



# LC7152, 7152M, 7152NM, 7152KM

## Universal Dual-PLL Frequency Synthesizers



### Overview

The LC7152, 7152M, 7152NM, 7152KM are universal dual-PLL frequency synthesizers for use in weak signal type cordless telephone applications in the USA, South Korea, and Japan, and broadcast satellite (BS) tuners in the USA and Europe.

### Features

- Dual charge pump built in for fast channel switching
- Digital lock detector enables PLL lock status check with crystal oscillator precision
- Programmable reference frequency divider supports various applications
- The LC7152NM is a built-in power-on reset circuit version of the LC7152M
- The LC7152KM is an enhanced frequency characteristics version of the LC7152M

### Functions

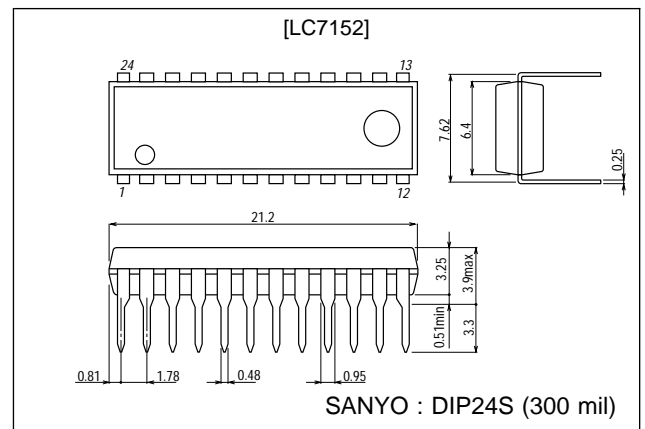
- 2-system PLL built-in (dual PLL)
- 16-bit programmable local-oscillator divider 1.5 to 55 MHz ( $V_{DD} = 2.0$  to  $3.3$  V), LC7152KM: 55 to 80 MHz ( $V_{DD} = 2.7$  to  $3.3$  V)
- 14-bit programmable reference-frequency divider  
320 Hz to 640 kHz reference frequency using a 10.24 MHz crystal oscillator
- Digital lock detector
- Dual charge pump
- Amplifier built-in for an active LPF
- Serial transmission data input (CCB format)
- LC7152NM with power-on reset circuit (pins  $\overline{OUTA}$  and  $\overline{OUTB}$  become open at power-on)
- 2.0 to 3.3 V supply voltage
- DIP24S and MFP24S packages

• CCB is a trademark of SANYO ELECTRIC CO., LTD.  
• CCB is SANYO's original bus format and all the bus addresses are controlled by SANYO.

### Package Dimensions

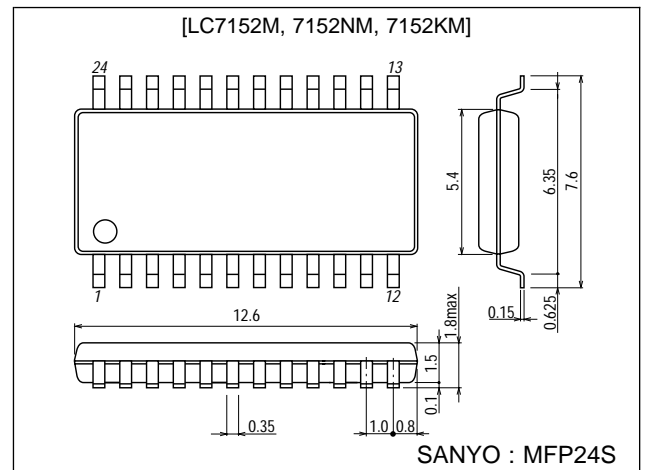
unit : mm

#### 3067-DIP24S



unit : mm

#### 3112-MFP24S



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61199RM (II)/41495TH(ID) No.3889-1/13

# LC7152, 7152M, 7152NM, 7152KM

## Specifications

### Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$ , $V_{SS} = 0\text{ V}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{DDmax}$	$V_{DD}$	-0.3 to +7.0	V
Maximum input voltage	$V_{INmax(1)}$	CE, CL, DI, AIA, AIB	-0.3 to +7.0	V
	$V_{INmax(2)}$	XIN, PIA, PIB, TEST	-0.3 to $V_{DD}+0.3$	V
Maximum output voltage	$V_{Omax(1)}$	$\overline{LDI}$ , $\overline{LDB}$	-0.3 to +7.0	V
	$V_{Omax(2)}$	AOA, AOB, $\overline{OUTA}$ , $\overline{OUTB}$	-0.3 to +15	V
	$V_{Omax(3)}$	PDA1, PDA2, PDB1, PDB2, XOUT	-0.3 to $V_{DD}+0.3$	V
Maximum output current	$I_{Omax(1)}$	$\overline{LDA}$ , $\overline{LDB}$ , $\overline{OUTA}$ , $\overline{OUTB}$	0 to 3	mA
	$I_{Omax(2)}$	AOA, AOB	0 to 6	mA
Allowable power dissipation	Pd max	$T_a \leq 85^\circ\text{C}$ , LC7152	350	mW
		$T_a \leq 85^\circ\text{C}$ , LC7152M, 7152NM, 7152KM	160	mW
Operating temperature	Topr		-40 to +85	$^\circ\text{C}$
Storage temperature	Tstg		-55 to +125	$^\circ\text{C}$

### Allowable Operating Ranges at $T_a = -40$ to $+85^\circ\text{C}$ , $V_{SS} = 0\text{ V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	$V_{DD(1)}$	$V_{DD}$	2.0		3.3	V
	$V_{DD(2)}$	$V_{DD}$ : Serial data retention voltage, see Figure1, *1	1.5			V
	$V_{DD(3)}$	$V_{DD}$ : Power-on reset voltage, $t_R \geq 20\text{ ms}$ , see Figure1, *1			0.05	V
Input high-level voltage	$V_{IH(1)}$	CE, CL, DI: $V_{DD} = 2.0\text{ V}$	1.5		5.5	V
	$V_{IH(2)}$	CE, CL, DI: $V_{DD} = 3.3\text{ V}$	1.7		5.5	V
Input low-level voltage	$V_{IL(1)}$	CE, CL, DI: $V_{DD} = 2.0\text{ V}$	0		0.4	V
	$V_{IL(2)}$	CE, CL, DI: $V_{DD} = 3.3\text{ V}$	0		0.6	V
Output voltage	$V_O(1)$	$\overline{LDA}$ , $\overline{LDB}$	0		5.5	V
	$V_O(2)$	AOA, AOB, $\overline{OUTA}$ , $\overline{OUTB}$	0		13	V
Input frequency	$f_{IN(1)}$	XIN: Sine wave, capacitively coupled	1.0		13	MHz
	$f_{IN(2)}$	PIA, PIB: Sine wave, capacitively coupled *2	1.5		55	MHz
	$f_{IN(3)}$	PIA, PIB: Sine wave, capacitively coupled *3	55		80	MHz
Input amplitude	$V_{IN(1)}$	XIN: Sine wave, capacitively coupled	200		600	mVrms
	$V_{IN(2)}$	PIA, PIB: Sine wave, capacitively coupled *2,3	100		600	mVrms
Crystal oscillator frequency	$f_{X'tal}$	XIN, XOUT: $CI \leq 50\ \Omega$ $CL \leq 16\text{ pF}$ *4	4	10.24	11	MHz

Note \*1 LC7152NM

		FA/FB (serial data input frequency select bits)		$V_{DD}$	Device
		[0]	[1]		
*2	$f_{IN(2)}$	1.5 to 23 MHz	20 to 55 MHz	2.0 to 3.3 V	LC7152, 7152M, LC7152NM, 7152KM
*3	$f_{IN(3)}$	—————	55 to 80 MHz	2.7 to 3.3 V	LC7152KM

\*4 CI is the crystal impedance and CL is the load capacitance.

## LC7152, 7152M, 7152NM, 7152KM

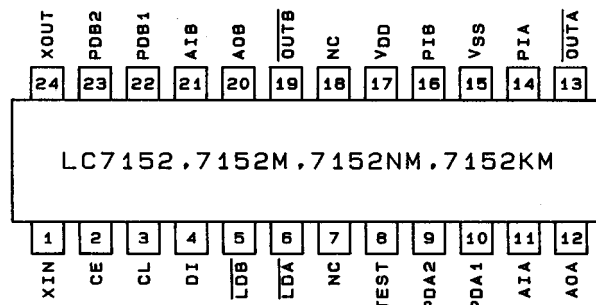
### Electrical Characteristics in the allowable operating ranges

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output high-level voltage	V <sub>OH</sub> (1)	PDA1, PDB1: I <sub>O</sub> = 1 mA	V <sub>DD</sub> - 1.0			V
	V <sub>OH</sub> (2)	PDA2, PDB2: I <sub>O</sub> = 2 mA	V <sub>DD</sub> - 1.0			V
Output low-level voltage	V <sub>OL</sub> (1)	PDA1, PDB1: I <sub>O</sub> = 1 mA			1.0	V
	V <sub>OL</sub> (2)	PDA2, PDB2: I <sub>O</sub> = 2 mA			1.0	V
	V <sub>OL</sub> (3)	OUTA, OUTB: I <sub>O</sub> = 1 mA			1.0	V
	V <sub>OL</sub> (4)	LDA, LDB: I <sub>O</sub> = 2 mA			1.0	V
	V <sub>OL</sub> (5)	AOA, AOB: I <sub>O</sub> = 0.5 mA, AIA = AIB = 1.2 V			0.5	V
	V <sub>OL</sub> (6)	AOA, AOB: I <sub>O</sub> = 1 mA, AIA = AIB = 1.3 V			0.5	V
Output off-leakage current	I <sub>OFF</sub> (1)	LDA, LDB: V <sub>O</sub> = 5.5 V			5.0	μA
	I <sub>OFF</sub> (2)	PDA1, PDB1, PDA2, PDB2: V <sub>O</sub> = 0/3.3 V		0.01	10.0	nA
	I <sub>OFF</sub> (3)	AOA, AOB, OUTA, OUTB: V <sub>O</sub> = 13 V			5.0	μA
Input high-level current	I <sub>IH</sub> (1)	CE, CL, DI: V <sub>I</sub> = 5.5 V			5.0	μA
	I <sub>IH</sub> (2)	XIN: V <sub>I</sub> = 3.3 V, V <sub>DD</sub> = 3.3 V	2.0		6.5	μA
	I <sub>IH</sub> (3)	PIA, PIB: V <sub>I</sub> = 3.3 V, V <sub>DD</sub> = 3.3 V	3.5		10.0	μA
	I <sub>IH</sub> (4)	AIA, AIB: V <sub>I</sub> = 3.3 V		0.01	10.0	nA
	I <sub>IH</sub> (5)	TEST: V <sub>I</sub> = 3.3 V, V <sub>DD</sub> = 3.3 V		120		μA
Input low-level current	I <sub>IL</sub> (1)	CE, CL, DI: V <sub>I</sub> = 0 V			5.0	μA
	I <sub>IL</sub> (2)	XIN: V <sub>I</sub> = 0 V, V <sub>DD</sub> = 3.3 V	2.0		6.5	μA
	I <sub>IL</sub> (3)	PIA, PIB: V <sub>I</sub> = 0 V, V <sub>DD</sub> = 3.3 V	3.5		10.0	μA
	I <sub>IL</sub> (4)	AIA, AIB: V <sub>I</sub> = 0 V		0.01	10.0	nA
	I <sub>IL</sub> (5)	TEST: V <sub>I</sub> = 0 V, V <sub>DD</sub> = 3.3 V			5.0	μA
Internal feedback resistance	R <sub>f</sub> (1)	XIN: V <sub>DD</sub> = 3.3 V		1.0		MΩ
	R <sub>f</sub> (2)	PIA, PIB: V <sub>DD</sub> = 3.3 V		600		kΩ
Internal pull-down resistance	R <sub>d</sub>	TEST: V <sub>DD</sub> = 3.3 V		30		kΩ
Input capacitance	C <sub>IN</sub>	XIN, PIA, PIB		2.5		pF
Supply current*1	I <sub>DD</sub> (1)	V <sub>DD</sub> (= 2.0 V): f <sub>IN</sub> = 55 MHz		3.0	8.0	mA
	I <sub>DD</sub> (2)	V <sub>DD</sub> (= 3.3 V): f <sub>IN</sub> = 55 MHz		7.0	14.0	mA
Supply current*2	I <sub>DD</sub> (4)	V <sub>DD</sub> (= 2.0 V): f <sub>IN</sub> = 55 MHz		1.5	4.5	mA
	I <sub>DD</sub> (5)	V <sub>DD</sub> (= 3.3 V): f <sub>IN</sub> = 55 MHz		3.9	8.0	mA

Note \*1. Dual PLL operation (both PLL-A and PLL-B), SB= 0, XIN= 10.24 MHz (crystal), PIA and PIB input = 100mVrms at f<sub>IN</sub>, all other inputs at V<sub>SS</sub>, all other outputs open.

\*2. Standby mode: Single PLL operation (PLL-A operating and PLL-B stopped), SB = 1, XIN = 10.24 MHz (crystal), PIA input = 100mVrms at f<sub>IN</sub>, all other inputs at V<sub>SS</sub>, all other outputs open.

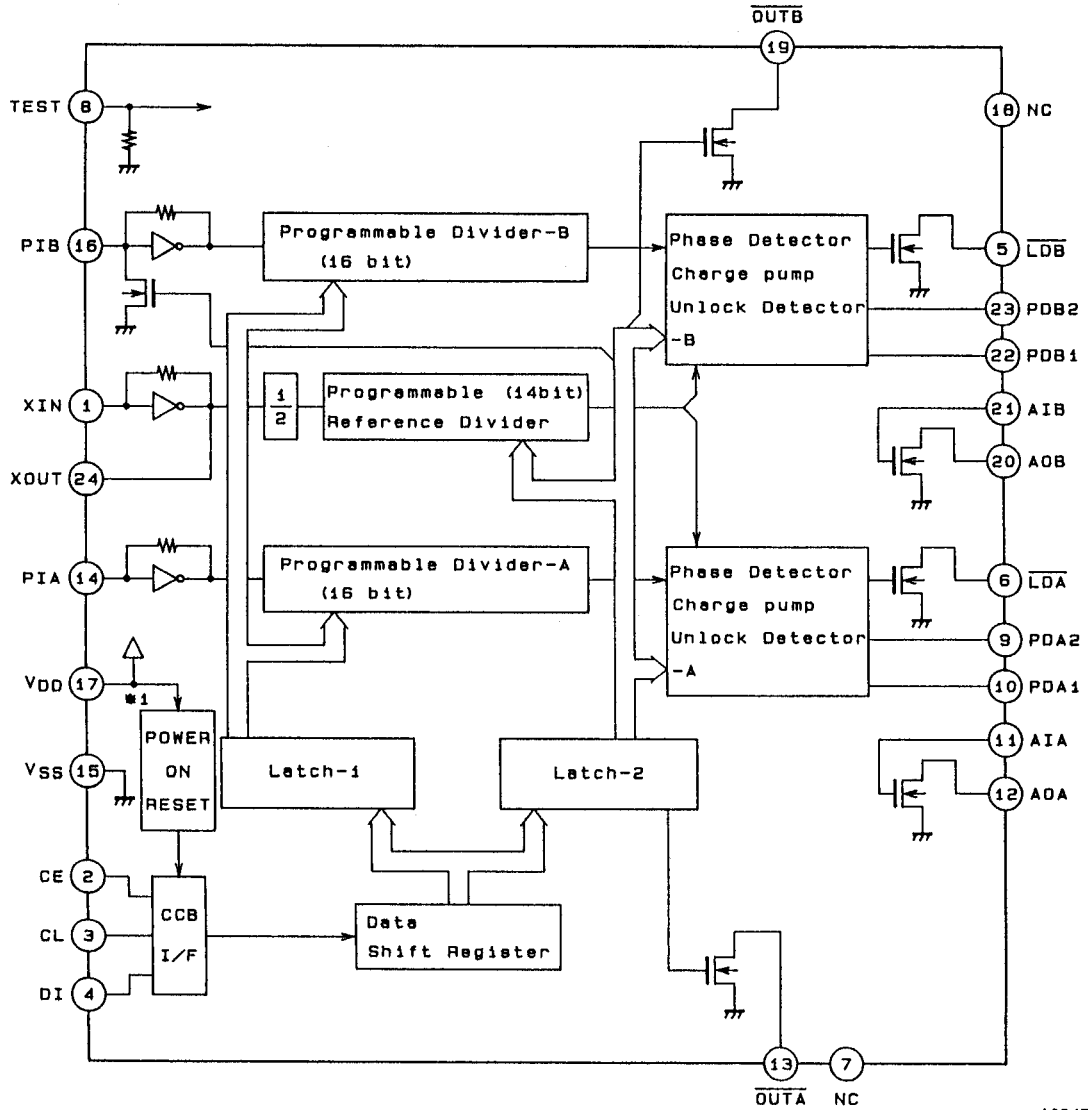
### Pin Assignment



Top view  
A03478

# LC7152, 7152M, 7152NM, 7152KM

## Equivalent Block Diagram



A03470

## Pin Functions

Symbol	Pin No.	Function	Symbol	Pin No.	Function	
PIB	16	Side-B oscillator signal input	PDB2	23	Sub charge pump	
XIN	1	Crystal oscillator	PDB1	22	Main charge pump	
XOUT	24		AIB	21	Low-pass filter transistors	
PIA	14	Side-A oscillator signal output	AOB	20		
V <sub>DD</sub>	17	Power supply	OUTB	19	General-purpose output port	
V <sub>SS</sub>	15	Ground	LDA	6	Side-A unlock detection	
CE	2	Serial data input	PDA2	9	Sub charge pump	
CL	3		Chip enable	PDA1	10	Main charge pump
DI	4		Clock	AIA	11	Low-pass filter transistors
TEST	8	Data	AOA	12		
NC	7, 18	No connections	OUTA	13	General-purpose output port	
LDB	5	Side-B unlock detection				

## LC7152, 7152M, 7152NM, 7152KM

### Pin Description

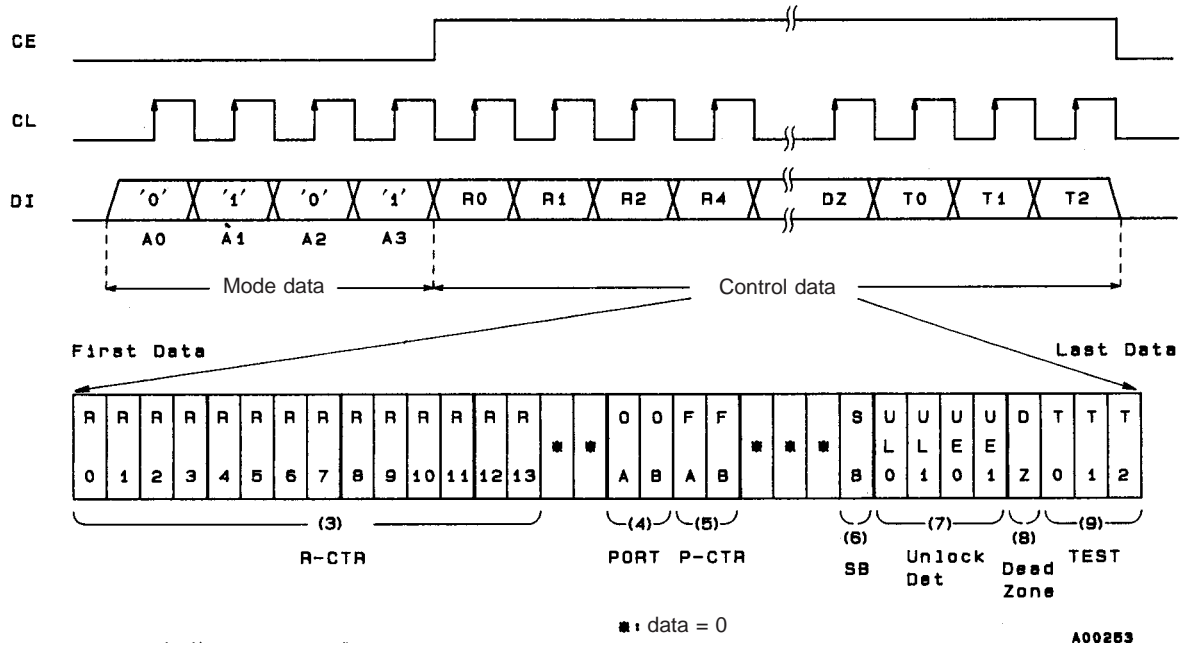
Symbol	Pin No.	Function	Description of function												
PIA	14	Side-A local oscillator signal input	<ul style="list-style-type: none"> <li>Side-A programmable divider. The input frequency ranges are as follows. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>FA = [0]</th> <th>FA = [1]</th> <th>V<sub>DD</sub></th> <th>Device</th> </tr> </thead> <tbody> <tr> <td>1.5 to 23 MHz</td> <td>20 to 55 MHz</td> <td>2.0 to 3.3 V</td> <td>LC7152, 7152M LC7152NM, 7152KM</td> </tr> <tr> <td>—————</td> <td>55 to 80 MHz</td> <td>2.7 to 3.3 V</td> <td>LC7152KM</td> </tr> </tbody> </table> </li> <li>FA: Serial data</li> <li>Bits DA0 to DA15 determine the divider ratios Divider ratio N = 272 to 65535</li> </ul>	FA = [0]	FA = [1]	V <sub>DD</sub>	Device	1.5 to 23 MHz	20 to 55 MHz	2.0 to 3.3 V	LC7152, 7152M LC7152NM, 7152KM	—————	55 to 80 MHz	2.7 to 3.3 V	LC7152KM
FA = [0]	FA = [1]	V <sub>DD</sub>	Device												
1.5 to 23 MHz	20 to 55 MHz	2.0 to 3.3 V	LC7152, 7152M LC7152NM, 7152KM												
—————	55 to 80 MHz	2.7 to 3.3 V	LC7152KM												
PIB	16	Side-B local-oscillator signal input	<ul style="list-style-type: none"> <li>Side-B programmable divider The input frequency ranges are the same as for PIA. FB(→ FA): Determined by the serial data</li> <li>Bits DB0 to DB15 determine the divider ratios Divider ratio N= 272 to 65535</li> <li>Serial data: Bit SB is the standby mode control bit When SB = 1, standby mode is selected. In standby mode, side-B is stopped, PIB is pulled down to V<sub>SS</sub>. When SB = 0, normal operation is selected.</li> </ul>												
XIN XOUT	1 24	Crystal oscillator	<ul style="list-style-type: none"> <li>Crystal oscillator connections (C<sub>I</sub> ≤ 50 Ω, C<sub>L</sub> ≤ 16pF).</li> <li>Note) When using a crystal other than as indicated above, its compatibility with the crystal oscillator must be thoroughly studied.</li> </ul>												
PDA1  PDB1	10  22	Side-A main charge pump  Side-B main charge pump	<ul style="list-style-type: none"> <li>These are PLL charge pump outputs that output the PLL phase error signals. When the frequency generated by dividing the local oscillator signal frequency by N is higher than the reference frequency, the charge pump outputs a high-level signal for the phase error; when lower, the charge pump outputs a low-level signal for the phase error. If the two values match, these pins go to high-impedance.</li> <li>fosc/N &gt; fref or leading → Positive Pulse</li> <li>fosc/N &lt; fref or lagging → Negative Pulse</li> <li>fosc/N = fref and coincidence → High-Impedance (*SB = [1] : PDB1 → High-Impedance)</li> </ul>												
PDA2  PDB2	9  23	Side-A sub charge pump  Side-B sub charge pump	<ul style="list-style-type: none"> <li>PLL charge pump output; outputs PLL phase error signal only when the unlock condition is detected.</li> <li>The unlock detection threshold is set by serial data bits UL0 and UL1.</li> <li>When a phase error that is shorter than the detection threshold occurs, this signal goes to high impedance and the phase error signal for the main charge pump is output.</li> <li>The output pulse of the phase error signal has the same polarity as the main charge pump.</li> </ul>												
$\overline{\text{LDA}}$  $\overline{\text{LDB}}$	6  5	Side-A unlock detector output  Side-B unlock detector output	<ul style="list-style-type: none"> <li>Outputs the PLL lock/unlock status. Locked: Open Unlocked: Low</li> <li>The unlock detection threshold for lock/unlock discrimination is set by serial data bits UL0 and UL1.</li> <li>The output phase error extension is set by serial data bits UE0 and UE1.</li> <li>For details, refer to the description of the serial data.</li> <li>SB = 1: LDB → Open</li> </ul>												
AIA AOA AIB OAB	11 12 21 20	Side-A low-pass filter transistor  Side-B low-pass filter transistor	<ul style="list-style-type: none"> <li>MOS N-channel transistor for the PLL filter</li> <li>The AOA and AOB output withstand voltage is 13V.</li> </ul>												
$\overline{\text{OUTA}}$  $\overline{\text{OUTB}}$	13  19	Side-A general purpose output port  Side-B general purpose output port	<ul style="list-style-type: none"> <li>These latch the serial data bits OA and OB that are sent from the controller, and then invert and output the data. (OUTA can also output XIN divided by two.)</li> <li>In the LC7152NM, OUTA and OUTB are open at the power-on reset.</li> </ul>												

For more information on crystal oscillator : Nihon Dempa Kogyo Co., Ltd.

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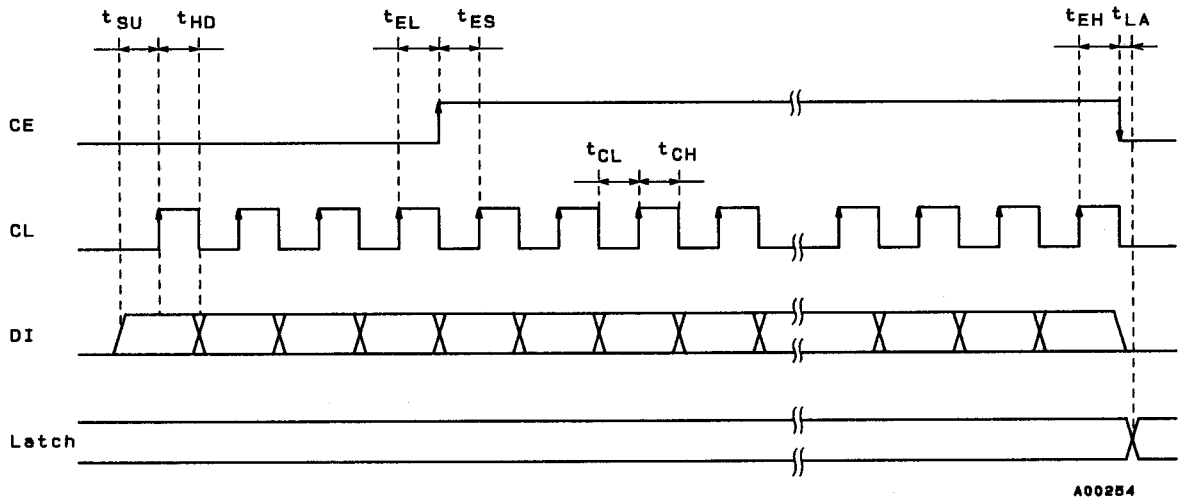


Mode 2: Latch-2 data (reference divider and control data)



A00253

Serial Data Transfer Timing



A00254

Symbol	Parameter	10.24 MHz crystal	Other crystal frequencies
$t_{SU}$	Data setup time	At least 0.40 $\mu$ s	At least $4/f_{X'tal}$
$t_{HD}$	Data hold time	At least 0.40 $\mu$ s	At least $4/f_{X'tal}$
$t_{EL}$	Enable low-level pulse width	At least 0.40 $\mu$ s	At least $4/f_{X'tal}$
$t_{ES}$	Enable setup time	At least 0.40 $\mu$ s	At least $4/f_{X'tal}$
$t_{EH}$	Enable hold time	At least 0.40 $\mu$ s	At least $4/f_{X'tal}$
$t_{CL}$	Clock low-level pulse width	At least 0.40 $\mu$ s	At least $4/f_{X'tal}$
$t_{CH}$	Clock high-level pulse width	At least 0.40 $\mu$ s	At least $4/f_{X'tal}$
$t_{LA}$	Latch propagation delay	Up to 0.40 $\mu$ s	Up to $4/f_{X'tal}$

Note Perform data transfer after the crystal oscillations normalize. Data transferred before normal oscillations will not be recognized.

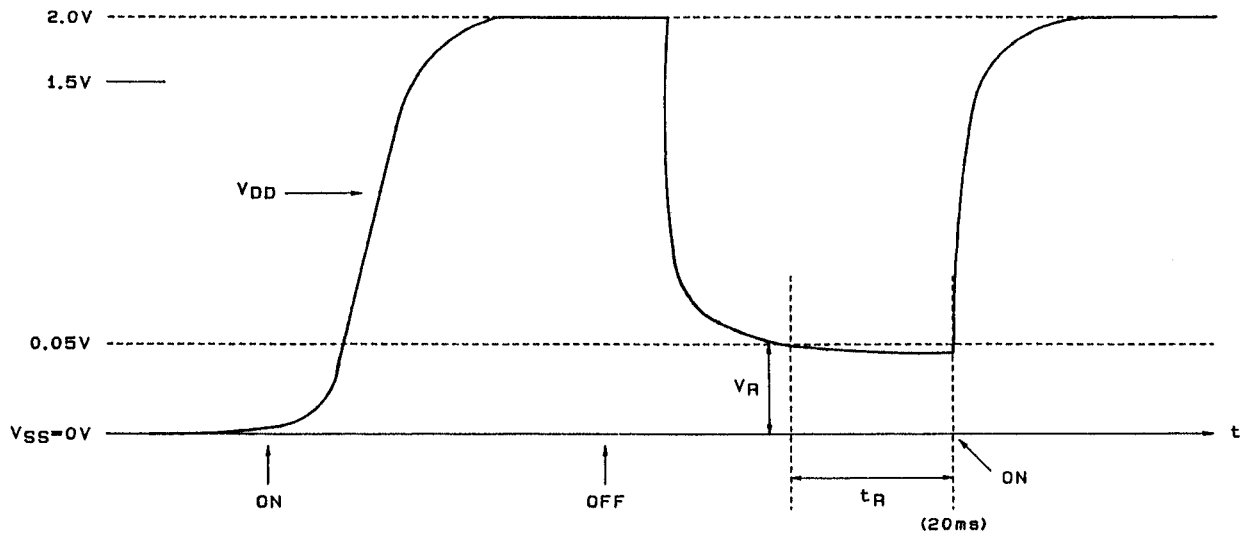




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No.	Controller/Data	Description	Related Data						
(8)	Dead zone control data: DZ	<ul style="list-style-type: none"> <li>This data controls the phase comparator dead zone. (<math>DZA &lt; DZB</math>)</li> </ul> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>DZ</th> <th>Mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>DZA</td> </tr> <tr> <td>1</td> <td>DZB</td> </tr> </tbody> </table>	DZ	Mode	0	DZA	1	DZB	
DZ	Mode								
0	DZA								
1	DZB								
(9)	IC test data: T0, T1, T2	<ul style="list-style-type: none"> <li>This is the IC test mode switching data. The user does not need to be concerned about this data.</li> <li>Assume that <math>T0 = T1 = T2 = 0</math>.</li> <li>Normally, the test pins must be either at <math>V_{SS}</math> or left open.</li> </ul>							

### Power-on Reset supply voltage

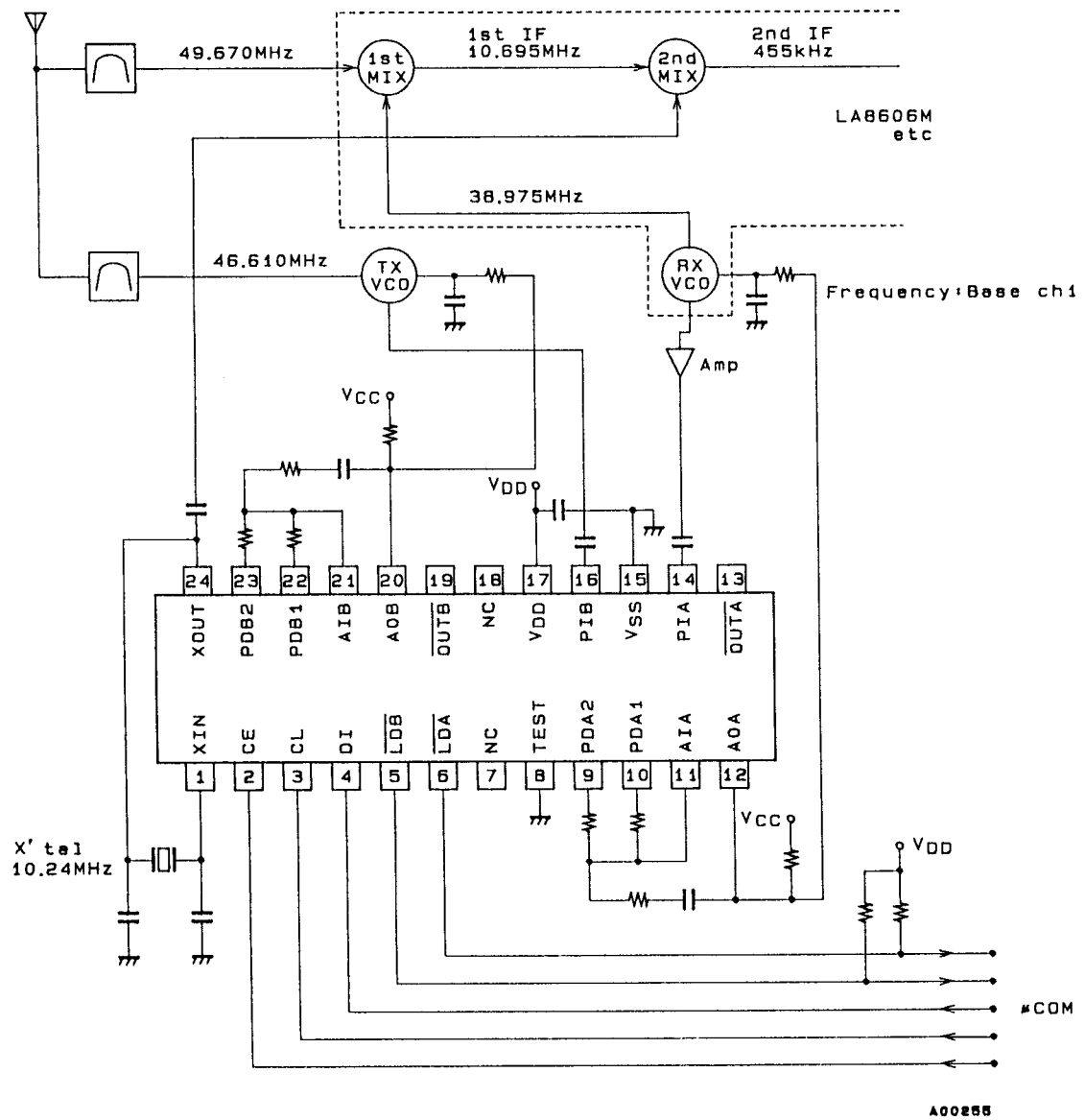


A03480

- Power-on reset is performed when the supply voltage  $V_{DD}$  exceeds 2.0 V by power application after the  $V_{DD}$  has once fallen under 0.05 V and kept the level for at least 20ms.
- Latch data is retained when the  $V_{DD}$  is 1.5 V, where power-on reset is not performed.

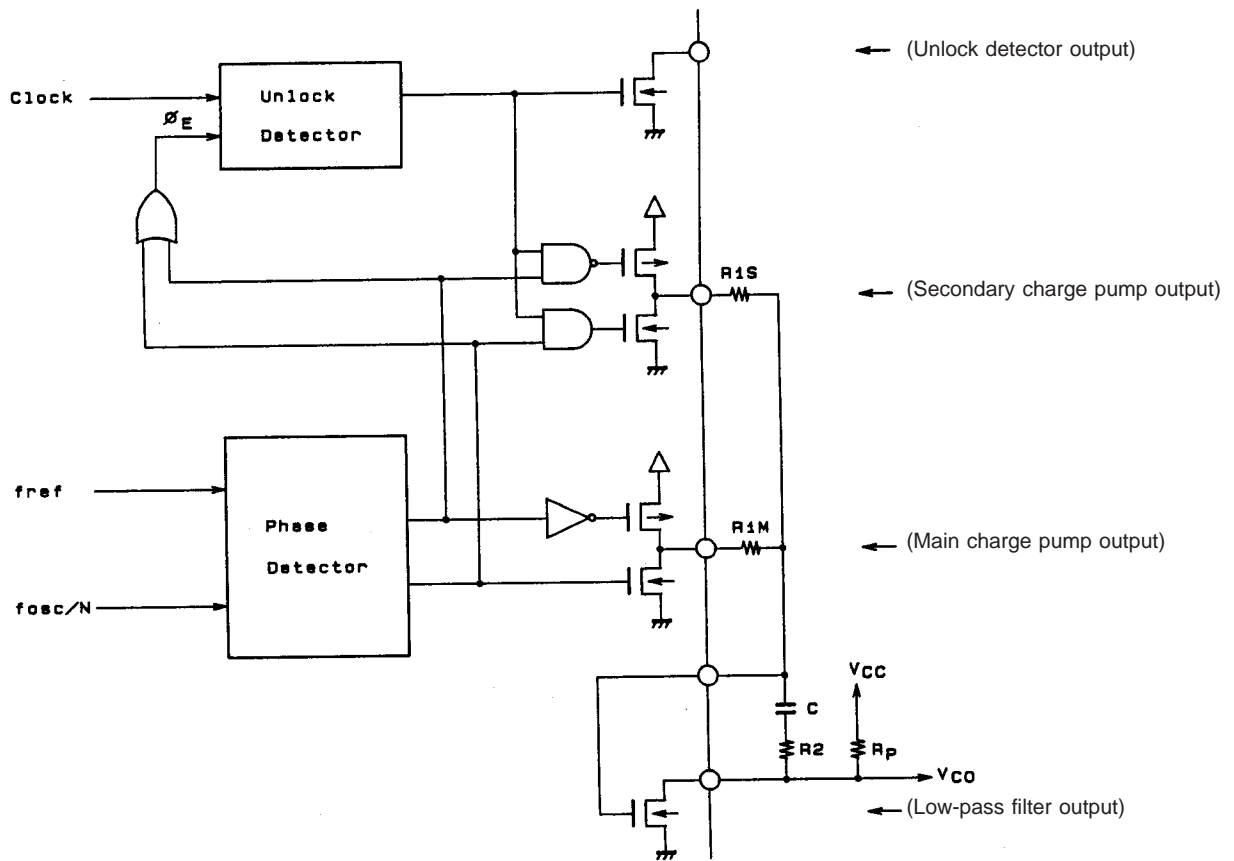
# LC7152, 7152M, 7152NM, 7152KM

## Sample Application Circuit (FCC: 10 ch 46/49 MHz cordless telephone)





Dual Charge Pump Descriptions



A00256

If an unlock state is detected at channel switch, the sub-charge pump operates, R1M/R1S becomes R1, low-pass filter's time constant is reduced, and the lockup accelerates.

When the circuit is locked, side-band characteristics and modulation characteristics are improved by making the sub-charge pump off, i.e., floating, R1M to be R1, and increasing low-pass filter's time constant.

Device Comparison

Device	Operating frequency			Power-on reset circuit	Package
	FA/FB = 0	FA/FB = 1			
	1.5 to 23 MHz	20 to 55 MHz	55 to 80 MHz		
LC7152	Yes	Yes	No	No	DIP24S
LC7152M	Yes	Yes	No	No	MFP24S
LC7152NM	Yes	Yes	No	Yes	MFP24S
LC7152KM	Yes	Yes	Yes ( $V_{DD} = 2.7$ to $3.3$ V)	No	MFP24S

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