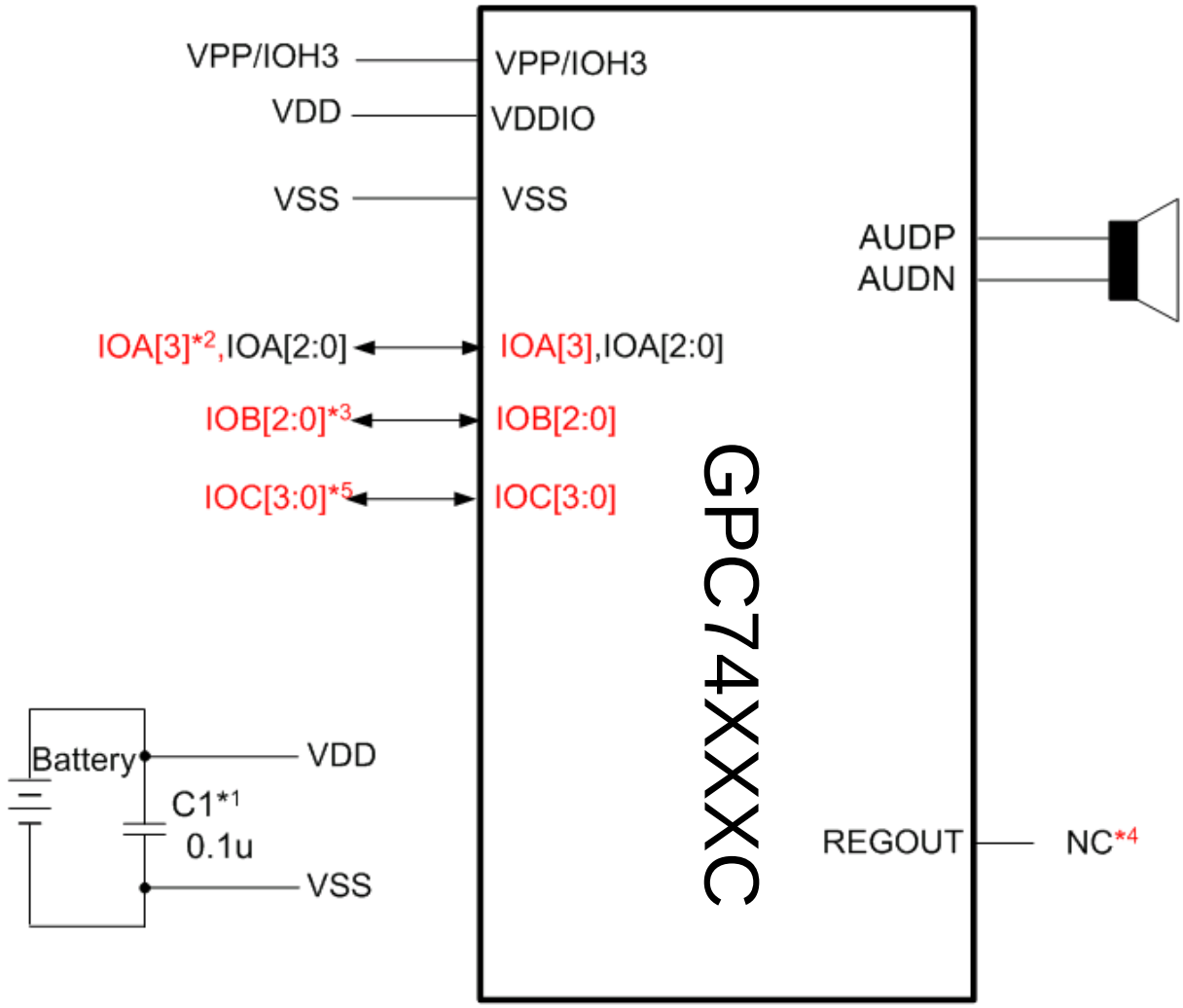


8.3 Internal Frequency (Fosc) and Temperature



9 APPLICATION CIRCUITS

9.1 Light Loading and Circuit without Noise



PCB Layout Guidelines:

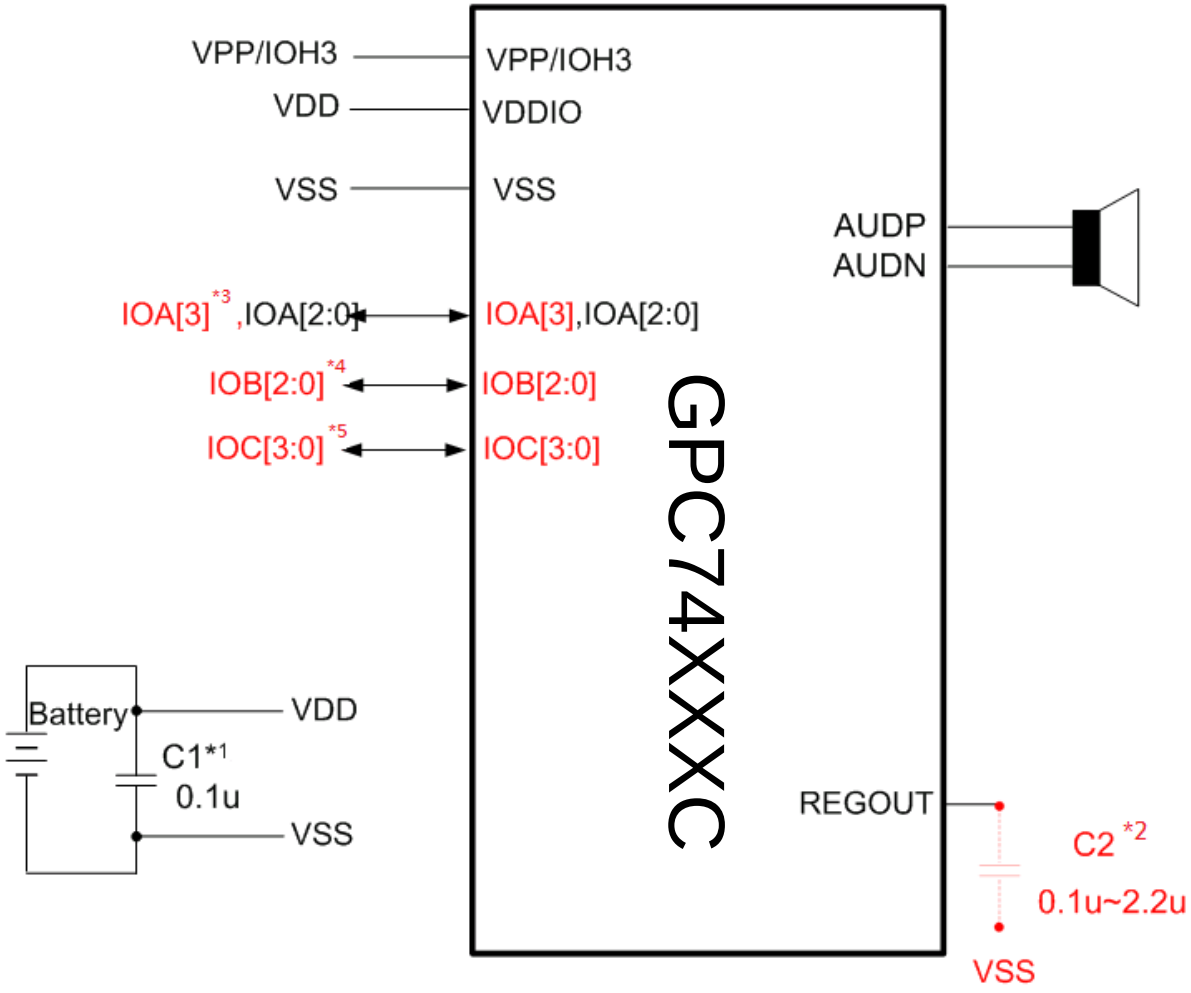
*1. VDD may be connected to VSS with 0.1uf capacitor (C1).

*2.*3. IOA[3] and IOB[2:0] are only available in GPC74048C/GPC74049C/GPC74080C/GPC74081C/GPC74170C/GPC74340C.

*4. There is no REGOUT pad in GPC74048C/GPC74080C.

*5. IOC[3:0] is only available on GPC74340C.

9.2 Heavy Loading or Circuit with Noise



PCB Layout Guidelines:

*1. VDD may be connected to VSS with 0.1uf capacitor (C1), and it may vary in different loadings.

*2. If there is application with motor, VDD should be connected with C1, and REGOUT should be connected with C2. There's no REGOUT pad in GPC74048C/GPC74080C.

*3,*4. IOA[3] and IOB[2:0] are only available in GPC74048C/GPC74049C/GPC74080C/GPC74081C/GPC74170C/GPC74340C.

*5. IOC[3:0] is only available on GPC74340C.

10 PACKAGE/PAD LOCATIONS

10.1 Ordering Information

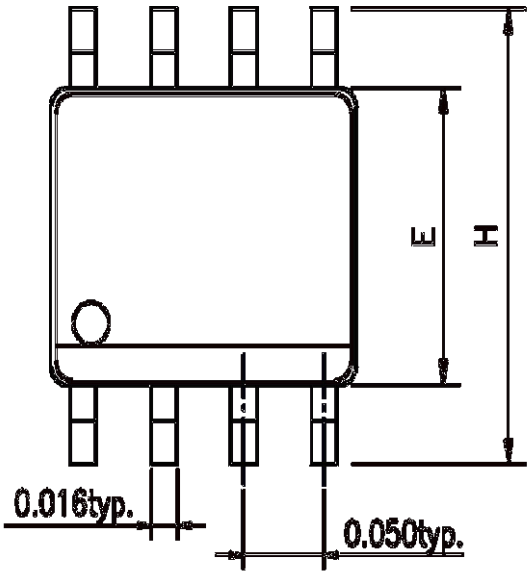
Product Number	Package Type
GPC74XXXC-NnnV-C	Chip form
GPC74XXXC-QS01X	Green Package –SOP8
GPC74XXXC-QS03X	Green Package –SOP16

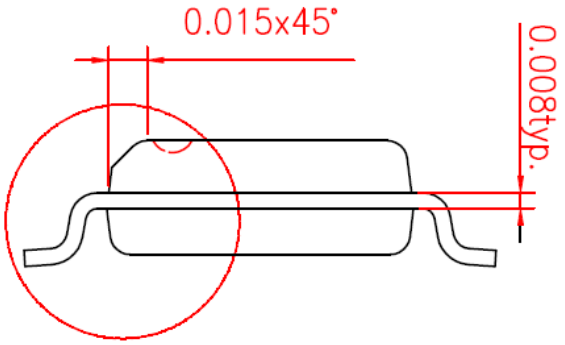
Note1: Code number is assigned for customer.

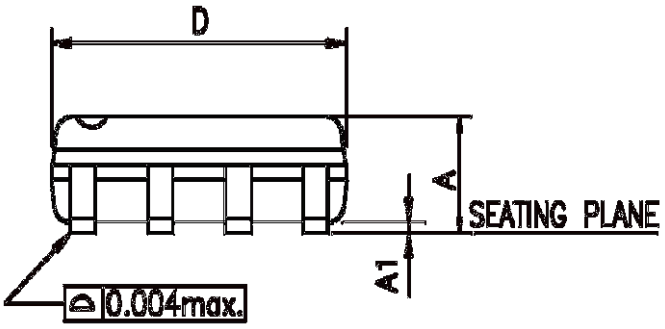
Note2: Code number (N = A - Z or 0 - 9, nn = 00 - 99); version (V = A - Z).

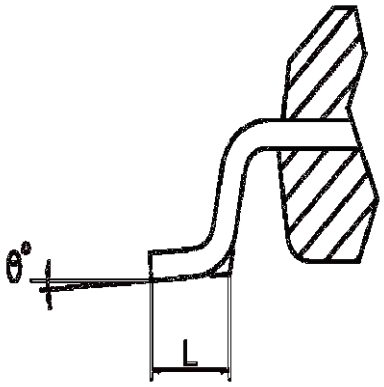
10.2 Package Information

8-PIN SOP(150 mil)





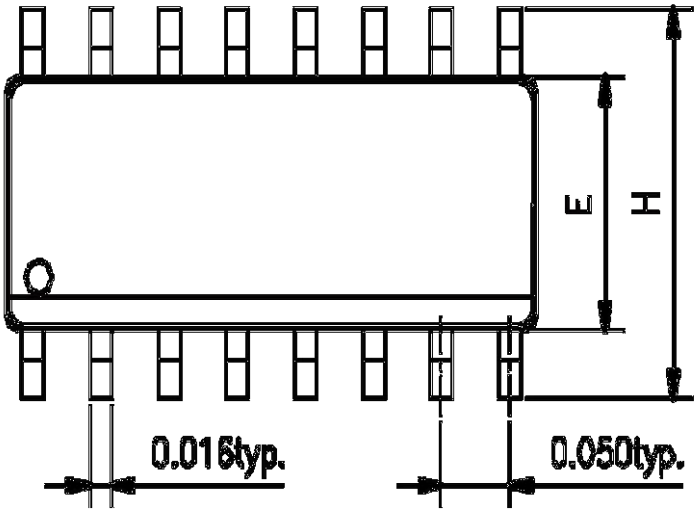


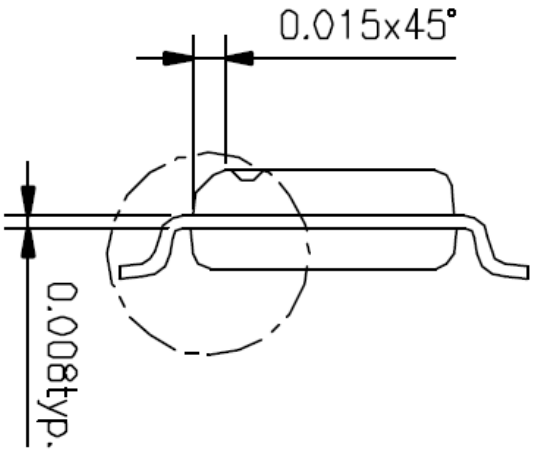


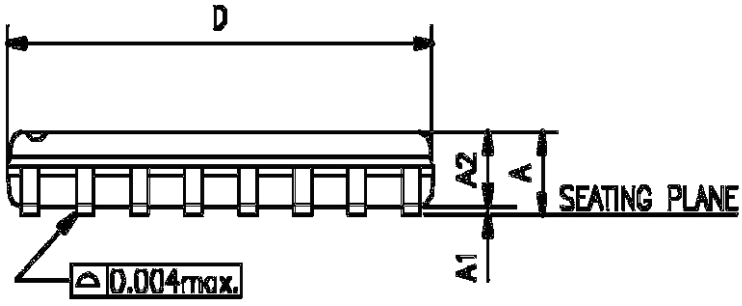
SYMBOLS	MIN.	MAX.
A	0.053	0.069
A1	0.004	0.010
D	0.189	0.196
E	0.150	0.157
H	0.228	0.244
L	0.016	0.050
θ°	0	8

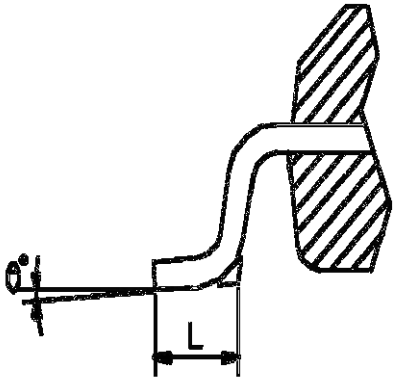
UNIT : INCH

16 PIN SOP(150 mil)









SYMBOLS	MIN.	MAX.
A	0.053	0.069
A1	0.004	0.010
D	0.386	0.394
E	0.150	0.157
H	0.228	0.244
L	0.016	0.050
θ°	0	8

UNIT : INCH

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12 REVISION HISTORY

Date	Revision #	Description	Page
May 31, 2022	1.5	1. Add Package SOP-16 information. 2. Modify DC Characteristics for VIH/VIL & Operating Current 3. Modify APPLICATION CIRCUITS	4,5,12,13 7 10,11
Apr. 14, 2022	1.4	Add new body GPC74049C/GPC74081C	3,7,9,10,11
Jul. 29, 2021	1.3	Add new body GPC74170C/GPC74340C	3,3,4,6,7,9,10,11
May 21, 2021	1.2	Add new body GPC74048C/GPC74080C	1,2,3,9,9
Sep. 29, 2020	1.1	Add new body GPC74032C/GPC74016C	3
Jul. 13, 2020	1.0	Release to version 1.0	15
Mar. 23, 2020	0.1	Preliminary Version	13