



## ICs for Carradio Applications

PLL Frequency Synthesizer, IF Counter, 7 bit ADC, 7 & 4 bit DAC

SDA 4335 Version V1

Target Specification  
(33 pages incl. this page)

03.05.99

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<b>SDA 4335</b>		
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Previous Version:		
old Page	new Page	Subjects (major changes since last revision)

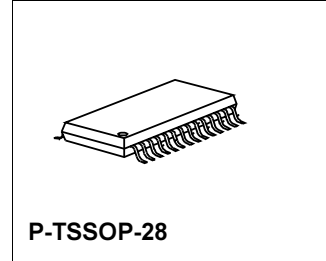
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Version V1

B6CA

**1 Overview**

The SDA 4335 is a Car-Radio PLL frequency synthesizer implemented in Infineon BiCMOS technology B6CA. The device contains the PLL, 2 pin 61.5MHz Oscillator internally coupled to PLL, an IF Counter for AM & FM an 7 bit ADC, an 7 & 4 bit DAC and additional 2 ports for input- or output-functions. Primary applications are in Car-Radio systems.



**1.1 Features**

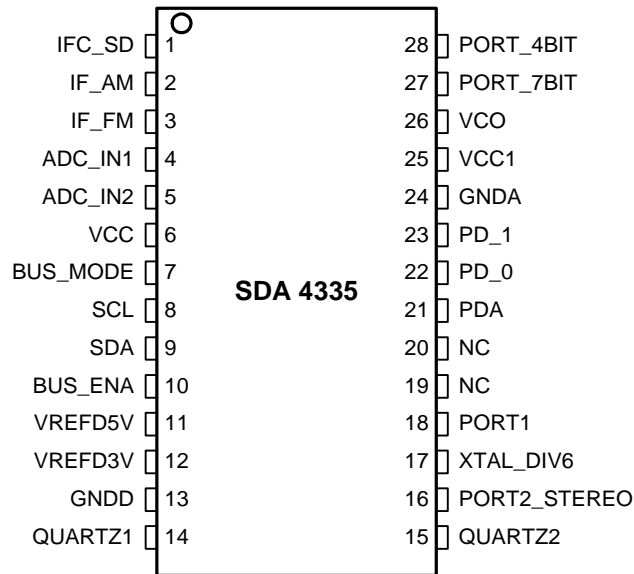
- Operation range 8 to 11 V
- I<sup>2</sup>C Bus and 3Wire Bus operation selectable
- Bus interface with low threshold voltage Schmitt-Trigger inputs for interfacing 3V or 5V microprocessors
- 16 bit fully programmable R- and N-Counter
- Resolution e.g.100kHz, 50kHz, 25kHz, 12.5kHz, 10kHz, 6.25kHz, 6kHz, 5kHz, 3kHz, 1kHz.
- 4 programmable phase detector currents : 0.5mA, 1mA, 2mA, 4mA.
- Rail to rail Loop-amplifier
- 2 Chargepump-outputs for different timeconstants
- High running 2 pin crystal oscillator  $f_Q=61.5\text{MHz}$  , adjustable via Bus
- Switchable output for 10.25MHz (500mV<sub>ss</sub> @ load-capacitance 10pF)
- Multiplexed 7 bit ADC for ADC\_IN1 and ADC\_IN2. Result read out via bus (2 bytes).
- 7 bit DAC-output, range 0...VREFD5V
- 4 bit DAC-output, range 0...VREFD5V
- 3 free programmable output PORTS
- PORT 1: free programmable output
- PORT 2: for AM seek mode or input port for stereo-indicator
- PORT 3: IFC\_SD for IF counter resolution or input port for station-detect
- Search tuning stop with IF counter measurement, result read out via bus or port.

	FM-mode	AM-mode
gatetime	320us...40.96ms	1ms...64ms
center-frequency (standard) (double)	10.40 MHz ... 11.19375 MHz or 20.80 MHz ... 22.3875 MHz	440kHz...471kHz
window-resolution (standard) (double)	+/- 6.25 kHz...100 kHz +/- 12.5 kHz...200 kHz	+/- 250Hz...4kHz

Type	Ordering Code	Package
SDA 4335		P-TSSOP-28

2 Circuit Description

2.1 Pin Configuration



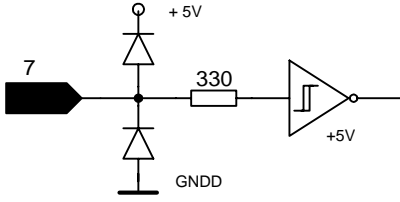
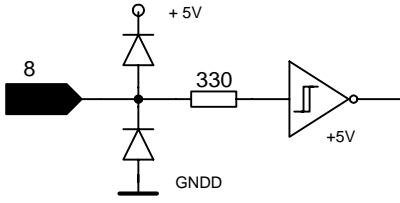
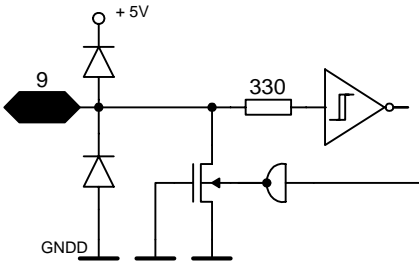
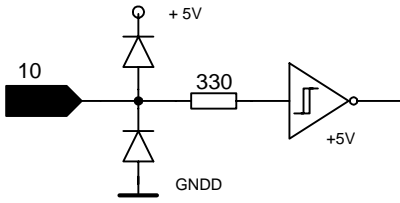
## 2.2 Pin Definitions and Functions

Pin No.	Symbol	Function
1	IFC_SD	PORT IF_Counter result output or Station-Detect input set by bus
2	IF_AM	IF_AM frequency input with counter request
3	IF_FM	IF_FM frequency input with counter request
4	ADC_IN1	PORT ADC1 Input
45	ADC_IN2	PORT ADC2 Input
6	VCC	Positive supply voltage (8...11V)
7	BUS_MODE	Data bus input: Bus-mode select Must be Low for I <sup>2</sup> C-Bus-mode, must be High for 3 Wire -Bus-mode
8	SCL	Data bus input: Clock Clock input of the serial control interface with Schmitt-Trigger input stage
9	SDA	Data bus input / output: Bidirectional Data-input/output Data input of the serial control interface with Schmitt-Trigger input stage in write-mode. Data output in read-mode.
10	BUS_ENA	Bus input: Enable Enable input of the serial control interface with Schmitt-Trigger input stage. When EN=H the input signals CLK and DA are disabled. When EN=L the serial control interface is enabled. The received data are transferred to the registers with the positive edge of the EN_Q-signal.
11	VREFD5V	Reference voltage for analogue BiCMOS circuitry
12	VREFD3V	Reference voltage for digital CMOS circuitry
13	GNDD	Digital ground for CMOS circuitry
14	QUARTZ1	Reference oscillator input1 / Crystal
15	QUARTZ2	Reference oscillator input2 / Crystal
16	PORT2_STEREO	Port2 open-drain output or Stereo detection input set by bus
17	XTAL_DIV6	Output crystal frequency divided by 6
18	PORT1	Port1 free programmable open-drain output
19	NC	Not connected (replaced by Digital Alignment SDA 4336)
20	NC	Not connected (replaced by Digital Alignment SDA 4336)
21	PDA	Phase detector output analogue (Tuningvoltage)
22	PD_0	Charge pump output Phase detector tristate charge pump output for PD_Select=Low
23	PD_1	Charge pump output Phase detector tristate charge pump output for PD_Select=High
24	GNDA	Analoge Ground for bipolar circuitry
25	VCC1	25:Positive supply voltage for loop-amplifier of PLL (8...11V)
26	VCO	VCO frequency input. VCO input with sensitive preampifier for PLL
27	PORT_7BIT	Output port 7 bit DAC (Range: 0...VREFD5V)
28	PORT_4BIT	Output port 4 bit DAC (Range: 0...VREFD5V)

## 2.3 Internal input/output circuits

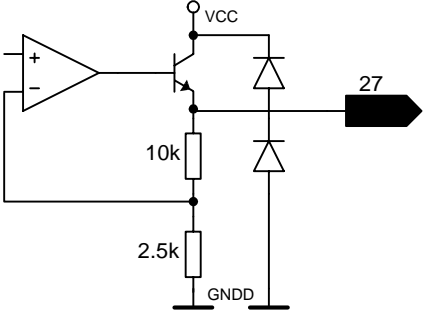
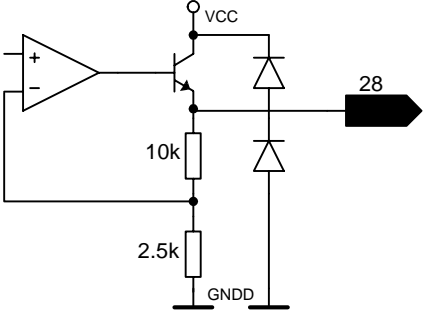
Pin No.	Symbol		Function
1	IFC_SD		1: IF_Counter output IF center or Station-Detect input
2	IF_AM		2: IF_AM input
3	IF_FM		3: IF_FM input
4	ADC_IN1		4: ADC Input_IN1
5	ADC_IN2		5: ADC Input_IN2
6	VCC		6: Positive supply voltage for serial bus and synthesizer



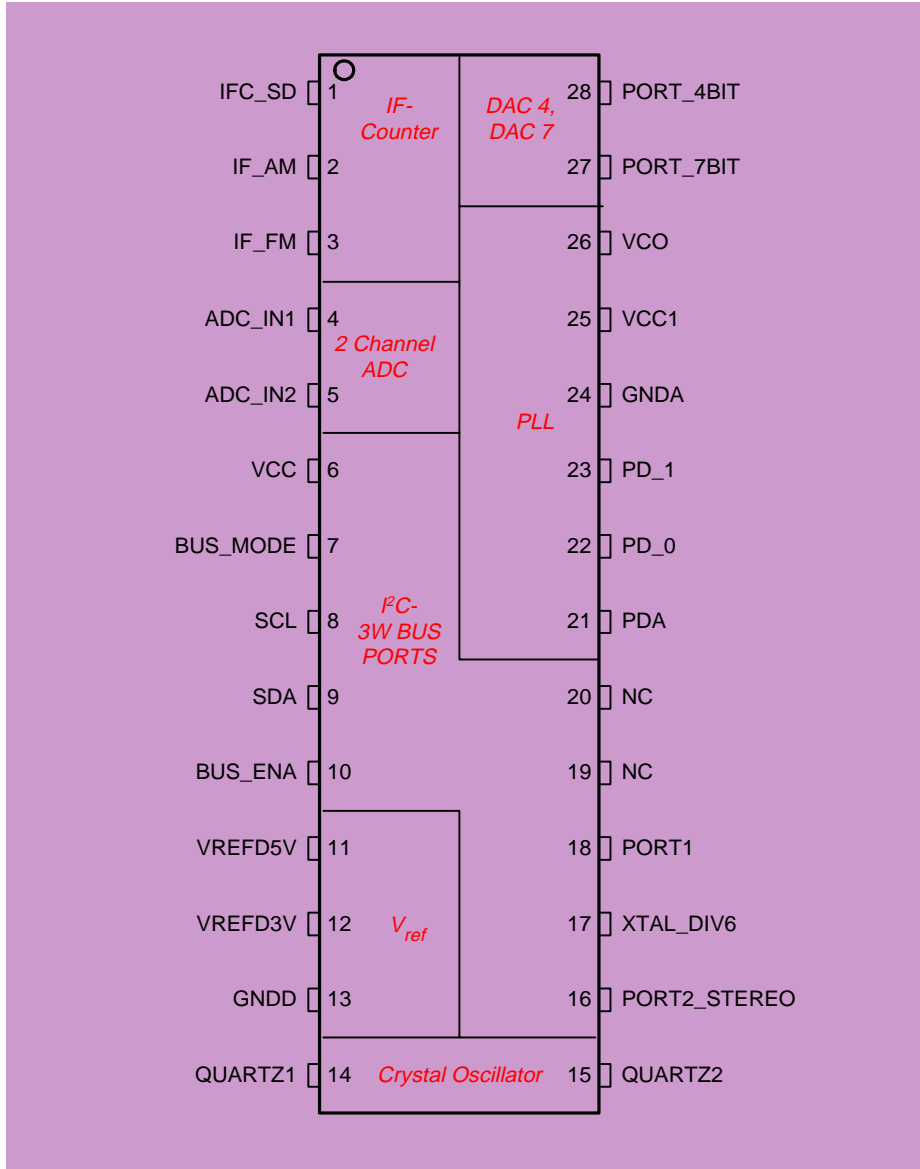
Pin No.	Symbol		Function
7	BUS_MODE		7: Bus mode input
8	SCL		8: Bus clock input
9	SDA		9: Data bus input / output
10	BUS_ENA		10: Bus enable input
11	VREFD5V		11: Reference voltage digital section 5V
12	VREFD3V		12: Reference voltage for digital section 3V
13	GNDD		13: Ground for serial bus and synthesizer

Pin No.	Symbol		Function
14	QUARTZ1		14: Reference oscillator input / Crystal
15	QUARTZ2		15: Reference oscillator input / Crystal
16	PORT2_STEREO		16: Port2 open-drain output or Stereo detection input set by bus
17	XTAL_D1 V6		17: Crystal oscillator auxiliary output (10.25 MHz)
18	PORT1		18: Switch port output 2 (open drain)
19	NC		Not connected
20	NC		Not connected

Pin No.	Symbol		Function
21	PDA		21: PLL phase detector output analog (Tuning voltage)
22	PD_0		22: PLL Charge pump output (Phase detector tristate charge pump output)
23	PD_1		23: PLL Charge pump output (Phase detector tristate charge pump output)
24	GND_A		24: Ground for loop amplifier
25	VCC1		25: Positive power supply for loop-amplifier
26	VCO		26: VCO input

Pin No.	Symbol		Function
27	PORT_7BIT		27: Output port 7 bit
28	PORT_4BIT		28: Output port 4 bit

3 Block diagram



## 4 Circuit Description

The SDA 4335 is a FM car radio PLL synthesizer system with IF counter for STS, a 2 channel multiplexed 7 bit ADC, a 7 bit DAC- and a 4 bit DAC multifunctional output. The serial bus is switchable between I<sup>2</sup>C and 3 Wire bus mode.

### 4.1 7 bit A/D converter for ADC\_IN1 and ADC\_IN2 detector

The 7 bit A/D converter has two input channels and works as successive approximation converter. The conversion time for both input signals is  $t = 32 \mu\text{s}$ . The 7-bit digital-words from both channels (14 bit) are read out together via bus into two bytes with the read subaddress 82H. The input voltage range for both channels is 0...VREFD5V.

### 4.2 IF counter for STS

For FM-mode the center frequency is adjustable in 128 steps (6.25kHz for standard IF-frequency/ 12.5kHz for double IF-frequency) from 10.40MHz...11.19375MHz (standard) / 20.80MHz ... 22.3875MHz (double).

The gate-time is adjustable in 8 steps from 320 $\mu\text{s}$ ...40.96ms and the tolerance of the accepted count value, the window is adjustable in 5 steps from +/- (250Hz...4kHz).

For AM-mode the center frequency is adjustable in 128 steps (1kHz) from 384kHz ... 511kHz. Mode is selectable by bus. In FM-mode the input IF\_AM is going low with a internally NMOS Open drain transistor. In AM-mode the input IF\_FM is going low with a internally NMOS Opendrain transistor.

The gate-time is adjustable in 7 steps from 1ms...64ms and the tolerance of the accepted count value, the window is adjustable in 5 steps from +/- (250Hz...4kHz).

The results IF\_CENT and IF\_WINDOW are read out via bus (read-subaddress 82H). The result IF\_CENT is optional available on pin IFC\_SD set by bus.

If the IF frequency into the preselected window, IF\_CENT goes from high to low level.

The IF frequency is outside the preselected window, IF\_CENT is high. The bit IF\_WINDOW is a hint IF-frequency is to low (IF\_WINDOW=high) or is to high (IF\_WINDOW=low).

In addition to the frequency measurement, thresholds for ADC\_IN1 and ADC\_IN2 voltages can be programmed via bus (subaddress 0BH). IF\_CENT will only go to low level in case fo ADC\_IN1 and ADC\_IN2 voltages are beyond the thresholds and the frequency is inside the window.

When setting the thresholds to zero ADC\_IN1 and ADC\_IN2 evaluation is disabled.

### 4.3 Crystal oscillator

A master crystal oscillator provides all necessary clock frequencies for the whole IC. A 61.5 MHz crystal is used in 3rd harmonic mode.

The oscillator frequency can fine tuned with a serial bus controlled 4 bit D/A converter.

The crystal frequency is used as reference frequency for the PLL oscillator and IF counter. It is also used as clock for the ADC. Finally the crystal frequency divided by 6 (10.25 MHz) is available at a pin as low pass filtered voltage. It can be disabled with the serial bus.

### 4.4 Output / input Ports

PORT1 is a NMOS Open drain output,

PORT2\_STEREO and IFC\_SD are NMOS Open drain outputs in port mode or inputs set by bus.

PORT\_7BIT / PORT\_4BIT are multifunctionally DAC outputs with a output voltage range from  $V_{\text{out}} = 0 \dots V_{\text{REFD5V}}$ , with a resolution from 7 bit and 4 bit.

### 4.5 SOCCAR Bus

The SDA 4335 supports the I<sup>2</sup>C bus protocol (2 wire) or 3 Wire bus protocol operation selectable by pin 7: BUS\_MODE (I<sup>2</sup>C=low, 3W=high). All bus pins ( BUS\_MODE, SCL, SDA, BUS\_ENA) are Schmitt-triggered input buffer for 3V or 5V  $\mu\text{C}$ .

The bit stream begins with the most significant bit (MSB), is shifted in (write mode) on the low to high transition of CLK and is shifted out (read mode) on the high to low transition of CLK.

**I<sup>2</sup>C bus mode**

In this mode pin7 (BUS\_MODE) = low and pin10 (BUS\_ENA)=low. In this mode SDA is a bidirectional input / output pin.

**Data Transition:**

Data transition on the pin SDA must only occur when the clock SCL is low. SDA transitions while SCL is high will be interpreted as start or stop condition.

**Start Condition (STA):**

A start condition is defined by a high to low transition of the SDA line while SCL is at a stable high level. This start condition must precede any command and initiate a data transfer onto the bus.

**Stop Condition (STO):**

A stop condition is defined by a low to high transition of the SDA while the SCL line is at a stable high level. This condition terminates the communication between the devices and forces the bus interface into the initial conditions.

**Acknowledge (ACK):**

Indicates a successful data transfer. The transmitter will release the bus after sending 8 bits of data. During the 9th clock cycle the receiver will pull the SDA line to low level to indicate it has received the 8 bits of data correctly.

**Data Transfer Write Mode:**

To start the communication, the bus master must initiate a start condition, followed by the 8-bit chip address (write). The chip address for the SDA 4335 is fixed as "1100110" (MSB at first). The last bit (LSB=A0) of the chip address byte defines the type of operation to be performed:

A0=1, a read operation is selected and A0=0, a write operation is selected. After this comparison the SDA 4335 will generate an ACK.

After this device addressing the desired sub address byte and data bytes must be followed. The subaddresses determine which one of the 9 data bytes (00H...07H, 0BH) is transmitted first. At the end of data transition the master must generate the stop condition.

**Data Transfer Read Mode:**

To start the communication in the read mode, the bus master must initiate a start condition, followed by the 8-bit chip address (write: A0=0), followed by the sub address read (82H or 83H), followed by the chip address (read: A0=1). After that procedure the 16-bit data register 82H or the 8-bit data register 83H is read out. After the first 8-bit read out, the uP mandatorily send LOW during the ACK-clock. After the second 8-bit read out the uP mandatorily send HIGH during the ACK-clock. At the end of data transition the master must generate the stop condition.

**3W bus mode**

In this mode pin4 (BUS\_MODE) =high. Pin6 (SDA) is a bidirectional input / output pin in this mode. Pin8 (BUS\_ENA) is used to activate the bus interface to allow the transfer of data to / from the device. When BUS\_ENA is in an inactive high state, shifting is inhibited.

**Data Transition:**

Data transition on the pin SDA must only occur when the clock SCL is low. To transfer data to / from the device, BUS\_ENA (which must start inactive high) is taken low, a serial transfer is made via SDA, CLK and BUS\_ENA is taken back high. The bit stream needs neither the chip address.

**Data Transfer Write Mode:**

To start the communication, the BUS\_ENA is taken low. The desired sub address byte and data bytes must be followed. The subaddresses determine which one of the 9 data bytes (00H...07H, 0BH) is transmitted first. At the end of data transition the BUS\_ENA must be high.

**Data Transfer Read Mode:**

To start the communication in the read mode, the BUS\_ENA is taken low, followed by the sub address read (82H or 83H). After that the device is ready to read out the 16-bit data register 82H or the 8-bit data register 83H. At the end of data transition the BUS\_ENA must be high.

#### 4.6 PLL Synthesizer

##### R / N Counter

The SDA 4335 has 2 identical 16bit counter for R and N path. Input frequency for the R-counter is the buffered XTAL-frequency (61.5MHz). Tuning steps can be selected by the 16bit R-counter from  $f_R = 6.25\text{kHz} \dots 100\text{kHz}$ . Input frequency for the N-counter is the buffered LO-frequency (in FM mode 98.2MHz...118.7MHz).

##### Three State Phase Comparator

The phase comparator generates a phase error signal according to phase difference between  $f_R$  (R counter output) and  $f_N$  (N counter output). This phase error signal drives the charge pump current generator. Polarity is fixed positiv for this application note.

##### Charge Pump

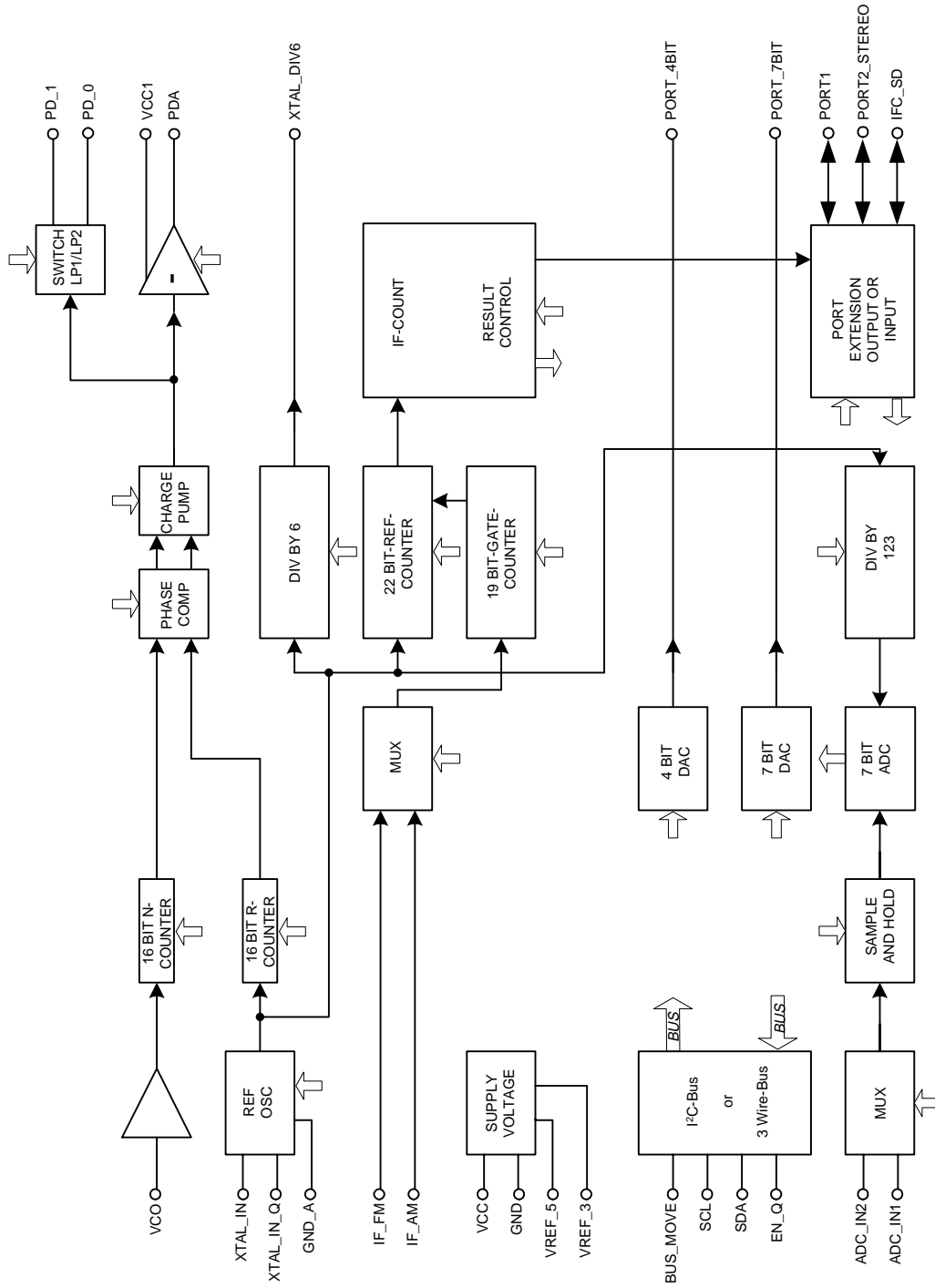
The charge pump generates signed pulses of current. 4 current values and 2 outputs are available.

##### Loop Amp

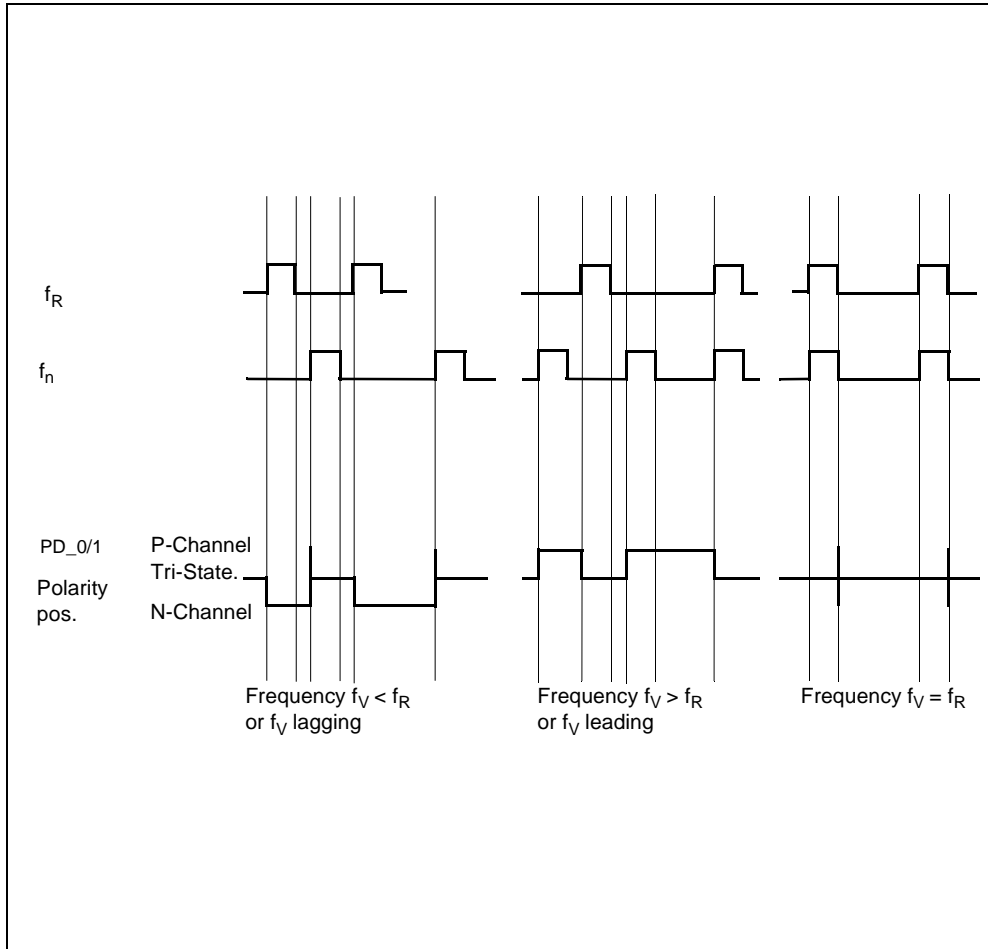
The integrated rail to rail loop amplifier allows an active loop filter design with external components. Two modes are available with status bit D11: high speed and normal mode.



5 Functional Block Diagram



6 Phase detector outputs



## 6.1 Bus Interface

### Pin Function

Pin name	BUS_MODE	BUS_ENA	SCL	SDA
Function	Bus mode select	Enable	Serial clock	Serial data
I2C-mode	Low	High=Inactiv, Low=Activ	Clock input	Data in / out
3Wire mode	High			

### 6.1.1 Bus Data Format

#### I<sup>2</sup>C Bus Write Mode

	MSB	CHIP ADDRESS (WRITE)							LSB		MSB	SUB ADDRESS (WRITE) 00H...07H, 0BH							LSB		MSB	DATA IN X...0 (X=7 or 15)							LSB		
STA	1	1	0	0	1	1	0	0	ACK	S7	S6	S5	S4	S3	S2	S1	S0	ACK	DX	...	D5	D4	D3	D2	D1	D0	ACK	STO			

#### I<sup>2</sup>C Bus Read Mode

	MSB	CHIP ADDRESS (WRITE)							LSB		MSB	SUB ADDRESS (READ) 82H / 83H							LSB			MSB	CHIP ADDRESS (READ)							LSB	
STA	1	1	0	0	1	1	0	0	ACK	1	0	0	0	0	0	1	0	ACK	STA	1	1	0	0	1	1	0	1	ACK			

MSB	DATA OUT FROM SUB ADD 82H							LSB		MSB	DATA OUT FROM SUB ADD 82H							LSB		
R15	R14	R13	R12	R11	R10	R9	R8	ACK <sup>1)</sup>	R7	R6	R5	R4	R3	R2	R1	R0	ACK <sup>2)</sup>	STO		
MSB	DATA OUT FROM SUB ADD 83H							LSB												
R7	R6	R5	R4	R3	R2	R1	R0	ACK <sup>2)</sup>	STO											

1): mandatory LOW send by uP, 2): mandatory HiGH send by uP

#### 3W Bus Write Mode

MSB	SUB ADDRESS (WRITE) 00H...07H, 0BH							LSB	MSB	DATA IN X...0 (X=7 or 15)							LSB
S7	S6	S5	S4	S3	S2	S1	S0	DX	...	D5	D4	D3	D2	D1	D0		

#### 3W Bus Read Mode

MSB	SUB ADDRESS (READ) 82H							LSB	MSB	DATA OUT FROM SUB ADD 82H (MSB)							LSB	MSB	DATA OUT FROM SUB ADD 82H (LSB)							LSB
1	0	0	0	0	0	1	0	R15	R14	R13	R12	R11	R10	R9	R8	R7	R6	R5	R4	R3	R2	R1	R0			
MSB	SUB ADDRESS (READ) 83H							LSB	MSB	DATA OUT FROM SUB ADD 83H (MSB)							LSB									
1	0	0	0	0	0	1	1	R7	R6	R5	R4	R3	R2	R1	R0											

### Chipaddress Organisation

Chip Address (only I <sup>2</sup> C mode)								
MSB							LSB	Function
1	1	0	0	1	1	0	0	Chip Address Write
1	1	0	0	1	1	0	1	Chip Address Read

### Subaddress

Sub Addresses of Data Registers Write									
MSB	Bin						LSB	Hex	Function
0	0	0	0	0	0	0	0	00H	Status
0	0	0	0	0	0	0	1	01H	R_Counter
0	0	0	0	0	0	1	0	02H	N_Counter
0	0	0	0	0	0	1	1	03H	DAC7
0	0	0	0	0	1	0	0	04H	IF_COUNT_P1
0	0	0	0	0	1	0	1	05H	IF_COUNT_P2
0	0	0	0	0	1	1	0	06H	Specials
0	0	0	0	0	1	1	1	07H	DAC4
0	0	0	0	1	0	1	1	0BH	COMP_PRESET

Sub Address of Data Register Read									
MSB	Bin						LSB	Hex	Function
1	0	0	0	0	0	1	0	82H	Result ADC_IN2, ADC_IN1, IF_Window and IF_Center
1	0	0	0	0	0	1	1	83H	Result_Misc

## Data Byte Specification

Status Subaddress 00H	
Bit	Function
MSB D15	not used (must be=0)
D14	PORT2_STEREO
D13	PORT1
D12	Stereo-Flag
D11	Loopamp current
D10	not used (must be=0)
D9	not used (must be=0)
D8	AM / FM
D7	ADC_Single
D6	ADC_Mode
D5	ADC_ON
D4	DAC4
D3	PD_Select
D2	CP_Current 2
D1	CP_Current 1
D0 LSB	CP_Mode

R_Counter Subaddress 01H	
Bit	Function
MSB D15	$2^{15}$
D14	$2^{14}$
D13	$2^{13}$
D12	$2^{12}$
D11	$2^{11}$
D10	$2^{10}$
D9	$2^9$
D8	$2^8$
D7	$2^7$
D6	$2^6$
D5	$2^5$
D4	$2^4$
D3	$2^3$
D2	$2^2$
D1	$2^1$
D0 LSB	$2^0$

N_Counter Subaddress 02H	
Bit	Function
MSB D15	$2^{15}$
D14	$2^{14}$
D13	$2^{13}$
D12	$2^{12}$
D11	$2^{11}$
D10	$2^{10}$
D9	$2^9$
D8	$2^8$
D7	$2^7$
D6	$2^6$
D5	$2^5$
D4	$2^4$
D3	$2^3$
D2	$2^2$
D1	$2^1$
D0 LSB	$2^0$

COMP_PRESET Subaddress 0BH	
Bit	Function
MSB D15	not used
D14	V_IN1_2 <sup>6</sup>
D13	V_IN1_2 <sup>5</sup>
D12	V_IN1_2 <sup>4</sup>
D11	V_IN1_2 <sup>3</sup>
D10	V_IN1_2 <sup>2</sup>
D9	V_IN1_2 <sup>1</sup>
D8	V_IN1_2 <sup>0</sup>
D7	not used
D6	V_IN2_2 <sup>6</sup>
D5	V_IN2_2 <sup>5</sup>
D4	V_IN2_2 <sup>4</sup>
D3	V_IN2_2 <sup>3</sup>
D2	V_IN2_2 <sup>2</sup>
D1	V_IN2_2 <sup>1</sup>
D0 LSB	V_IN2_2 <sup>0</sup>

DAC7 Subaddress 03H	
Bit	Function
MSB D7	Enable
D6	DAC7_6
D5	DAC7_5
D4	DAC7_4
D3	DAC7_3
D2	DAC7_2
D1	DAC7_1
D0 LSB	DAC7_0

IF_Count_P1 Subaddress 04H	
Bit	Function
MSB D7	Enable
D6	Station_Detect
D5	Win_2
D4	Win_1
D3	Win_0
D2	Gate_2
D1	Gate_1
D0 LSB	Gate_0

IF_Count_P2 Subaddress 05H	
Bit	Function
MSB D7	CF_Mode
D6	CF_6
D5	CF_5
D4	CF_4
D3	CF_3
D2	CF_2
D1	CF_1
D0 LSB	CF_0

Specials Subaddress 06H	
Bit	Function
MSB D7	XTAL_DIV6
D6	not used
D5	not used
D4	not used
D3	XTAL_3
D2	XTAL_2
D1	XTAL_1
D0 LSB	XTAL_0

IF_DAC4 Subaddress 07H	
Bit	Function
MSB D7	not used
D6	not used
D5	not used
D4	not used
D3	DAC4_3
D2	DAC4_2
D1	DAC4_1
D0 LSB	DAC4_0

Results ADC_IN1, ADC_IN2 and IF counter Subaddress 82H (read address)	
Bit	Function
MSB D15	IF_window
D14	ADC_IN2_2 <sup>6</sup>
D13	ADC_IN2_2 <sup>5</sup>
D12	ADC_IN2_2 <sup>4</sup>
D11	ADC_IN2_2 <sup>3</sup>
D10	ADC_IN2_2 <sup>2</sup>
D9	ADC_IN2_2 <sup>1</sup>
D8	ADC_IN2_2 <sup>0</sup>
D7	IF_center
D6	ADC_IN1_2 <sup>6</sup>
D5	ADC_IN1_2 <sup>5</sup>
D4	ADC_IN1_2 <sup>4</sup>
D3	ADC_IN1_2 <sup>3</sup>
D2	ADC_IN1_2 <sup>2</sup>
D1	ADC_IN1_2 <sup>1</sup>
D0 LSB	ADC_IN1_2 <sup>0</sup>

Result Misc Subaddress 83H	
Bit	Function
MSB D7	IF_Window
D6	IF_Center
D5	ADC_IN1_Comp
D4	ADC_IN2_Comp
D3	Res
D2	Res
D1	Station_Detect
D0 LSB	Stereo_Flag

Status, Subaddress 00H																		
MSB								LSB	MSB								LSB	Function
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0			
0					0	0										these bits must be = 0		
0	1		0													opendrain Port2_Stereo output = high level (port-mode)		
0	0		0													opendrain Port2_Stereo output = low level (port-mode)		
0	x		1													opendrain Port2_Stereo is input for Stereoflag		
0		1														opendrain Port1 output = high level		
0		0														opendrain Port1 output = low level		
0				1												Loopamp currentsource high (I <sub>LOOPAMP</sub> =2.4mA) for high speed tuning		
0				0												Loopamp currentsource low (I <sub>LOOPAMP</sub> =1.2mA)		
0							1									AM-Mode		
0							0									FM-Mode		
0								0	0	1						7 bit AD Converter enabled for single mode, stop		
0								1	0	1						7 bit AD Converter enabled for single mode start. To restart single mode write the same bits once more.		
0								0	1	1						7 bit AD Converter enabled for continuous mode run.		
0								x	x	1						7 bit AD Converter enabled for single or continuous mode		
0								x	x	0						7 bit AD Converter disabled for single and continuous mode		
0											1					DAC4 enabled (see subaddress 07H)		
0											0					DAC4 disabled (see subaddress 07H)		
0												1				Phase detector select; PD_1=ON, PD_0=OFF		
0												0				Phase detector select; PD_1=OFF, PD_0=ON		
0													1	1		Chargepump current I <sub>cp3</sub> = 4mA		
0													1	0		Chargepump current I <sub>cp2</sub> = 2mA		

0																0	1	Chargepump current $I_{cp1} = 1mA$
0																0	0	Chargepump current $I_{cp0} = 500uA$
0																	1	Chargepump enabled
0																	0	Chargepump disabled

Subaddress 01H, R_Counter and Subaddress 02H, N_Counter																		
MSB								LSB	MSB								LSB	Function
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0			
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Divider by 65535	
0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0	Divider by 2000	
0	0	0	0	0	1	0	0	1	1	0	0	1	1	1	0	0	Divider by 1230	
0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	Divider by 1000	
0	0	0	0	0	0	1	0	0	1	1	0	0	1	1	1	1	Divider by 615	
0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	Divider by 100	
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	Divider by 10	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	Divider by 2	

Subaddress 03H, DAC7									
MSB								LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0		
1									DAC7 enabled
0	x	x	x	x	x	x	x	x	DAC7 disabled
1	1	1	1	1	1	1	1	1	DAC7_127 (full scale)
1	1	0	0	0	0	1	1		DAC7_66 (MSB+3*LSB)
1	1	0	0	0	0	1	0		DAC7_65 (MSB+2*LSB)
1	1	0	0	0	0	0	1		DAC7_64 (MSB+LSB)
1	1	0	0	0	0	0	0		DAC7_63 (MSB)
1	0	1	1	1	1	1	1		DAC7_62 (MSB-LSB)
1	0	1	1	1	1	1	0		DAC7_61 (MSB-2*LSB)
1	0	1	1	1	1	0	1		DAC7_60 (MSB-3*LSB)
1	0	1	1	1	1	0	0		DAC7_59 (MSB-4*LSB)
1	0	0	0	0	0	1	0		DAC7_2 (zero+2*LSB)
1	0	0	0	0	0	0	1		DAC7_1 (zero+LSB; LSB=39mV)
1	0	0	0	0	0	0	0		DAC7_0 zero

Subaddress 04H, IF_Count_P1									
MSB								LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0		
1									IF_Count enabled
0									IF_Count disabled
	1								Port IFC_SD is input for station_detect to start IF_COUNT externally, if the station detect goes to high
	0								Port IFC_SD is output for result IF_CENTER
FM_MODE / AM_MODE									
		1	0	0					Window= ±100kHz* / 4kHz
		0	1	1					Window= ±50kHz* / 2kHz
		0	1	0					Window= ±25kHz* / 1kHz
		0	0	1					Window= ±12.5kHz* / 500Hz
		0	0	0					Window= ±6.25kHz* / 250Hz
					1	1	1		Gatetime= 40.96ms/not used
					1	1	0		Gatetime= 20.48ms / 64ms
					1	0	1		Gatetime= 10.24ms / 32ms
					1	0	0		Gatetime= 5.12ms / 16ms
					0	1	1		Gatetime= 2.56ms / 8ms
					0	1	0		Gatetime= 1.28ms / 4ms
					0	0	1		Gatetime= 640us / 2ms
					0	0	0		Gatetime= 320us / 1ms

\* Valid for D7=0 in subaddress 05H in FM\_Mode  
 Multiply window value with 2 for D7=1 in subaddress 05H  
 (e. g. D7=0 Window= ± 6.25 kHz  
 D7=1 Window= ± 12.5 kHz)

Subaddress 05H, IF_Count_P2, FM_Mode									
Centerfrequency = CF, CF <sub>FM</sub> <sub>step</sub> = 6.25kHz/12.5kHz									
MSB								LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0		
1								Centerfrequency CF1	
0								Centerfrequency CF0	
1	1	1	1	1	1	1	1	CF1= 22.3875 MHz	
0	1	1	1	1	1	1	1	CF0= 11.1937 MHz	
1	1	0	0	0	0	0	0	CF1= 22.600 MHz	
0	1	0	0	0	0	0	0	CF0= 10.800 MHz	
1	0	1	1	0	0	0	1	CF1= 21.4125 MHz	
0	0	1	1	0	0	0	1	CF0= 10.70625 MHz	
1	0	1	1	0	0	0	0	CF1= 21.400 MHz	
0	0	1	1	0	0	0	0	CF0= 10.700 MHz	
1	0	1	0	1	1	1	1	CF1= 21.3875 MHz	
0	0	1	0	1	1	1	1	CF0= 10.69375 MHz	
1	0	1	0	0	0	0	0	CF1= 21.200 MHz	
0	0	1	0	0	0	0	0	CF0= 10.600 MHz	
1	0	0	1	0	0	0	0	CF1= 21.000 MHz	
0	0	0	1	0	0	0	0	CF0= 10.500 MHz	
1	0	0	0	0	0	0	0	CF1= 20.800 MHz	
0	0	0	0	0	0	0	0	CF0= 10.400 MHz	

Centerfrequencies FM for

D7=1 CF1= 20.800 MHz +n\*12.5 kHz, CF<sub>Step</sub>=12.5 kHz

D7=0 CF0= 10.400 MHz +n\*6.25 kHz, CF<sub>Step</sub>=6.25 kHz

n=0...127

Subaddress 05H, IF_Count_P2, AM_MODE									
Centerfrequency = CF, CF <sub>AM</sub> <sub>step</sub> = 1kHz)									
MSB								LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0		
0								Centerfrequency CFO	
0	1	0	1	0	1	1	1	CF_AM= 471kHz	
0	1	0	1	0	1	1	0	CF_AM= 470kHz	
0	1	0	1	0	1	0	1	CF_AM= 469kHz	
0	1	0	1	0	1	0	0	CF_AM= 468kHz	
0	1	0	1	0	0	1	1	CF_AM= 467kHz	
0	1	0	1	0	0	1	0	CF_AM= 466kHz	
0	1	0	1	0	0	0	1	CF_AM= 465kHz	
0	1	0	1	0	0	0	0	CF_AM= 464kHz	
0	1	0	0	1	1	1	1	CF_AM= 463kHz	
0	1	0	0	1	1	1	0	CF_AM= 462kHz	
0	1	0	0	1	1	0	1	CF_AM= 461kHz	
0	1	0	0	1	1	0	0	CF_AM= 460kHz	
0	1	0	0	1	0	1	1	CF_AM= 459kHz	
0	1	0	0	1	0	1	0	CF_AM= 458kHz	
0	1	0	0	1	0	0	1	CF_AM= 457kHz	
0	1	0	0	1	0	0	0	CF_AM= 456kHz	
0	1	0	0	0	1	1	1	CF_AM= 455kHz	
0	1	0	0	0	1	1	0	CF_AM= 454kHz	
0	1	0	0	0	1	0	1	CF_AM= 453kHz	
0	1	0	0	0	1	0	0	CF_AM= 452kHz	
0	1	0	0	0	0	1	1	CF_AM= 451kHz	
0	1	0	0	0	0	1	0	CF_AM= 450kHz	
0	1	0	0	0	0	0	1	CF_AM= 449kHz	
0	1	0	0	0	0	0	0	CF_AM= 448kHz	
0	0	1	1	1	1	1	1	CF_AM= 447kHz	
0	0	1	1	1	1	1	0	CF_AM= 446kHz	
0	0	1	1	1	1	0	1	CF_AM= 445kHz	
0	0	1	1	1	1	0	0	CF_AM= 444kHz	
0	0	1	1	1	0	1	1	CF_AM= 443kHz	
0	0	1	1	1	0	1	0	CF_AM= 442kHz	
0	0	1	1	1	0	0	1	CF_AM= 441kHz	
0	0	1	1	1	0	0	0	CF_AM= 440kHz	

Centerfrequencies AM for

D7=0 CF\_AM=384kHz+n\*1kHz, CF<sub>Step</sub>=1kHz

n=0...127



Subaddress 06H, Specials									
MSB								LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0		
	x	x	x						not used
1									XTAL_DIV6 enabled
0									XTAL_DIV6 disabled
				1	1	1	1		XTAL_adjust C <sub>L</sub> = 15 pF
				1	1	1	0		XTAL_adjust C <sub>L</sub> = 14pF
				1	1	0	1		XTAL_adjust C <sub>L</sub> = 13 pF
				1	1	0	0		XTAL_adjust C <sub>L</sub> = 12 pF
				1	0	1	1		XTAL_adjust C <sub>L</sub> = 11 pF
				1	0	1	0		XTAL_adjust C <sub>L</sub> = 10 pF
				1	0	0	1		XTAL_adjust C <sub>L</sub> = 9 pF
				1	0	0	0		XTAL_adjust C <sub>L</sub> = 8 pF
				0	1	1	1		XTAL_adjust C <sub>L</sub> = 7 pF
				0	1	1	0		XTAL_adjust C <sub>L</sub> = 6 pF
				0	1	0	1		XTAL_adjust C <sub>L</sub> = 5 pF
				0	1	0	0		XTAL_adjust C <sub>L</sub> = 4 pF
				0	0	1	1		XTAL_adjust C <sub>L</sub> = 3 pF
				0	0	1	0		XTAL_adjust C <sub>L</sub> = 2 pF
				0	0	0	1		XTAL_adjust C <sub>L</sub> = 1pF
				0	0	0	0		XTAL_adjust C <sub>L</sub> = 0pF

Subaddress 07H, IF_DAC4									
MSB								LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0		
x	x	x	x						not used
				1	1	1	1		DAC4_15 (full scale)
				1	1	1	0		DAC4_14
				1	1	0	1		DAC4_13
				1	1	0	0		DAC4_12
				1	0	1	1		DAC4_11
				1	0	1	0		DAC4_10 (MSB+2*LSB)
				1	0	0	1		DAC4_9 (MSB+LSB)
				1	0	0	0		DAC4_8 (MSB)
				0	1	1	1		DAC4_7
				0	1	1	0		DAC4_6
				0	1	0	1		DAC4_5
				0	1	0	0		DAC4_4
				0	0	1	1		DAC4_3 (zero+3*LSB)
				0	0	1	0		DAC4_2 (zero+2*LSB)
				0	0	0	1		DAC4_1 (zero+LSB; LSB=333mV)
				0	0	0	0		DAC4_0 zero

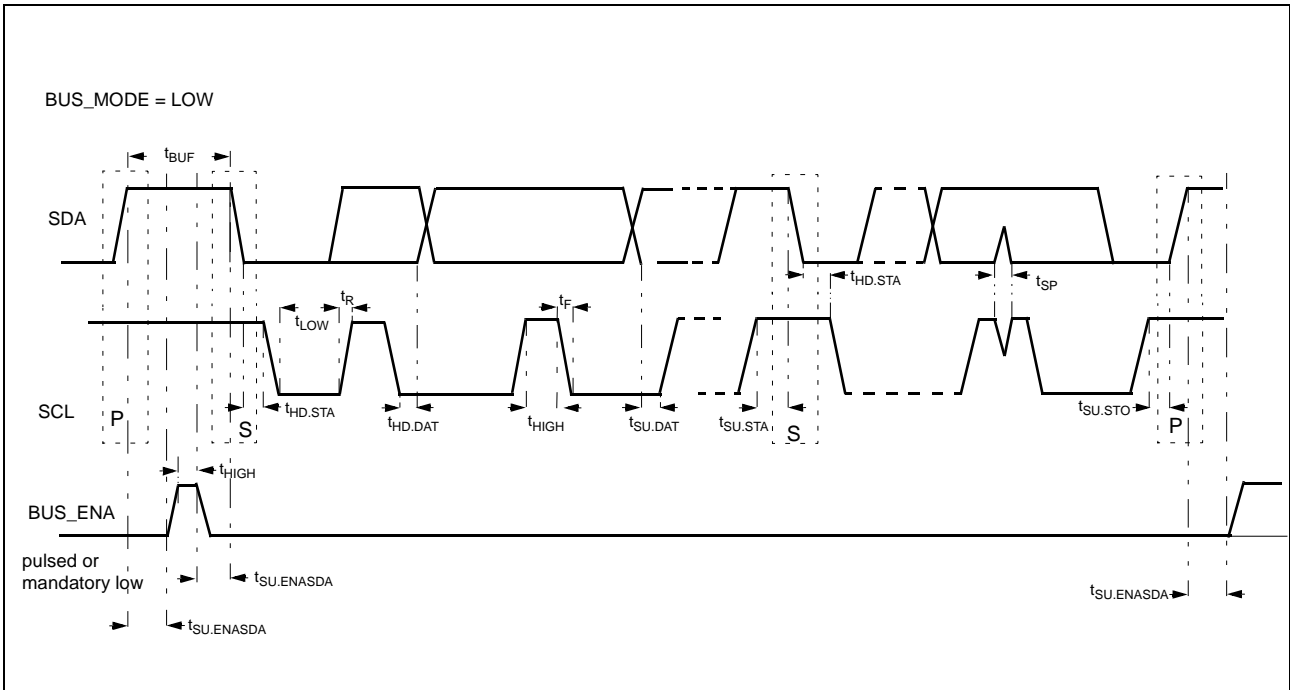
Subaddress 0BH, Comp preset																		
MSB								MSB								LSB		Function
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0			
X								X								not used		
	IN1P2 <sup>6</sup>	IN1P2 <sup>5</sup>	IN1P2 <sup>4</sup>	IN1P2 <sup>3</sup>	IN1P2 <sup>2</sup>	IN1P2 <sup>1</sup>	IN1P2 <sup>0</sup>									Preset value IN1		
									IN2P2 <sup>6</sup>	IN2P2 <sup>5</sup>	IN2P2 <sup>4</sup>	IN2P2 <sup>3</sup>	IN2P2 <sup>2</sup>	IN2P2 <sup>1</sup>	IN2P2 <sup>0</sup>	Preset value IN2		

Subaddress 82H, Read Results from ADC_IN1, ADC_IN2 and IF counter																		
MSB								MSB								LSB		Function
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0			
1								1								IF_counter result: IF frequency is outside the desired window. IF frequency is lower as the desired IF frequency.		
0								1								IF_counter result: IF frequency is outside the desired window. IF frequency is higher as the desired IF frequency.		
x								0								IF_counter result: IF frequency is inside the desired window		
	IN2_2 <sup>6</sup>	IN2_2 <sup>5</sup>	IN2_2 <sup>4</sup>	IN2_2 <sup>3</sup>	IN2_2 <sup>2</sup>	IN2_2 <sup>1</sup>	IN2_2 <sup>0</sup>									Result ADC_IN2 byte IN2_6...IN2_0		
									IN1_2 <sup>6</sup>	IN1_2 <sup>5</sup>	IN1_2 <sup>4</sup>	IN1_2 <sup>3</sup>	IN1_2 <sup>2</sup>	IN1_2 <sup>1</sup>	IN1_2 <sup>0</sup>	Result ADC_IN1 byte IN1_6...IN1_0		

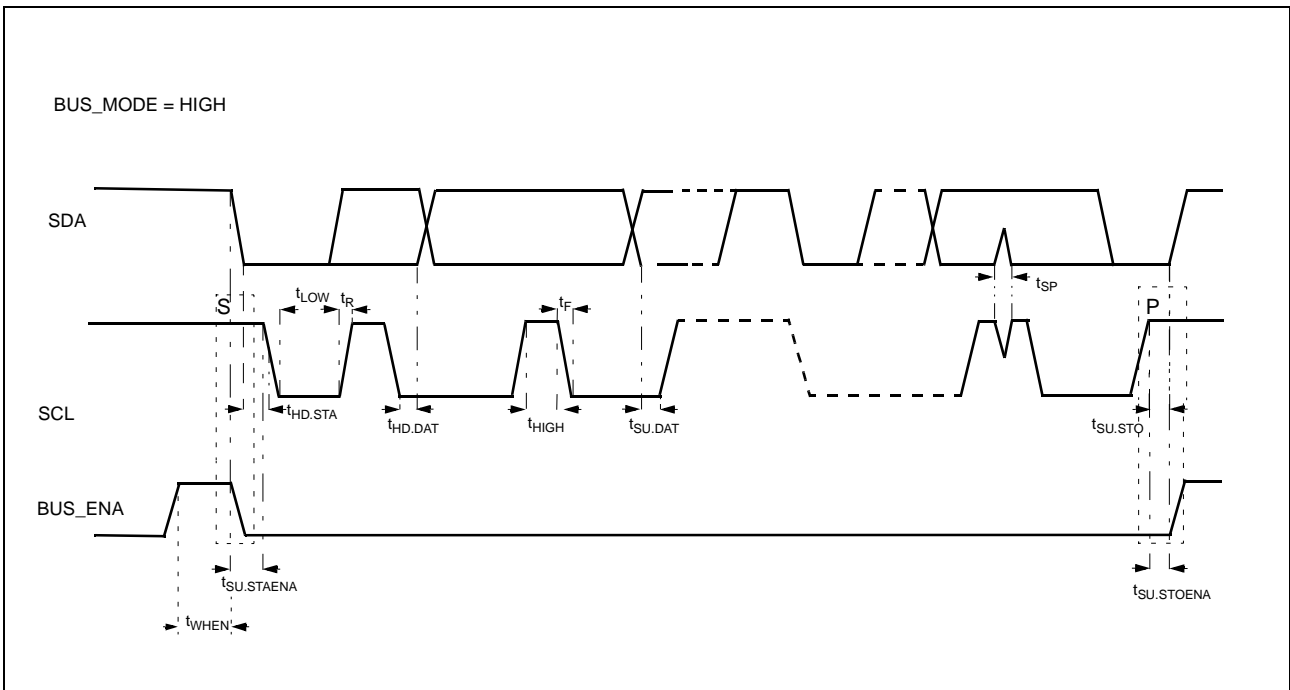
Subaddress 83H, Read Results from MISC								
MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
1	1							IF_counter result: IF frequency is outside the desired window. IF frequency is lower as the desired IF frequency.
0	1							IF_counter result: IF frequency is outside the desired window. IF frequency is higher as the desired IF frequency.
X	0							IF_counter result: IF frequency is inside the desired window.
		1						IN1_Voltage is higher than the presetted value (D8 .. D14) in 0BH
		0						IN1_Voltage is lower than the presetted value (D8 .. D14) in 0BH
			1					IN2_Voltage is higher than the presetted value (D0 .. D6) in 0BH
			0					IN2_Voltage is lower than the presetted value (D0 .. D6) in 0BH
				1	1			not used
						1		Start IF_counter on the rising edge from low to high
						0		Standby IF_counter
							X	Input signal Stereo_Flag from PORT2_STEREO (x=0 or 1)

see also D7 & D6 in Subaddress 04H, IF\_Count\_P1

6.1.2 I<sup>2</sup>C Bus Timing



3W-Bus Timing



Parameter	Symbol	Limit Values		Unit
		min.	max.	
LOW level input voltage (SDA, SCL, BUS_ENA, BUS_MODE)	$V_{IL}$	-0.5	0.90	V
HIGH level input voltage (SDA, SCL, BUS_ENA, BUS_MODE)	$V_{IH}$	2.10	5.50	V
Pulse width of spikes which must be suppressed by the input filter	$t_{SP}$	0	50	ns
LOW level output voltage 3mA sink current (SDA)	$V_{OL}$	0	0.40	V
Output fall time from $V_{IHmin}$ to $V_{ILmax}$ with a bus capacitance from 10pF to 400pF with up to 3mA	$t_{OF}$	$20+0.1C_b^{3)}$	250	ns
SCL clock frequency	$f_{SCL}$	0	400	kHz
Bus free time between a STOP and START condition <sup>1)</sup>	$t_{BUF}$	1.3		us
Hold time (repeated) START condition. After this period, the first clock pulse is generated. <sup>1)</sup>	$t_{HO.STA}$	0.6		us
LOW period of the SCL clock	$t_{LOW}$	1.3		us
HIGH period of the SCL clock	$t_{HIGH}$	0.6		us
Set-up time for a repeated START condition <sup>1)</sup>	$t_{SU.STA}$	0.6		us
Data hold time	$t_{HD.DAT}$	0		ns
Data set-up time	$t_{SU.DAT}$	100		ns
Rise, fall time of both SDA and SCL signals	$t_R, t_F$	$20+0.1C_b^{3)}$	300	ns
Set-up time for STOP condition <sup>1)</sup>	$t_{SU.STO}$	0.6		us
Capacitive load for each bus line	$C_b$		400	pF
Setup time SCL to BUS_ENA <sup>2)</sup>	$t_{SU.SCLEN}$	0.6		us
H-pulsewidth (BUS_ENA)	$t_{WHEN}$	0.6		us

<sup>1)</sup> only in I<sup>2</sup>C bus mode

<sup>2)</sup> only in 3W bus mode

<sup>3)</sup>  $C_b$  = capacitance of one bus line in pF.

Note that the maximum  $t_F$  for the SDA and SCL bus lines quoted at 300ns is longer than the specified maximum  $t_{OF}$  for the output stages (250ns). This allows series protection resistors to be connected between the SDA / SCL pins and the SDA / SCL bus lines without exceeding the maximum specified  $t_F$ .

7 Electrical Characteristics

7.1 Absolute Maximum Ratings

*The maximal ratings may not be exceeded under any circumstances, not even momentary and individual, as permanent damage to the IC will result.*

Parameter	Symbol	Limit Values		Units
		min.	max.	
ESD-Protection all bipolar pins HBM ( R=1.5kΩ , C=100pF )	V <sub>ESD</sub>	- 2	2	kV
ESD-Protection all CMOS pins HBM ( R=1.5kΩ , C=100pF )	V <sub>ESD</sub>	t.b.d.	t.b.d.	kV
Total power dissipation	P <sub>tot</sub>		150	mW
Ambient temperature	T <sub>A</sub>	- 40	85	°C
Junction temperature	T <sub>j</sub>		125	°C
Storage temperature	T <sub>stg</sub>	- 40	125	°C
Thermal resistance P-TSSOP-28 (sys-air)	T <sub>thSA</sub>		114	K/W

All values are referred to ground (pin), unless stated otherwise.

All currents are designated according to the source and sink principle, i.e. if the device pin is to be regarded as a sink (the current flows into the stated pin to internal ground), it has a negative sign, and if it is a source (the current flows from V<sub>s</sub> across the designated pin), it has a positive sign.

7.2 Operating Range

Within the operational range the IC operates as described in the circuit description.  
The AC / DC characteristic limits are not guaranteed.

Parameter	Symbol	Limit Values		Unit	Test Conditions
		min	max		
Supply voltage	$V_{VCC}$	8	11	V	
Current consumption	$I_{VCC}$		30	mA	
Ambient temperature	$T_A$	- 40	85	°C	

7.3 AC/DC Characteristics

AC / DC characteristics involve the spread of values guaranteed in the specified supply voltage and ambient temperature range. Typical characteristics are the median of the production.

Parameter $T_A = 25\text{ °C}, V_{VCC} = 8.5V$	Symbol	Limit Values			Unit	Test conditions
		min	typ	max		
<b>Power supply</b>						
Total current consumption	$I_{VCC}$		20		mA	
<b>Crystal oscillator</b>						
Operating frequency	$f_{16-17}$		61.5		MHz	3rd harmonic
Negative input impedance	$Z_{16-17}$		- 250		$\Omega$	$f = 61.5\text{ MHz}$
Negative input impedance	$Z_{16-17}$		1.4		k $\Omega$	$f = 20.5\text{ MHz}$
Input impedance crystal	$R_{cr}$			tbd	$\Omega$	3rd harmonic
Spurious harmonics crystal	$a_{sp}$			- 20	dB	$f < 200\text{ MHz}$
Bus controlled adjust range	$\Delta f_{adj}$		$\pm 40$		ppm	see diagram SUB06h
Bus controlled output XTAL_DIV6	$V_{XTAL\_DIV6\_ON}$		500		mV <sub>pp</sub>	$f = 10.25\text{ MHz}, C_{load} = 10pF$
	$V_{XTAL\_DIV6\_ON}$		1.5		V <sub>DC</sub>	$f = 10.25\text{ MHz}, C_{load} = 10pF$
	$V_{XTAL\_DIV6\_OFF}$	60			dB	Signal supression $f=10.25\text{ MHz}$
	$V_{XTAL\_DIV6\_OFF}$			50	mV <sub>DC</sub>	$C_{load} = 10pF$
<b>Chargepump output PD_1, PD_0 (Loopfilter input)</b>						
DC voltage	$V_{PD\_1}$ $V_{PD\_0}$		2.5		V	locked
DC current	$\pm I_{PD\_1\_3}$ $\pm I_{PD\_0\_3}$	3.2	4	4.8	mA	see Status, Subaddress 00H, bit D1, D2 $V_{PD\_0/1} = 2.5V$
DC current	$\pm I_{PD\_1\_2}$ $\pm I_{PD\_0\_2}$	1.6	2	2.4	mA	
DC current	$\pm I_{PD\_1\_1}$ $\pm I_{PD\_0\_1}$	0.8	1	1.2	mA	
DC current	$\pm I_{PD\_1\_0}$ $\pm I_{PD\_0\_0}$	400	500	600	uA	
Tristate output current	$\pm I_{PD\_1\_OFF}$ $\pm I_{PD\_0\_OFF}$		0.1	10	nA	$V_{PD\_0/1} = 2.5V$ , guaranteed by design

Parameter $T_A = 25\text{ }^\circ\text{C}, V_{VCC} = 8.5\text{V}$	Symbol	Limit Values			Unit	Test conditions
		min	typ	max		
<b>Loop amplifier tuning voltage output (Loopfilter output)</b>						
LOW output voltage	$V_{PDA\_L}$	0	tbd.	400	mV	$I_{TUNE} = 100\text{ }\mu\text{A}$
HIGH output voltage	$V_{PDA\_H}$	$V_{VCC} - 0.5\text{V}$	tbd.	$V_{CC}$	mV	$I_{TUNE} = -100\text{ }\mu\text{A}$
HIGH output current source	$I_{PDA\_H}$		-2.4		mA	$V_{TUNE} = 4\text{V},$ $V_{PD\_1} = 0\text{V},$ $V_{PD\_0} = 0\text{V}$ (see Status, Subaddress 00H, bit D11)
LOW output current source	$I_{PDA\_L}$		-1.2			
<b>IF_Counter</b>						
input sensitivity AM	$V_{IF\_1}$	50	tbd.		mV	$f_{IF\_1} = 440\dots471\text{kHz}$
input impedance AM	$Z_{IF\_1}$		180		k $\Omega$	$f_{IF\_1} = 455\text{kHz}$
input sensitivity FM	$V_{IF\_0}$	50	tbd.		mV	$f_{IF\_0} =$ 10.60...10.80MHz
input impedance FM	$Z_{IF\_0}$		10		k $\Omega$	$f_{IF\_0} = 10.70\text{MHz}$
<b>PLL for synthesizer</b> (see PLL Synthesizer on page 16)						
PLL / VCO step size (programmable via R-counter)	$f_{ref}$	6.25		100	kHz	$f_{crystal} = 61.5\text{ MHz}$
N-counter divide ratio	N	2		65535		16-Bit
R-counter divide ratio	R	2		65535		16-Bit
input sensitivity	$V_{VCO}$	50	tbd.		mV	$f_{VCO} = 70\dots120\text{MHz}$
input impedance	$Z_{VCO}$		2.5		k $\Omega$	$f_{VCO} = 120\text{MHz}$
<b>ADC converter ADC_IN1 / IN2</b>						
input voltage range	$V_{ADC\_IN1/2}$	0		$V_{REFD5V}$	V	tbd.
Sampling capacitance	$C_S$		5		pF	
least significant bit	$V_{LSB}$		39, 37		mV	
zero offset failure	$V_{ZERO}$		tbd.		mV	
full scale	$V_{FS}$	tbd.	$V_{REFD5V}$	tbd.	V	
nonlinearity	$\Delta V$			+/-1.5	LSB	
converting time for both channels	$f_{CONV}$		32		us	
<b>DAC_7 converter PORT_7BIT</b>						
output voltage range	$V_{PORT\_7BIT}$	0		5,40	V	tbd.
least significant bit	$V_{LSB}$		39.37		mV	
zero offset failure	$V_{ZERO}$		tbd.		mV	
full scale	$V_{FS}$	tbd.	$V_{REFD5V}$	tbd.	V	
nonlinearity	$\Delta V$			+/-1.5	LSB	
output current	$I_{PORT\_7BIT}$			50	uA	
output capacitance	$C_{PORT\_7BIT}$			10	pF	

Parameter $T_A = 25\text{ °C}, V_{VCC} = 8.5V$	Symbol	Limit Values			Unit	Test conditions
		min	typ	max		
<b>DAC_4 converter PORT_4BIT</b>						
output voltage range	$V_{PORT\_7BIT}$	0		5,40	V	tbd.
least significant bit	$V_{LSB}$		333.33		mV	
zero offset failure	$V_{ZERO}$		tbd.		mV	
full scale	$V_{FS}$	tbd.	$V_{REFD5V}$	tbd.	V	
nonlinearity	$\Delta V$			+/-1.5	LSB	
output current	$I_{PORT\_4BIT}$			50	uA	
output capacitance	$C_{PORT\_4BIT}$			10	pF	
<b>Port outputs, PORT1, PORT2_STEREO, IFC_SD</b> (see <a href="#">Output / input Ports on page 14</a> )						
LOW output voltage	$V_P$	0	100	400	mV	$I_P = 1\text{ mA}$
HIGH Leakage current	$I_{P\_LEACK}$	0		100	nA	$V_P = 5\text{ V}$
<b>I2C / 3-Wire-bus (BUS_MODE, SCL, SDA, BUS_ENA)</b> (see <a href="#">I2C Bus Timing on page 27</a> and <a href="#">Bus Data Format on page 19</a> )						
H-input voltage	$V_{IH}$	2.10		5.50	V	
L-input voltage	$V_{IL}$	-0.5		0.90	V	
Hysteresis of Schmitt trigger inputs (BUS_MODE, SCL, SDA, BUS_ENA)	$V_{hys}$		0.30		V	
Input capacity	$C_I$			5	pF	



8 Package Outlines

