APExx24 Series

DATA SHEET

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1.0 General Description

The **APExx24** series are very low cost voice and melody synthesizer with 4-bits CPU. They have various features including 4-bits ALU, ROM, RAM, I/O ports, timers, clock generator, voice and melody synthesizer, and PWM (Direct drive) or D/A current outputs, etc. The audio synthesizer contains one voice-channel and two melody-channels. Furthermore, they consist of 27 instructions in these devices. With CMOS technology and halt function can minimize power dissipation. Their architectures are similar to RISC, with two stages of instruction pipeline. They allow all instructions to be executed in a single cycle, except for program branches and data table read instructions (which need two instruction cycles).

2.0 Features

(1) Single power supply can operate from 2.4V to 5.5V at 4MHz or 8MHz.

(2) Program ROM: 64k x 10 bits

(3) 1 set of 16-bits DPR can access up to 64k x 10 bits melody data memory space, and 1 set of 20-bits VPR can access up to 1024k x 10 bits voice data memory space.

Product	Voice Duration (sec)	Voice Pointer (VPR)	ROM Size (10-bits)
APE12724	127	19-bits	384k
APE17024	170	19-bits	512k
APE25524	255	20-bits	768k
APE34024	340	20-bits	1024k

(4) Data Registers:

a). 128 x 4-bits data RAM (00-7Fh)

b). Unbanked special function registers (SFR) range: 00h-2Fh

(5) I/O Ports:

a). PRA: 4-bits I/O Port A (10h) can be programmed to input/output individually. (Register control)

b). PRB: 4-bits I/O Port B (13h) can be configured to input/output individually. (Mask option)

c). PRC: 4-bits I/O Port C (14h) can be programmed to input/output individually. (Register control)

d). PRD: 4-bits I/O Port D (15h) can be programmed to input/output individually. (Register control)

e). PRE: 4-bits I/O Port E (17h) can be programmed to input/output individually. (Register control)

f). PRF: 4-bits I/O Port F (18h) can be programmed to input/output individually. (Register control)

(6) On-chip clock generator: Resistive Clock Drive ***(RM)*** or Crystal oscillator ***(HM)***

(7) Timer: 1-set Voice Interrupt (Timer0: a 9-bits auto-reload timer/counter).

(8) Stack: 2-level subroutine nesting.

(9) Built-in 4 Level Volume Control can be programmed.

(10) Built-in 8 Level DAC Current Control can be configured. (Mask option)

(11) Built-in IR Carry Output: Port B[1] can be configured as IR pin by 38k / 56kHz. (Mask option)

(12) External Reset: Port B[3] can be configured as reset pin. (Mask opton)

(13) HALT and Release from HALT function to reduce power consumption

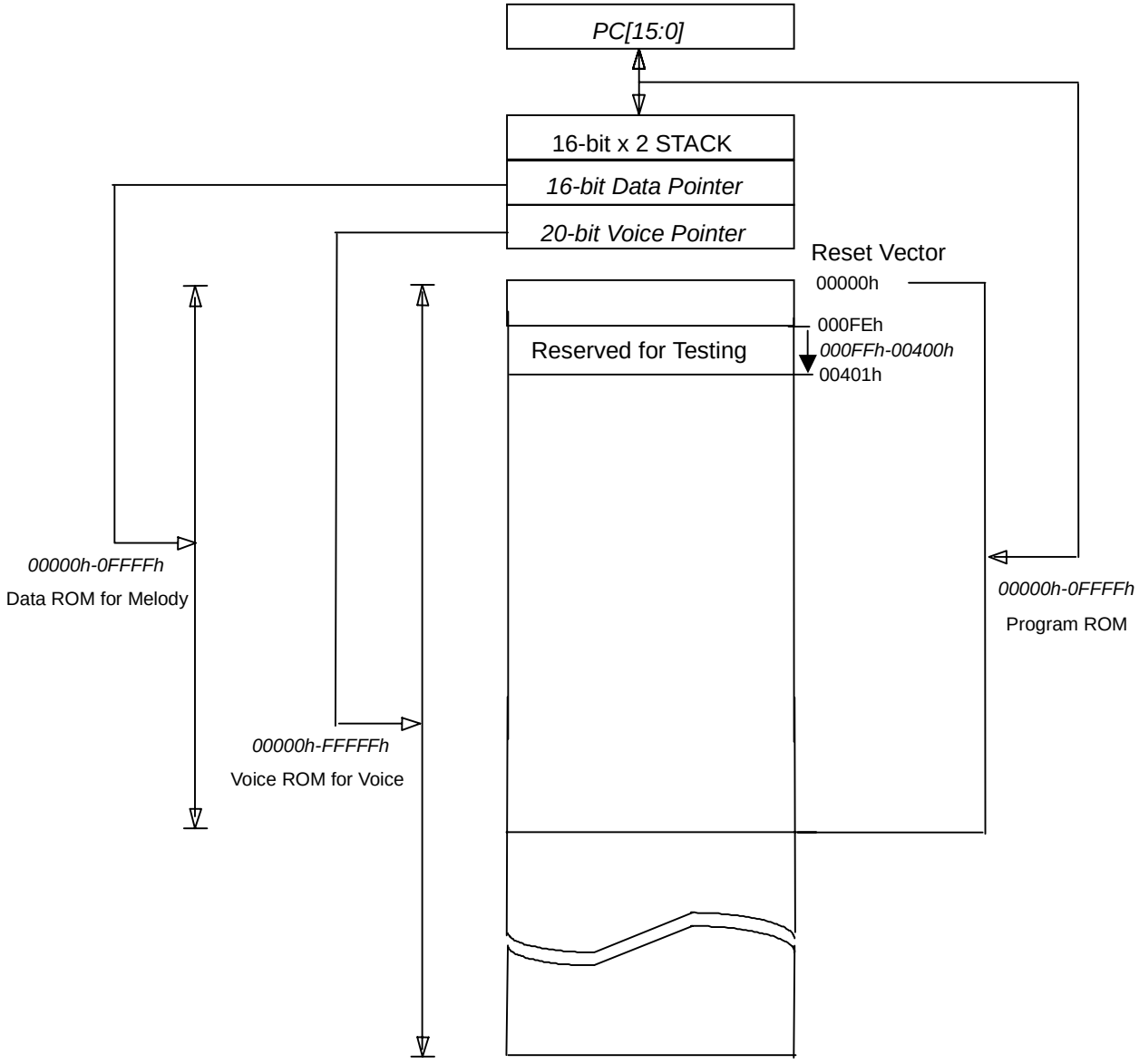
(14) Watch Dog Timer (***WDT***)

(15) Instruction: 1-cycle instruction except for table read and program branches which are 2-cycles

(16) Number of instruction: 27

(17) DAC: 1 channel voice and dual tone melody synthesizer (One 9-bits Cout or 8-bits PWM output).

FIGURE 1 : ROM Map of APExx24 Series



3.0 Pin Description

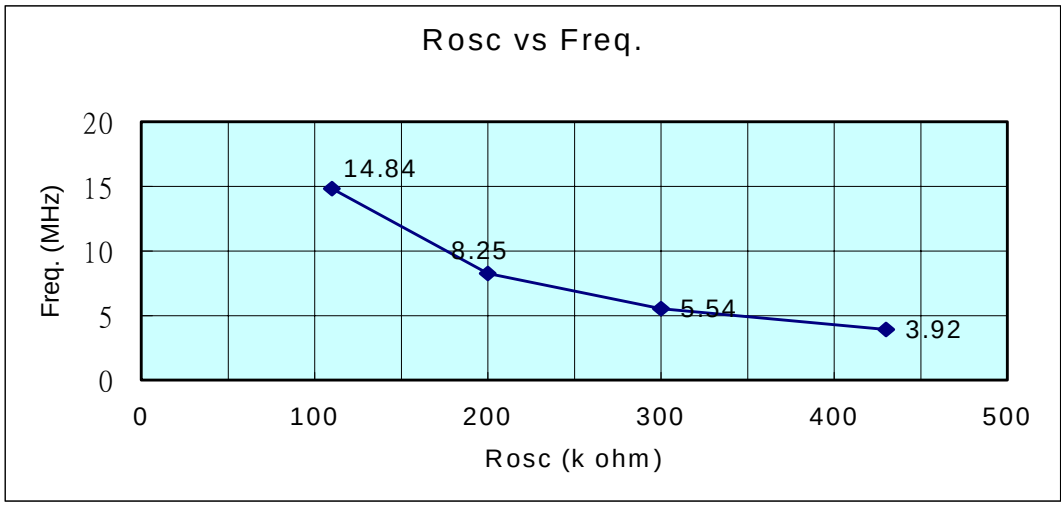
Pad Name	Pin Attr.	Description
PWM2/Cout	O	PWM2 output, or Current Output of Audio.
PWM1	O	PWM1 output.
Vdd1~3	Power	Power supply during operation.
PRA0~3 **PRC0~3** **PRD0~3** **PRE0~3** **PRF0~3**	I/O	I/O port can be programmed to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type.
PRB0 / OSC2	I/O	I/O port can be configured to input/output individually or **HM** OSC pad. Input type with weak pull-low or fix-input-floating capability. Buffer Output type.
PRB1 / IR	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type. *Mask option selected as an IR Carrier Output with 38k / 56kHz*
PRB2	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type.
PRB3 / Reset	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type. *Mask option selected as an external RESET pin with weak pull-low capability.*
OSC1	I	RM/HM mode Oscillator input
GND1~4	Power	Ground Potential

4.0 DC Characteristics

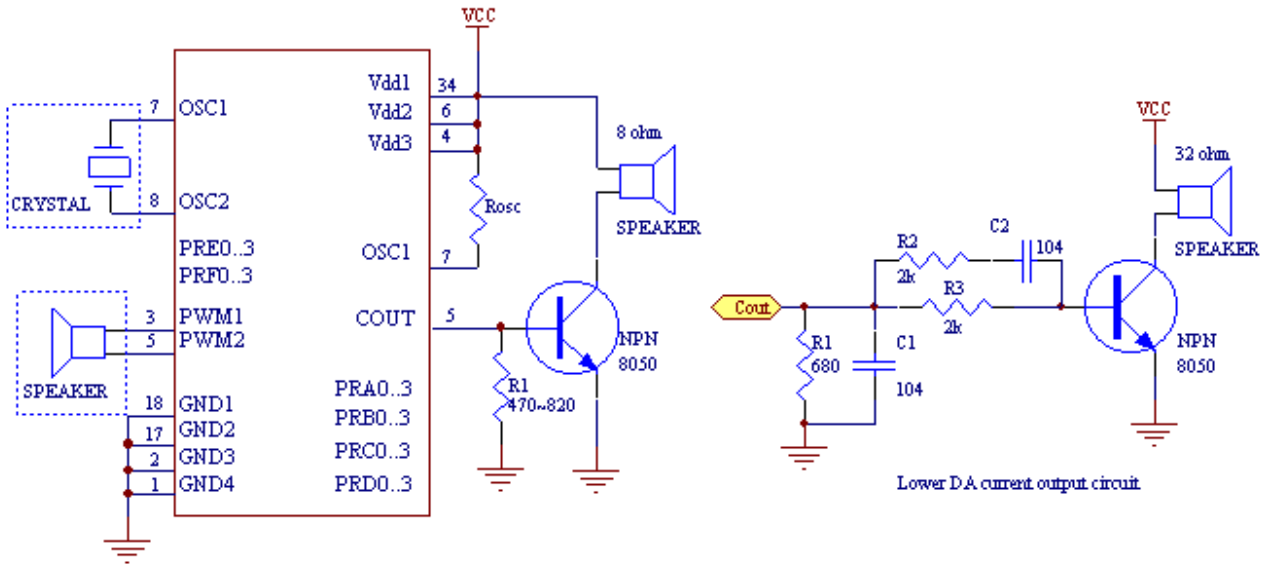
Symbol	Parameter		Vdd	Min.	Typ.	Max.	Unit	Condition
Vdd	Operating voltage			2.4	3	5.5	V	depending on Freq.
Isb	Supply current	Standby	3			1	uA	4MHz, RM, in HALT Mode
			4.5			1		
Iop		Operating	3		2		mA	4MHz, RM, IO Floating
			4.5		7			
Iih	Input current (Internal pull low)		3		3		uA	Input ports with weak pull-low
			4.5		10			
Ioh	Output-high current		3		-3		mA	4MHz, RM (IO ports)
			4.5		-10			
Iol	Output-low current		3		7			
			4.5		19			
Cout	DAC output current (8-level option)		3	0.8 ~ 4.8			mA	4MHz, RM (Full scale)
			4.5	0.9 ~ 6.5				
dF/F	Frequency stability			-5		5	%	Fosc(3v- 2.4v) / Fosc (3v)
dF/F	Fosc lot variation			-10		10	%	Vdd=3V, Rosc=180k, 4MHz

FIGURE 2 : Frequency vs. Rosc (at 3V)

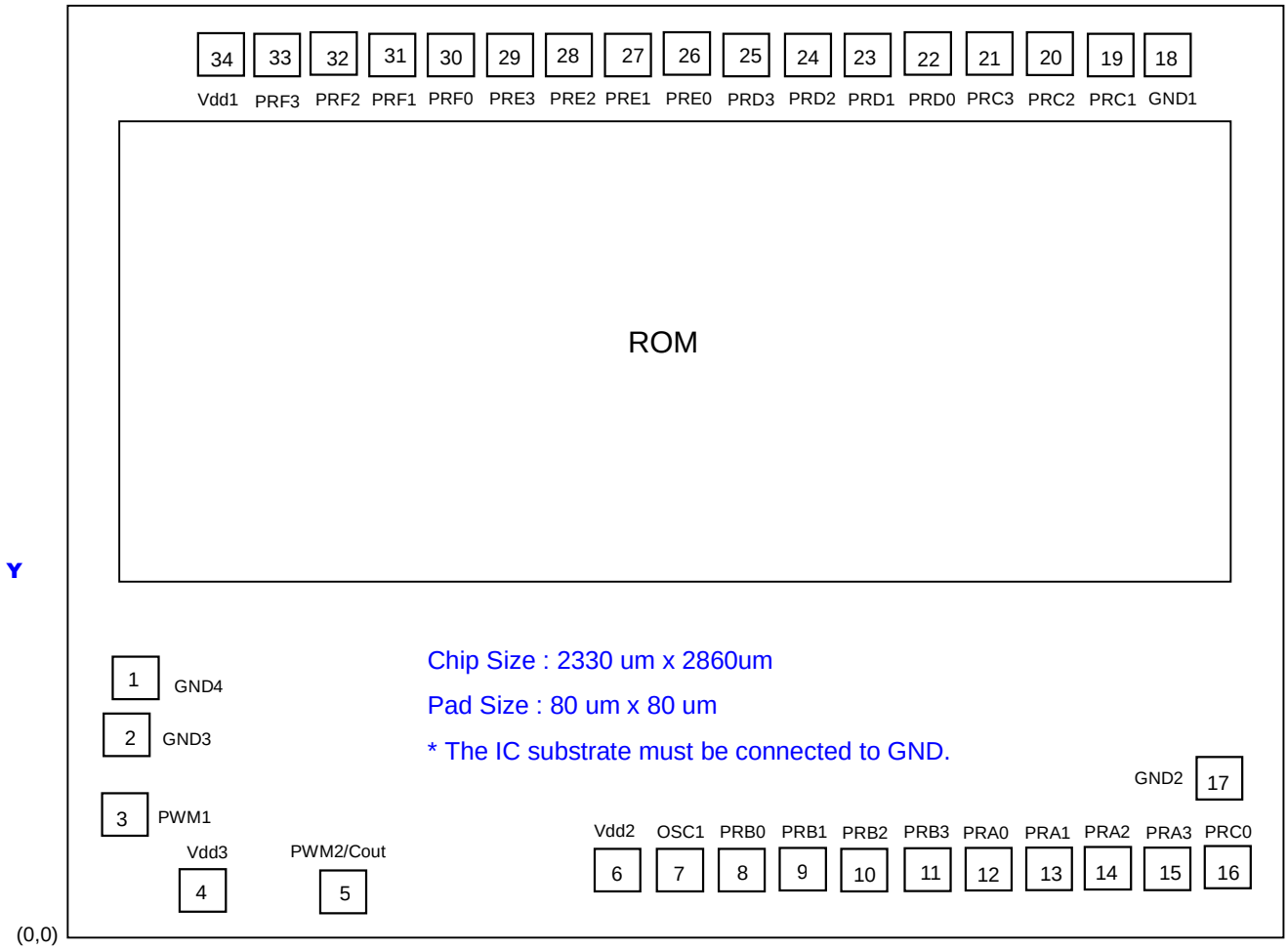
Resistor (Rosc ohms)	110k	200k	300k	430k
Frequency (MHz)	14.84	8.25	5.54	3.92



5.0 Application Circuit

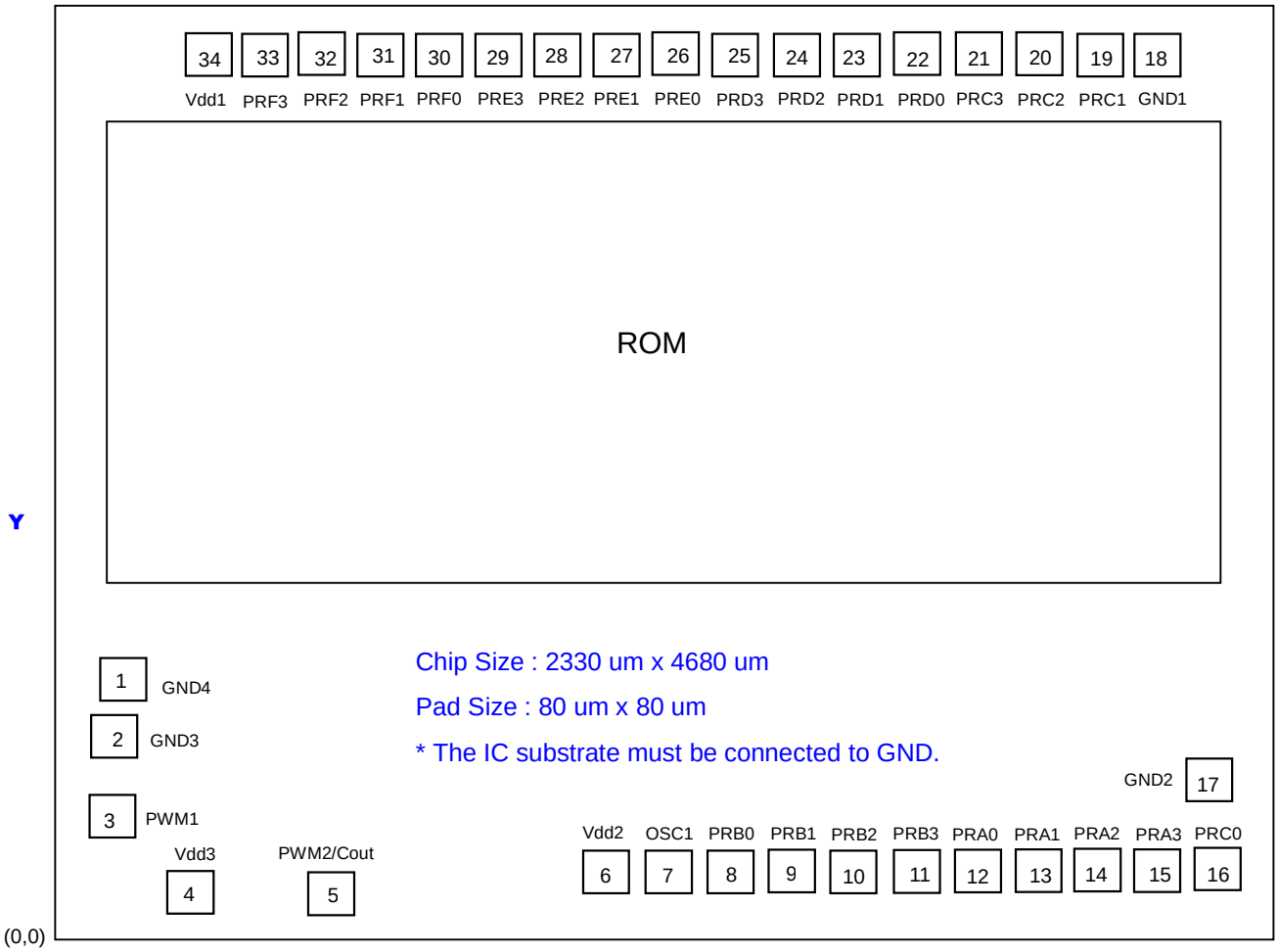


6.0 Bonding Diagram of APE12724 / APE17024



Pad #	Pad Name	X	Y	Pad #	Pad Name	X	Y
1	GND4	75	404	**18**	GND1	2033	2688
2	GND3	57	293	**19**	PRC1	1920	2688
3	PWM1	56	145	**20**	PRC2	1807	2688
4	Vdd3	183	60	**21**	PRC3	1694	2688
5	PWM2/Cout	467	58	**22**	PRD0	1581	2688
6	Vdd2	988	86	**23**	PRD1	1468	2688
7	OSC1	1106	86	**24**	PRD2	1355	2688
8	PRB0/OSC2	1224	86	**25**	PRD3	1242	2688
9	PRB1/IR	1342	86	**26**	PRE0	1129	2688
10	PRB2	1460	86	**27**	PRE1	1016	2688
11	PRB3/Reset	1578	86	**28**	PRE2	903	2688
12	PRA0	1696	86	**29**	PRE3	790	2688
13	PRA1	1814	86	**30**	PRF0	676	2688
14	PRA2	1932	86	**31**	PRF1	563	2688
15	PRA3	2050	86	**32**	PRF2	450	2688
16	PRC0	2168	86	**33**	PRF3	337	2688
17	GND2	2160	230	**34**	Vdd1	223	2688

6.2 Bonding Diagram of APE25524 / APE34024



Pad #	Pad Name	X	Y	Pad #	Pad Name	X	Y
1	GND4	75	404	**18**	GND1	2033	4508
2	GND3	58	293	**19**	PRC1	1920	4508
3	PWM1	56	145	**20**	PRC2	1807	4508
4	Vdd3	183	60	**21**	PRC3	1694	4508
5	PWM2/Cout	467	58	**22**	PRD0	1581	4508
6	Vdd2	988	86	**23**	PRD1	1468	4508
7	OSC1	1106	86	**24**	PRD2	1355	4508
8	PRB0/OSC2	1224	86	**25**	PRD3	1242	4508
9	PRB1/IR	1342	86	**26**	PRE0	1129	4508
10	PRB2	1460	86	**27**	PRE1	1016	4508
11	PRB3/Reset	1578	86	**28**	PRE2	903	4508
12	PRA0	1696	86	**29**	PRE3	790	4508
13	PRA1	1814	86	**30**	PRF0	676	4508
14	PRA2	1932	86	**31**	PRF1	563	4508
15	PRA3	2050	86	**32**	PRF2	450	4508
16	PRC0	2168	86	**33**	PRF3	337	4508
17	GND2	2160	230	**34**	Vdd1	223	4508