

一、概述：

SP3777A-N 是一颗高集成度的调频立体声接收芯片。集成了低噪声放大、模拟数字转换模块、数字解调模块、音频功率放大和电源管理等模块。该电路采用 CMOS 工艺设计。

二、特点：

I²C 总线控制

接收频率范围：70-108MHz

内置 LDO

高品质立体声效果

可编程的音量控制系统

具备软静音功能

可选配外部晶体或外部的时钟输入，包括：32.768KHz，13MHz

支持两种预加重时间常数：50/75uS

超低待机电流：10uA

封装形式 QFN4*4 24pin

三、应用范围

个人导航装置

无线麦克风

个人电脑

手机

MP3

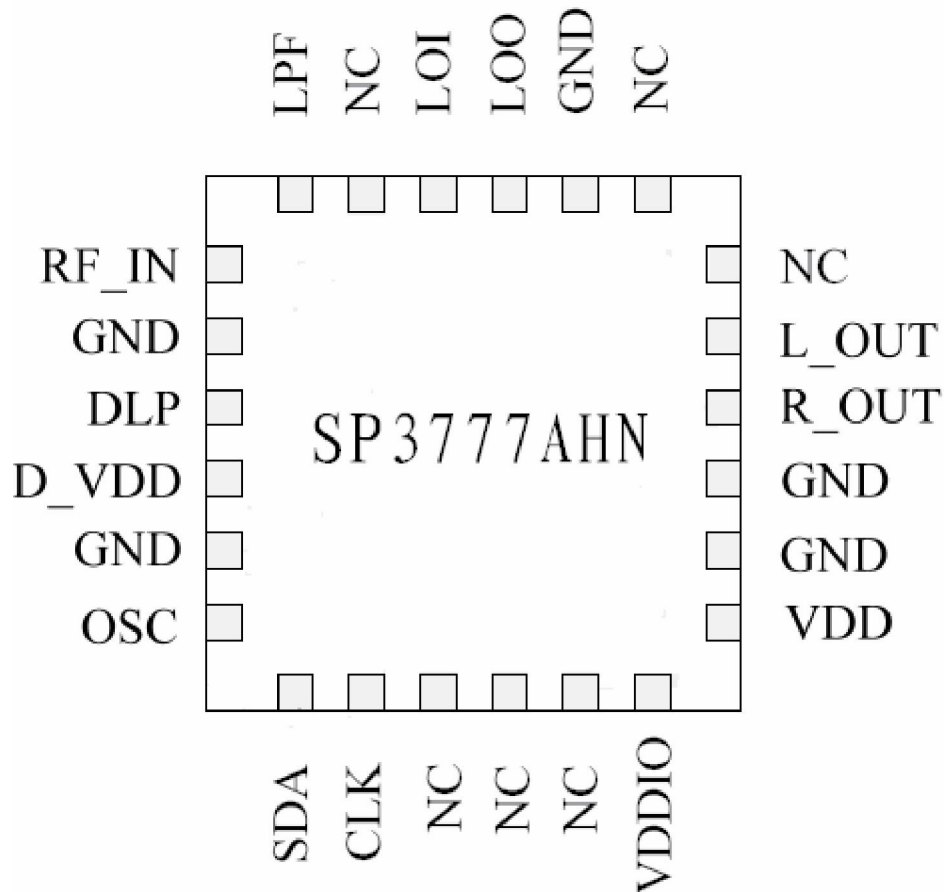
四、极限参数：

参数	符号	参数范围	单位
工作电压	V _{dd}	2.4 to 4.2	V
I/O电平	V _{in-D}	-0.3~V _{DD} +0.3	V
储存温度	T _{stg}	-55~+125	
工作温度	T _{opr}	-25 to +85	

五、推荐工作条件

参数	符号	参数范围	单位
工作电压	V _{cc}	3	V
数字接口工作电压	V _{io}	1.8 to 3.3	V
输入高电平	V _{IH}	0.8V _{cc} to V _{io}	V
输入低电平	V _{IL}	GND to 0.2V _{io}	V

六、管脚定义：



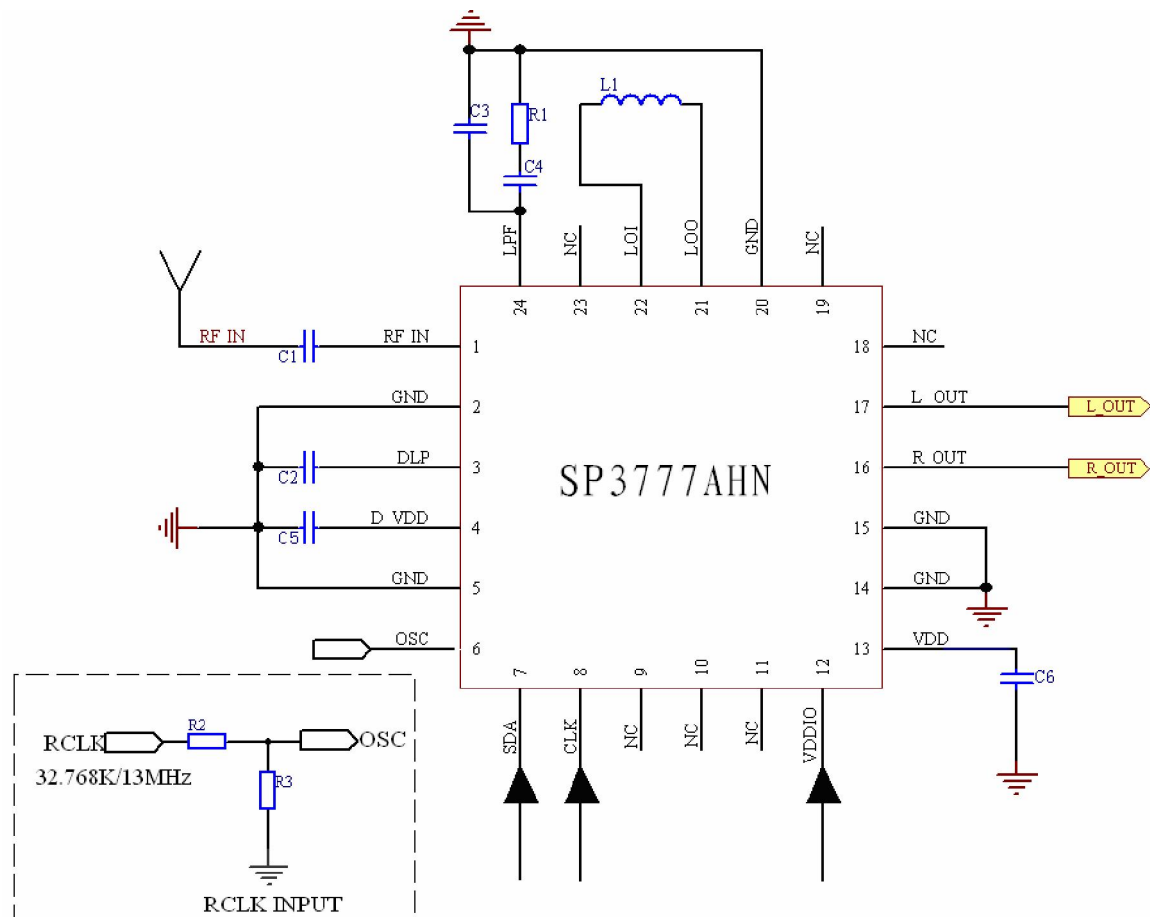
管脚	管脚名称	定义	管脚	管脚名称	定义
1	RF_IN	射频输入	13	VDD	电源电压
2	GND	地	14	GND	地
3	DLP	数字锁相环滤波器	15	GND	地
4	D_VDD	数字 LDO 输出	16	R_OUT	右声道输出
5	GND	地	17	L_OUT	左声道输出
6	OSC	晶体或者 接参考时钟输入	18	NC	空脚
7	SDA	I ² C data	19	NC	空脚
8	SCL	I ² C CLK	20	GND	地
9	NC	空脚	21	LOO	VCC
10	NC	空脚	22	LOI	VCC
11	NC	空脚	23	NC	空脚
12	VDDIO	数字接口电源	24	LPF	锁相环环路滤波器

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七、电气参数：（ $T_a=25$ ， $V_{DD}=3V$ ）

参数	类型	测试条件	最小值	典型值	最大值	单位
待机电流	Ist	Powerdown		20		μA
工作电流	Icc			24		mA
输入频率范围	Fre		70		108	MHz
灵敏度	Sen	(S+N)/N=26dB		6		dB μV EMF
Input IIP3	IIP3in	f2-f1 >1MHz, f0=2*f1-f2, AGC disable		88		dB μV EMF
调幅抑制	AMsp	m=0.3		50		dB
邻道选择性	ACS ₂₀₀	f=± 200kHz		40		dB
隔信道选择性	ACS ₄₀₀	f=± 400kHz		45		dB
音频输出电压	Vaudio			80		mV _{RMS}
左右声道幅度平衡性	V _{AIMB}			0.1		dB
左右声道隔离度	ASS			30		dB
音频输出信噪比	SNR			60		dB
音频谐波失真	THD			0.05	0.1	%
去加重时常数	DT	DE=0		75		μs
		DE=1		50		μs
音频输出驱动负载电阻	RL			10K		
音频输出驱动负载电容	CL			10		pF
搜台时间	Tseek				60	ms/channel
参考时钟频率	Ref	支持两种频率		32.768KHz 13MHz		

八、典型应用：



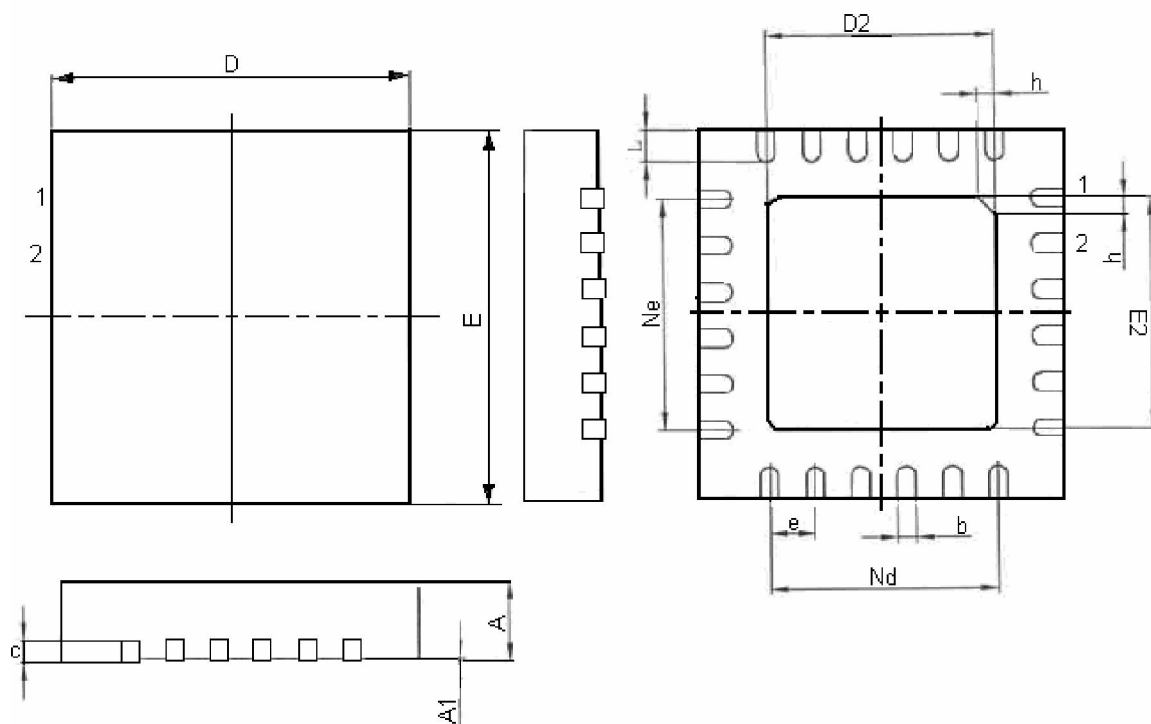
外围器件：

32.768KHz参考时钟输入	
元件标号	元件值
C1	1nF
C2	2nF
C3	15nF
C4	150 nF
C5,C6	0.47uF
L1	56 nH
R1	15 Kohm
R2	10 Kohm
R3	10 Kohm

注：当使用 32.768KHz/13MHz 晶体时，不需分压电阻，直接从 OSC 脚接入即可。

九、封装外形 (单位: mm)

QFN24 pin. 4 X4 X 0.9



符号	参数		
	最小	典型	最大
A	0.70	0.75	0.80
A1	--	0.01	0.05
b	0.18	0.25	0.30
c	0.18	0.20	0.25
D	3.9	4.0	4.1
D2	2.50REF		
e	0.50BSC		
Ne	2.50BSC		
Nd	2.50BSC		
E	3.9	4.0	4.1
E2	2.50REF		
L	0.35	0.4	0.45
h	0.3	0.35	0.4
L/F 载体尺寸	110*110		

十、使用附件

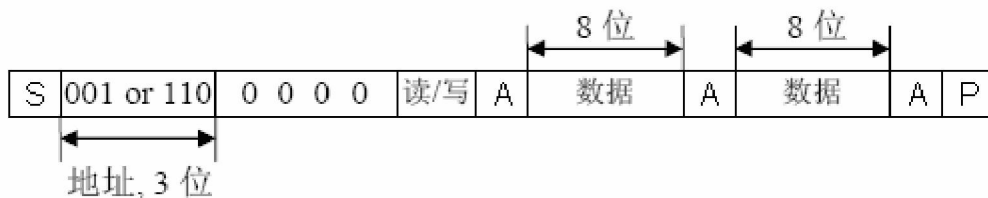
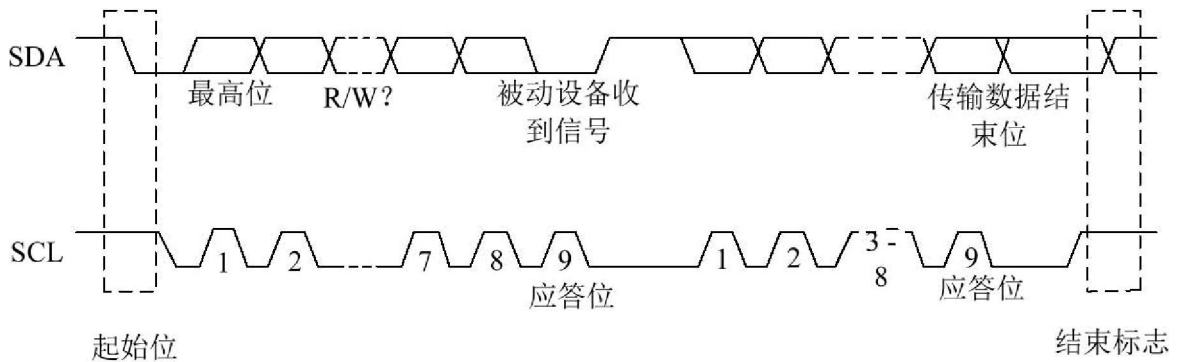
数字接口：

I²C兼容接口 为方便使用，SP3777A-N的寄存器阵列有两种操作模式：完全控制模式（A-Mbde）和简单操作模式（P-Mbde），两种模式是靠两个 I²C地址区分的，A-Mbde对应的地址是“0010000”，P-Mbde对应的地址是“1100000”。芯片上电后的默认工作状态是A-Mbde，工作状态的转换与 I²C的访问有关，若对芯片最后一次访问是针对P-Mbde寄存器的，则其工作模式为P-Mbde。

寄存器操作：

I²C写模式：MCU先写寄存器 03h的高八位，再写 03h的低八位，接着写 04h的高八位，直到写完最后一个寄存器。

I²C读模式：SP3777A-N先送寄存器 00h的高八位，再送 00h的低八位，接着送 01h的高八位，直到收到 NACK命令。



S 开始
 P 停止
 A 确认

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(1) A 模式寄存器表：

Register	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
00h					HLSI_FLAG	STC	SF	ST	RSSI							
01h	SNR_NUM						READCHAN									
02h	DeviceID							FD_NUM								
03h	DISABLE		MUTE	LMUTE	RMUTE	SDMUTE	TUNE	SEEK	SEEKUP	MONO	STEREO	HCCEN	BBEN			
04h	VOLUME						CHAN									
05h	BAND	SPACE		DEEN	DE											
06h	XTAL_Sel	RST_DSP							APLL_NK_SEL		APLLN					
07h	APLLK															
08h	SEEKTH												SNR_TH		FD_TH	

(2) A 模式寄存器描述：

Bit ID	Word	Bit	Type	Default	Function Description
	0	15	R	0	
	0	14	R	1	
	0	11	R	1	
STC	0	10	R	0	Seek/Tune Complete 0—Not complete 1—Complete
SF	0	9	R	0	Seek Fail 0—Seek successful 1—Seek failure
ST	0	8	R	0	Stereo Indicator 0—Mono 1—Stereo
RSSI	0	7:0	R	0x00	Received Signal Strength Indicator (RSSI) RSSI scale is logarithmic, 1dB/step
SNR_NUM	1	15:10	R	0	SNR detection of RF-signal, Lower is better
READCHAN	1	9:0	R	87.5MHz 10' d550	Current Channel Number Channel Freq.=50kHz*READCHAN + 70MHz
DeviceID	2	15:8	R	0x07	Device ID: SP3777AH-N
FD_NUM	2	7:0	R	0x00	Frequency deviation detection
DISABLE	3	15	RW	1	Power Down control 0—Work mode 1—Power down mode (Only I ² C supply is on for digital control access.)
	3	14	RW	1	
MUTE	3	13	RW	1	Mute 1—Mute L/R channel 0—Normal operation
LMUTE	3	12	RW	0	Left Mute 1—Mute 0—Normal operation
RMUTE	3	11	RW	0	Right Mute 1—Mute 0—Normal operation

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SDMUTE	3	10	RW	1	Soft Mute Disable 0—Mute 1—Normal operation(do not mute)
TUNE	3	9	RW	0	Tune Enable 0—Disable 1—Enable
SEEK	3	8	RW	0	Seek Enable 0—Disable 1—Enable
SEEKUP	3	7	RW	1	Seek process 0—Seek down 1—Seek up
MONO	3	6	RW	0	Mono Selection 0—Auto mode 1—Force in mono mode
STEREO	3	5	RW	0	Force in stereo mode 0—No force 1— If detect pilot, then force to stereo
HOCEN	3	4	RW	0	High Out Enable 0—Bypass high cut filter 1—Enable high cut filter
BBEN	3	3	RW	0	Bass Boost Enable 0—Disable 1— Enable
	3	2	RW	0	
	3	1	RW	1	
	3	0	RW	1	
	4	15	RW	0	
	4	14	RW	1	
VOLUME	4	13:10	RW	1111	Volume 0000—min volume 1111—max volume
CHAN	4	9:0	RW	87.5MHz 10' d350	Channel Selection Freq=50kHz*CHAN + 70MHz CHAN is updated every tune
BAND	5	15:14	RW	00	Band Selection 00— 87.5~108MHz (US/Europe, China) 10— 76~90MHz (Japan)
SPACE	5	13:12	RW	01	Channel Spacing 00— 200kHz 01— 100kHz (Europe, Japan) 10— 50kHz (USA)
DEEN	5	11	RW	1	De-emphasis enable. 0— Disable 1—Enable
DE	5	10	RW	1	De-emphases 0— 75 μs (USA) 1— 50 μs (China)

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	5	9	RW	1	
	5	8	RW	1	
	5	7	RW	1	
	5	6	RW	0	
	5	5:4	RW	00	
	5	3:2	RW	00	
	5	1:0	RW	00	
XTAL_Sel	6	15:14	RW	00	Crystal selection 00— 32.768kHz (Crystal or external XO) 01— 13MHz (external XO)
RST_DSP	6	13	RW	1	DSP reset software control 0— Reset DSP 1— Normal operation
	6	12	RW	1	
	6	11	RW	1	
	6	10:7	RW	0000	
APLL_NK_SEL	6	6	RW	1	APLL N/K mode selection 0— N/K value used in APLL is APLLN and APLLK (registers) 1— N/K value used in APLL is generated internally
APLLN	6	5:0	RW	6' d22	
APLLK	7	15:0	RW	16' d1395	
SEEKTH	8	15:8	RW	8' d176	Seek Threshold 11001001— 201, -65dBm 11111111— max RSSI RSSI scale is logarithmic.
	8	7:6	RW	11	
SNR_TH	8	5:3	RW	110	Signal SNR detection threshold, lower is better
FD_TH	8	2:0	RW	100	Frequency deviation detection

(3) A 模式寄存器初始化数据：

REG[0] = 0x00; REG[1] = 0x00;
 REG[2] = 0x00; REG[3] = 0x00;
 REG[4] = 0x00; REG[5] = 0x00;
 REG[6] = 0xe4; REG[7] = 0x81;
 REG[8] = 0x7e; REG[9] = 0x30;
 REG[10] = 0x19; REG[11] = 0xc0;
 REG[12] = 0x38; REG[13] = 0x56;
 REG[14] = 0x05; REG[15] = 0x73;
 REG[16] = 0xb4; REG[17] = 0xf4;
 REG[18] = 0x8d; REG[19] = 0xc1;
 REG[20] = 0xc2; REG[21] = 0x04;
 REG[22] = 0x01; REG[23] = 0x25;
 REG[24] = 0xff; REG[25] = 0xfd;
 REG[26] = 0x06; REG[27] = 0x0f;
 REG[28] = 0x41; REG[29] = 0x1d;
 REG[30] = 0x21; REG[31] = 0x0d;
 REG[32] = 0x3f; REG[33] = 0x6f;
 REG[34] = 0x00; REG[35] = 0x00;

(4) P 模式寄存器表：

P-Mode 定义了 5 个可写寄存器和 5 个只读寄存器。

下面是寄存器定义：

Reg	D7	D6	D5	D4	D3	D2	D1	D0
W 1	mute	sm	pll w[13:8]					
W 2	pll w[7:0]							
W 3	sud	ssl[1:0]		hlsi	ms	mr	ml	swp1
W 4	swp2	stby	bl	xtal	smute	hcc	snc	si
W 5	pll ref	dtc	0	0	0	0	0	0
R 1	rf	blf	pll r[13:8]					
R 2	pll r[7:0]							
R 3	stereo	ifcnt[6:0]						
R 4	lev[3:0]				ci[2:0]			0
R 5	0	0	0	0	0	0	0	0

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(5) P 模式寄存器表描述

Register (write)	Bits	Register Name	Type	Default	Function Description
1	7	mute	R/W	1	if MUTE = 1 then L and R audio are muted; if MUTE = 0 then L and R audio are not muted
1	6	sm	R/W	0	Search mode: if SM = 1 then in search mode; if SM = 0 then not in search mode
1, 2	[5:0], [7:0]	pllw[13:0]	R/W	87.5Mhz	setting of synthesizer programmable counter for search or preset
3	7	sud	R/W	1	Search Up/Down: if SUD = 1 then search up; if SUD = 0 then search down
3	[6:5]	ssl[1:0]	R/W	10	Search Stop Level: 00-- not allowed in search mode 01-- low; level ADC output = 5 10-- mid; level ADC output = 7 11-- high; level ADC output = 10
3	4	hlsi	R/W	1	High/Low Side Injection: if HLSI = 1 then high side LO injection; if HLSI = 0 then low side LO injection
3	3	ms	R/W	0	Mono to Stereo: if MS = 1 then forced mono; if MS = 0 then stereo ON
3	2	mr	R/W	1	Mute Right: if MR = 1 then the right audio channel is muted and forced mono; if MR = 0 then the right audio channel is not muted
3	1	ml	R/W	1	Mute Left: if ML = 1 then the left audio channel is muted and forced mono; if ML = 0 then the left audio channel is not muted
3	0	swp1	R/W	0	Software programmable port 1: if SWP1 = 1 then port 1 is HIGH; if SWP1 = 0 then port 1 is LOW
4	7	swp2	R/W	0	Software programmable port 2: if SWP2 = 1 then port 2 is HIGH; if SWP2 = 0 then port 2 is LOW
4	6	stby	R/W	1	Standby: if STBY = 1 then in Standby mode; if STBY = 0 then not in Standby mode

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4	5	bl	R/W	0	Band Limits: if BL = 1 then Japanese FM band; if BL = 0 then US/Europe FM band
4	4	xtal	R/W	1	Clock frequency: (work together with pllref) {pllref, xtal}=0 13 MHz {pllref, xtal}=1 32.768 kHz
4	3	smute	R/W	0	Soft Mute: if SMUTE = 1 then soft mute is ON; if SMUTE = 0 then soft mute is OFF
4	2	hcc	R/W	0	High Cut Control: if HCC = 1 then high cut control is ON; if HCC = 0 then high cut control is OFF
4	1	snc	R/W	0	Stereo Noise Cancelling: if SNC = 1 then stereo noise cancelling is ON; if SNC = 0 then stereo noise cancelling is OFF
4	0	si	R/W	0	Search Indicator: if SI = 1 then pin S _W PORT1 is output for the ready flag; if SI = 0 then pin S _W PORT1 is software programmable port 1
5	7		R/W	0	
5	6	dtc	R/W	0	if DTC = 1 then the de-emphasis time constant is 75 ms; if DTC = 0 then the de-emphasis time constant is 50 ms
Register (read)	Bits	Register Name	Type	Default	Function Description
1	7	rf	R	0	Ready Flag: if RF = 1 then a station has been found or the band limit has been reached; if RF = 0 then no station has been found
1	6	blf	R	0	Band Limit Flag: if BLF = 1 then the band limit has been reached; if BLF = 0 then the band limit has not been reached
1, 2	[5:0], [7:0]	pllref[13:0]	R	0	setting of synthesizer programmable counter after search or preset
3	7	stereo	R	0	Stereo indication: if STEREO = 1 then stereo reception; if STEREO =

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					0 then mono reception
3	[6:0]	ifcnt[6:0]	R	0	IF counter result
4	[7:4]	lev[3:0]	R	0	level ADC output
4	[3:1]	ci[2:0]	R	0	Chip Identification: these bits have to be set to logic 0
5	[7:0]	researved	R	0	