



APC5890 DE-COMPRESSION VOICE IC

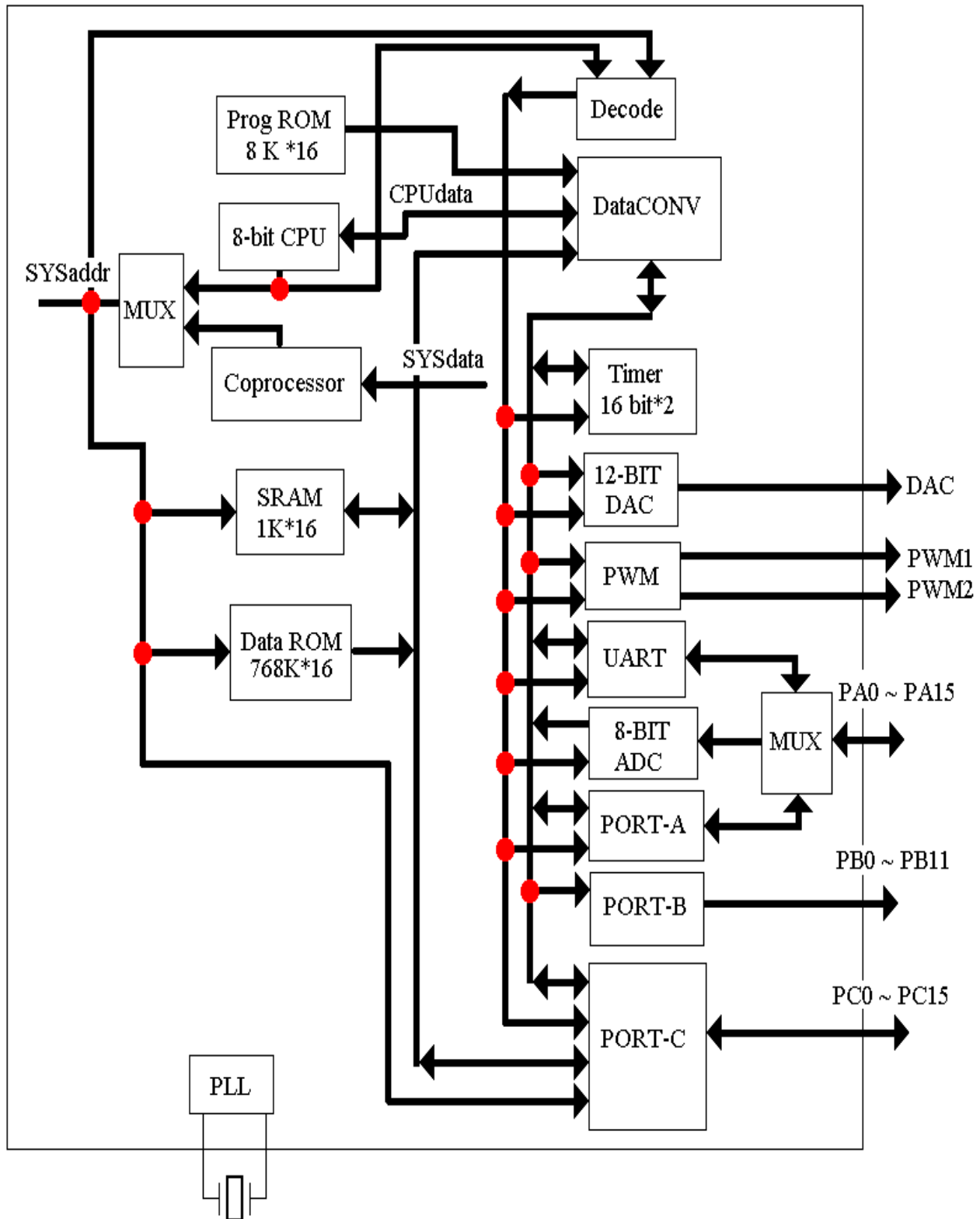
1. **CHIP FEATURES.**

- DUAL OPERATION FREQUENCIES:
 - 32.768 KHz & 0.5 SECOND TIMER INTERRUPT.
 - BUILT-IN PLL CIRCUIT TO GENERATE SYSTEM CLOCK MAX 20MHZ.
- BUILT-IN 2KBYTES(1K*16) RAM.
- ADDRESS UP TO 8MBYTE(4M*16) RAM OR ROM OR “ROM AND RAM”
BUILT-IN 16KBYTE(8K*16) PROGRAM ROM AND **1.5M BYTE(768K*16) DATA ROM**
- **BUILT-IN DECOMPRESSION ENGINE**
THE VOICE AND MUSIC DE-COMPRESSON RATE IS AS THE FOLLOWS:
 - 2.25KBIT/SEC - 2.7KBIT/SEC - 3.15KBIT/SEC - 3.6KBIT/SEC - 4.8KBIT/SEC - 6.0KBIT/SEC
 - 7.2KBIT/SEC - 8.4KBIT/SEC - 9.6KBIT/SEC - 10.8KBIT/SEC - 12.0 KBIT/SEC - 13.2 KBIT/SEC
 - 14.4 KBIT/SEC

DE-COMPRESSON RATE	VOICE DURATION	DE-COMPRESSON RATE	VOICE DURATION
2.25 K BIT/SEC	91 min.	8.4 K BIT/SEC	24.38 min.
2.7 K BIT/SEC	75.85 min.	9.6 K BIT/SEC	21.33 min.
3.15 K BIT/SEC	65.01 min.	10.8 K BIT/SEC	18.96 min.
3.6 K BIT/SEC	56.89 min.	12.0 K BIT/SEC	17.07 min.
4.8 K BIT/SEC	42.67 min.	13.2 K BIT/SEC	15.52 min.
6.0 K BIT/SEC	34.13 min.	14.4 K BIT/SEC	14.22 min.
7.2 K BIT/SEC	28.44 min.		

- BUILT-IN 12 BITS D/A, 8 BITS ADC.
- I/O PORTS
 - 16 I/O PINS FOR PORT A.
 - 12 OUTPUT FOR PORT B.
 - 16 I/O PINS FOR PORT C.
- Two 16BITS TIMERS : TIMER_A AND TIMER_B.
- WATCHDOG TIMER.
- SLEEP MODE : CRYSTAL & SYSTEM

2. BLOCK DIAGRAM.



2. PIN DESCRIPTION :

PIN NAME	I/O	DESCRIPTION
RESET	I	RESET INPUT. ACTIVE LOW.
PWM1,PWM2	O	PWM OUTPUT.
DAC	O	OUTPUT FROM D/A CONVERTER.
XOSC1	I	CRYSTAL OSCILLATOR INPUT PIN.
XOSC2	O	CRYSTAL OSCILLATOR OUTPUT PIN.
CAP	I	CAPACITOR FOR PLL CIRCUIT.
PA0-PA7	I/O	I/O PORT_A PIN 0 TO 7. ALSO AS EXTERNAL INTERRUPT SOURCE (FALL EDGE TRIGGER).
PA8-PA12	IO	I/O PORT_A PIN 8 TO 12.
PA13/ADC	I/O	I/O PORT_A PIN 13 OR ANALOG SIGNAL INPUT.
PA14	I/O	I/O PORT_A PIN 14
PA15	I/O	I/O PORT_A PIN 15
PB0-PB5/BANK3-BANK8	O	PORT_B OR EXTERNAL MEMORY BANK SELECT
PB6/EMEMRD	O	PORT_B PIN 6 OR EXTERNAL RAM READ (ACTIVE LOW).
PB7/EXTRAM	O	PORT_B PIN 7 OR EXTERNAL RAM SELECT PIN (ACTIVE LOW)
PB8/EMEMWRL	O	PORT_B PIN 8 OR EXTERNAL RAM LOW BYTE WRITE (ACTIVE LOW).
PB9/EXTIRQ	I/O	PORT_B PIN 9 OR EXTERNAL IRQ INPUT PIN (RISE EDGE TRIGGER).
PB10/EMEMWRH	O	PORT_B PIN 10 OR EXTERNAL RAM HIGH BYTE WRITE (ACTIVE LOW)
PB11/EXTROMCS	I/O	PORT_B PIN 11 ROM SELECT OR EXTERNAL ROM CHIP SELECT (ACTIVE LOW)
PC/EMEMAD	I/O	PC:16 BITS PROGRAMMABLE IO PORTS. EMEMAD: EXTERNAL MEMORY ADDRESS/DATA. IF IT IS ADDRESS THEN EMEMA0~EMEMA12 IS A1~A13. EMEMA13~EMEMA15 IS BANK0~BANK2.
ALE	O	EXTERNAL MEMORY ADDRESS LATCH ENABLE.
VDD1-VDD4	I	DIGITAL POWER INPUT.
GND1-GND4	I	DIGITAL GROUND.
PLLVDD,PLLGND	I	POWER AND GROUND FOR PLL CIRCUIT.
DACVDD,DACGND	I	POWER AND GROUND FOR DAC CIRCUIT.

4. ADDRESS ARRANGEMENT :

1) RAM :

0000-07FF : INTERNAL RAM, 1Kx16.

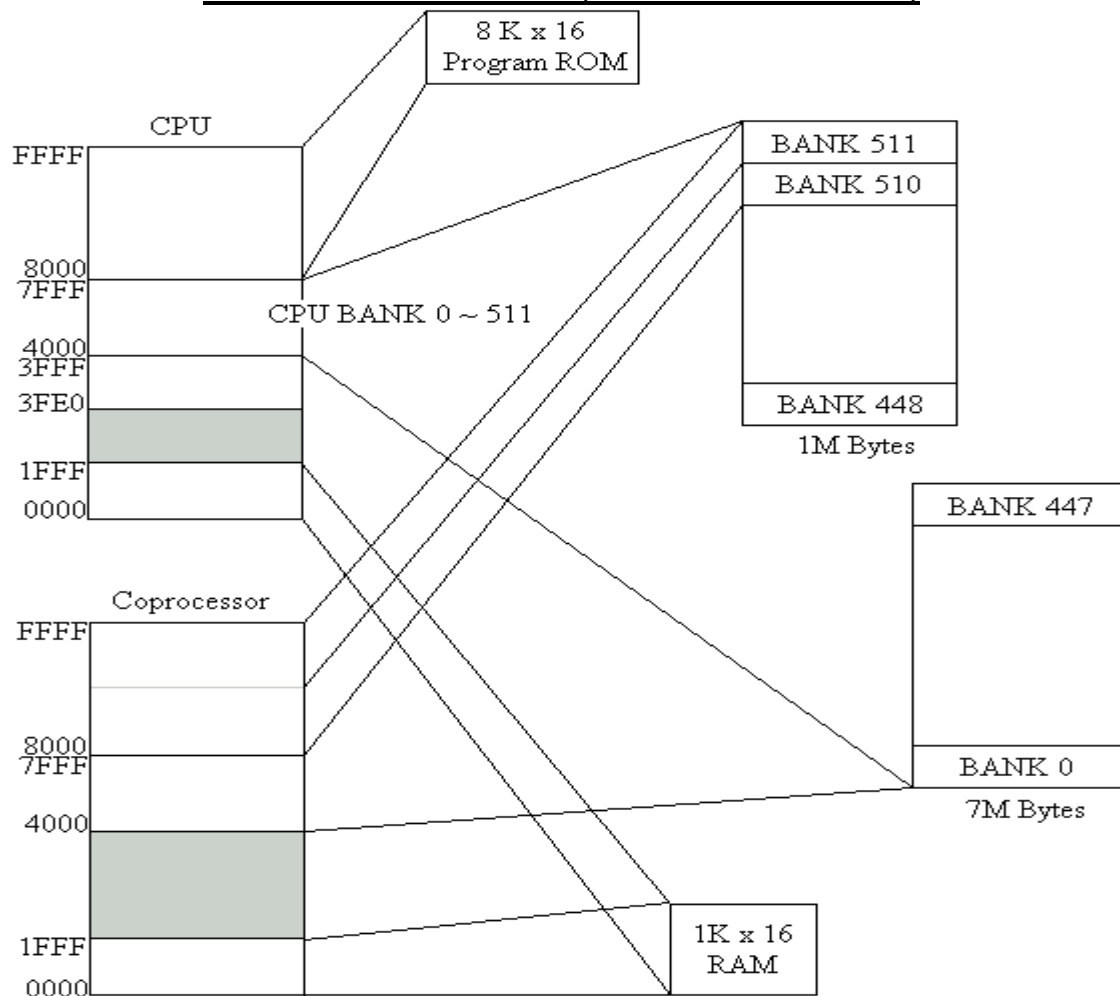
0000-1FFF : EXTERNAL NON-BANK RAM(EXTRAMCS=1), 4Kx16.

2) ROM :

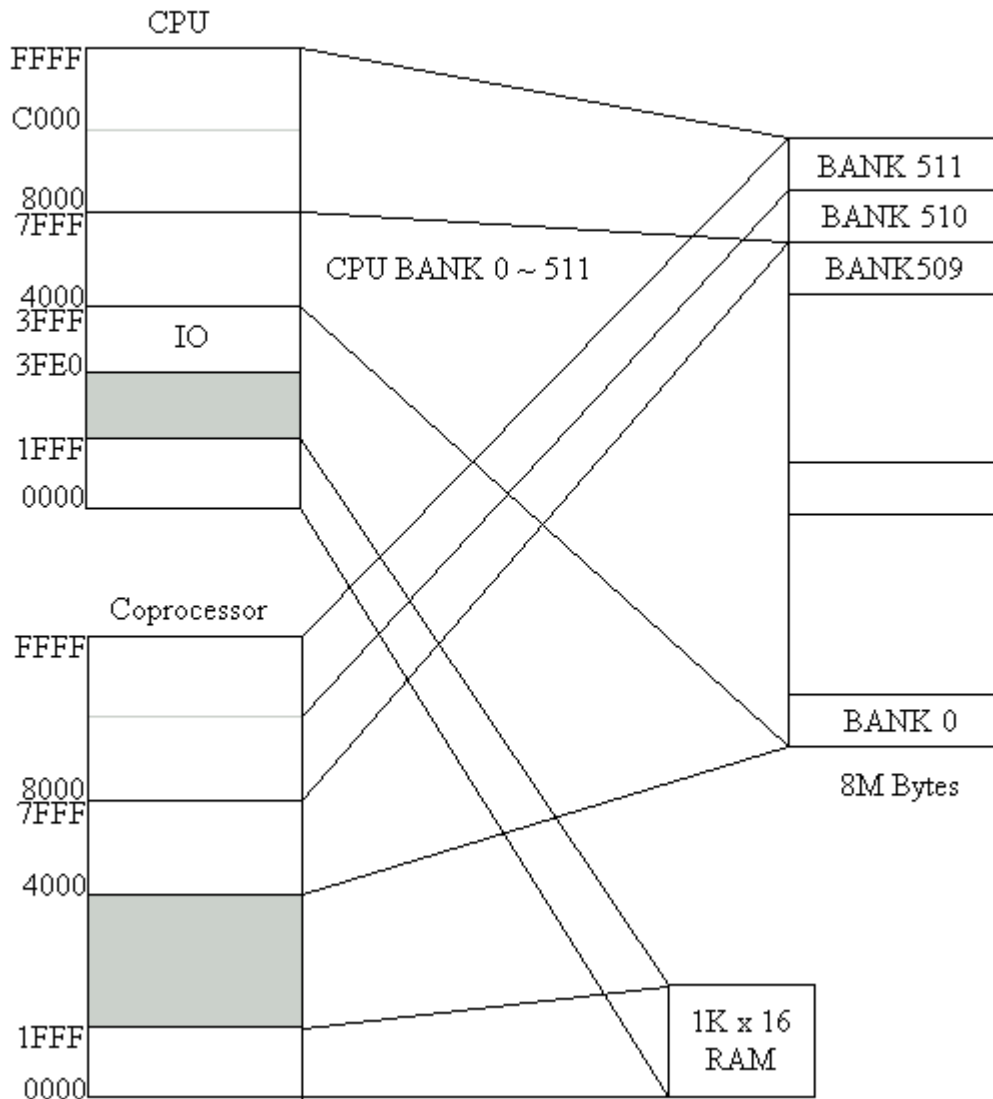
- 4000-7FFF : DATA AREA FOR BANK SELECT, 8Kx16 EACH,
MAX. TO 64MBIT BANK ROM OR BANK RAM.
- C000-FFFF : FOR SYSTEM PROGRAM OR USER PROGRAM, 8Kx16.
- FFF0, FFF1 : COPROCESSOR OK IRQ VECTOR.
- FFF2, FFF3 : ADC IRQ VECTOR.
- FFF4, FFF5 : NOT USE
- FFF6, FFF7 : TIMER IRQ(FIX_TIMER IRQ OR TIMER_A IRQ) VECTOR.
- FFF8, FFF9 : PA[7:0] IRQ VECTOR.
- FFFA, FFFB : TIMER_B NMI VECTOR.
- FFFC, FFFD : RES VECTOR.
- FFFE, FFFF : EXT IRQ VECTOR.

PRIORITY IS ARRANGED AS RES, NMI, OK_INT, ADC_INT, TIMER_INT, PA_INT,
AND EXT_IRQ.

MEMORY MAPPING (INTERNAL ROM)



MEMORY MAPPING (EXTERNAL ROM)



3) Others :

- 3FE0 System Flag. Read only. :

3FE0	0	1
BIT - 0	NO USE	NO USE
BIT - 1	NO USE	NO USE
BIT - 2	ADC NO ERROR.	ADC ERROR.
BIT - 3	TIMER_A INT FLAG	
	TIMER IRQ	TIMER_A INT FLAG
	1	1 TIMER_A INT
	1	0 FIX_TIMER INT
	1	X NO TIMER INT
BIT - 4		NO USE
BIT - 5		OK FLAG(COPROCESSOR OK)

BIT - 6		COPROCESSOR CARRY.
BIT - 7		TONE0 OR TONE1 ENABLE.

● **3FE0 System control 0. Write only. :**

3FE0	0	1
BIT - 0	MUST 0 = PA14,PA15 ARE IO PINS(DEFAULT).	
BIT - 1	PB9 IS IO PIN(DEFAULT).	PB9 IS EXTIRQ PIN.
BIT - 2	PB7 IS IO PIN(DEFAULT).	PB7 IS EXTRAMCS.
BIT - 3	ADC DISABLE, PA13 IS IO PIN(DEFAULT).	ADC ENABLE, PA13 IS ADC PIN.
BIT - 4	NO USE(MUST 0)	
BIT - 5	NO USE(MUST 0)	
BIT - 6	PWM DISABLE(DEFAULT).	PWM ENABLE.
BIT - 7	DAC DISABLE(DEFAULT).	DAC ENABLE.

● **3FE1 System Control 1. Write only.**

3FE1	0	1
BIT - 0	TIMER A CLOCK SELECT 32.768K HZ.(DEFAULT)	TIMER A CLOCK SELECT SYSTEM CLOCK.
BIT - 1	NO USE(MUST 0)	
BIT - 2	TIMER A DISABLE.(DEFAULT)	TIMER A ENABLE.
BIT - 3	TIMER B DISABLE.(DEFAULT)	TIMER B ENABLE.
BIT - 4	TIMER A INTERRUPT DISABLE.(DEFAULT)	TIMER A INTERRUPT ENABLE.
BIT - 5	TIMER B NMI DISABLE.(DEFAULT)	TIMER B NMI ENABLE.
BIT - 6	SYSTEM CLOCK = PLL CLOCK(DEFAULT).	SYSTEM CLOCK = 32768Hz.
BIT - 7	WATCHDOG TIMER DISABLE.	WATCHDOG TIMER ENABLE.(DEFAULT)

● **3FE2 System control 2. Write only.**

3FE2	0	1
BIT - 0	=1 → ENTRY STAND-BY MODE. IN STAND-BY MODE, HOLD CPU. THE NMI AND IRQ WILL WAKE UP THE CPU.	

BIT - 1	=1 → ENTRY SLEEP MODE. IN SLEEP MODE , THE BOTH OF MAIN SYSTEM CLOCK AND 32768Hz WILL BESTOPPED, SO ALL FUNCTION ARE STOPPED AND ONLY EXTERNAL INTERRUPT CAN WAKE UP THIS CHIP
BIT – 3 ~ 2	00 : SYSTEM CLOCK = FxOSC/2 X 256(4.19MHz)(DEFAULT). 01 : SYSTEM CLOCK = FxOSC/2 X 512(8.38MHz) 10 : SYSTEM CLOCK = FxOSC/2 X 768(12.58MHz)
BIT- 7 ~ 4	0xxx : FIX-TIMER DISABLE. 1000 : FIX-TIMER = 64Hz. 1001 : FIX-TIMER = 32Hz. 1010 : FIX-TIMER = 16Hz. 1011 : FIX-TIMER = 8Hz. 1100 : FIX-TIMER = 4Hz. 1101 : FIX-TIMER = 2Hz. 1110 : FIX-TIMER = 1Hz. 1111 : FIX-TIMER = 0.5Hz

- **3FE3** : PORT_A[7..0] INTERRUPT ENABLE REGISTER. WRITE ONLY.
AN '0' IN THIS REGISTER WILL SET THE INTERRUPT FUNCTION OF THE CORRESPONDING PIN OF PORT_A TO BE ENABLED. THE DEFAULT VALUE FOR EACH BIT IS '1'.
- **3FE4** : PORT_A[7..0] DATA REGISTER. READ AND WRITE.
- **3FE5** : PORT_A[7..0] DIRECTION REGISTER. WRITE ONLY.
AN '1' IN THIS REGISTER WILL SET THE CORRESPONDING PIN OF PORT_A TO BE OUTPUT.
THE DEFAULT VALUE FOR EACH BIT IS ZERO.
- **3FE6**: PORT_B[7..0] DATA REGISTER. WRITE ONLY.
- **3FE7** : CLEAR WATCHDOG TIMER. WRITE ONLY.
THE WATCHDOG TIMER RESET WILL HAPPEN IF THE PROGRAMMER DO NOT CLEAR THE WATCHDOG TIMER BEFORE WATCHDOG TIMER TIME-OUT.
- **3FE8** VOICE CHANNEL 0 LOW BYTE. WRITE ONLY.
BIT 2-0 : RESERVED.
BIT 3: NO USE (MUST 0)
BIT 7-4: = VOICE CHANNEL 0 LOW NIBBLE BYTE.
- **3FE9** : VOICE CHANNEL 0 HIGH BYTE. WRITE ONLY.
THE RESOLUTION OF VOICE CHANNEL 0 IS 12 BITS(\$3FE9,\$3FE8 BIT7_4).

- **3FEA** : BANK REGISTER FOR COPROCESSOR. WRITE ONLY.
- **3FEB** : BANK REGISTER MSB BIT FOR COPROCESSOR. WRITE ONLY.
BANK REGISTER IS 9 BITS REGISTER(\$3FEB BIT0, \$3FEA BIT7-0). THE MEMORY RANGE OF BANK IS FROM \$4000 TO \$7FFF.
BIT 7-1 : RESERVED.
- **3FEC,3FED** : TIMER A DATA OR TONE0 GENERATOR. READ AND WRITE. AFTER TIMER_A BE ENABLED, THE TIMER WILL START TO COUNT DOWN. WHEN TIMER COUNTS TO ZERO, THE TIMER WILL COUNT FROM THE INITIAL VALUE AND TIMER_A IRQ WILL BE HAPPEN.
THE TIME ELAPSE = $((\$3FED, \$3FEC)+1) / (\text{TIMER A INPUT CLOCK})$.
- **3FEE** : TIMER B LOW BYTE DATA. READ AND WRITE.
- **3FEF** : TIMER B HIGH BYTE DATA. READ AND WRITE.
AFTER TIMER_B BE ENABLED, THE TIMER WILL START TO COUNT DOWN. WHEN TIMER COUNTS TO ZERO, THE TIMER WILL COUNT FROM THE INITIAL VALUE AND TIMER_B NMI WILL BE HAPPEN.
THE TIME ELAPSE = $((\$3FEF, \$3FEE)+1) / (\text{TIMER B INPUT CLOCK})$.
- **3FF0** : PORT_A[15..8] DIRECTION REGISTER. WRITE ONLY.
AN '1' IN THIS REGISTER WILL SET THE CORRESPONDING PIN OF PORT_A TO BE OUTPUT.
THE DEFAULT VALUE FOR EACH BIT IS ZERO.
- **3FF1** : PORT_A[15..8] DATA REGISTER. READ AND WRITE.
- **3FF2** : PORT_B[11..8] DATA REGISTER. WRITE ONLY.
BIT 3-0: PORT_B PIN 11 TO PIN 8.
BIT 7-4 : RESERVED.
- **3FF4** : BANK REGISTER FOR CPU. WRITE ONLY.
- **3FF5** : BANK REGISTER MSB BIT FOR CPU. WRITE ONLY.
BANK REGISTER IS 9 BITS REGISTER(\$3FF5 BIT0, \$3FF4 BIT7-0).
THE MEMORY RANGE OF BANK IS FROM \$4000 TO \$7FFF.
BIT 1: RESERVED.
BIT 2: = 1 VOICE0 BUFFER BE TRANSFERRED TO DAC PORT DIRECTLY.(DEFAULT)
= 0 VOICE0 BUFFER WILL BE TRANSFERRED TO DAC PORT WHEN TIMER_B NMI HAPPEN.
BIT 7-3 : RESERVED.

- **3FF6** : PORT_C[7..0] DATA REGISTER. READ AND WRITE.
- **3FF7** : PORT_C[15..8] DATA REGISTER. READ AND WRITE.
- **3FF8**: PORT_C[7..0] DIRECTION REGISTER. WRITE ONLY.
AN '1' IN THIS REGISTER WILL SET THE CORRESPONDING PIN OF PORT_C TO BE OUTPUT.
THE DEFAULT VALUE FOR EACH BIT IS ZERO.
- **3FF9**: PORT_C[15..8] DIRECTION REGISTER. WRITE ONLY.
AN '1' IN THIS REGISTER WILL SET THE CORRESPONDING PIN OF PORT_C TO BE OUTPUT.
THE DEFAULT VALUE FOR EACH BIT IS ZERO.
- **3FFA** :ADC REGISTER. READ ONLY.
WHEN THE TIMER B NMI OCCURS, THE A/D CONVERSION PROCESS STARTS AND THE S/H CIRCUIT STOP SAMPLING AND BEGIN HOLDING IT UNTIL THE ADC PROCESS IS FINISHED.
THE ADC INT WILL GENERATE WHEN ADC PROCESS IS FINISHED.
- **3FFB,3FFC** :.....NO USE
- **3FFD** :NO USE
- **3FFE**: VOICE CHANNEL 1 LOW BYTE AND SYSTEM CONTROL 3. WRITE ONLY.

3FFE	0	1
BIT - 0	SEPARATE MODE FOR DAC OUTPUT(DEFAULT)	MIX MODE FOR DAC OUTPUT.
BIT - 1	SEPARATE MODE FOR PWM OUTPUT(DEFAULT)	MIX MODE FOR PWM OUTPUT
BIT - 2	NO USE(MUST 0)	
BIT - 3	NO USE (MUST 0)	
BIT - 7 ~ 4	VOICE CHANNEL 1 LOW NIBBLE BYTE.	

- **3FFF** : VOICE CHANNEL 1 HIGH BYTE. WRITE ONLY.
THE RESOLUTION OF VOICE CHANNEL 1 IS 12 BITS(\$3FFF,\$3FFE BIT7_4). THIS REGISTER WILL BE TRANSFERRED TO PWM PORT WHILE TIMER_B NMI HAPPEN IN SEPARATE MODE.

