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## Features

- Reference Oscillator up to 15 MHz
- Two Programmable 16-bit Dividers Adjustable from 2 to 65535
- Fine Tuning Steps
  - AM  $\geq 1$  kHz
  - FM  $\geq 2$  kHz
- Loop-push-pull Stage for AM/FM
- High Signal/Noise Ratio

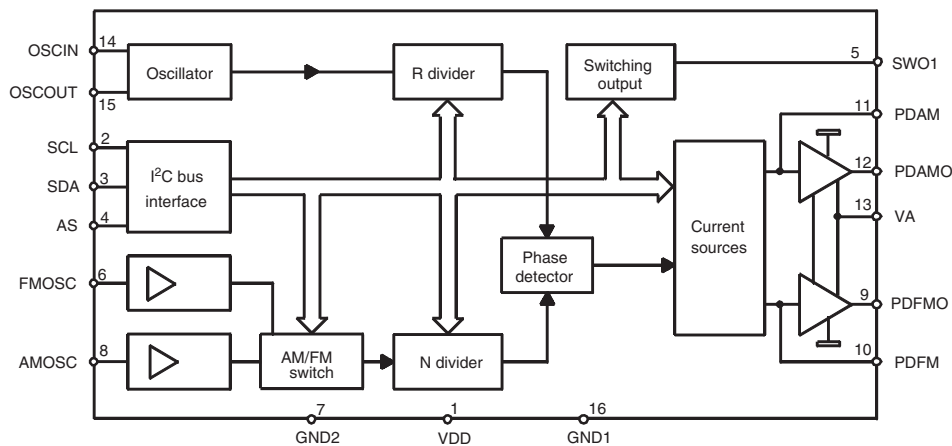


## AM/FM PLL with 1 Switch

## 1. Description

The ATR4289 is an integrated circuit in BiCMOS technology for frequency synthesizers. It performs all the functions of a PLL radio tuning system and is controlled by a 2-wire bus. The device is designed for all frequency synthesizer applications in radio receivers, as well as for radio data system (RDS) applications.

Figure 1-1. Block Diagram



## 2. Pin Configuration

Figure 2-1. Pinning SO16

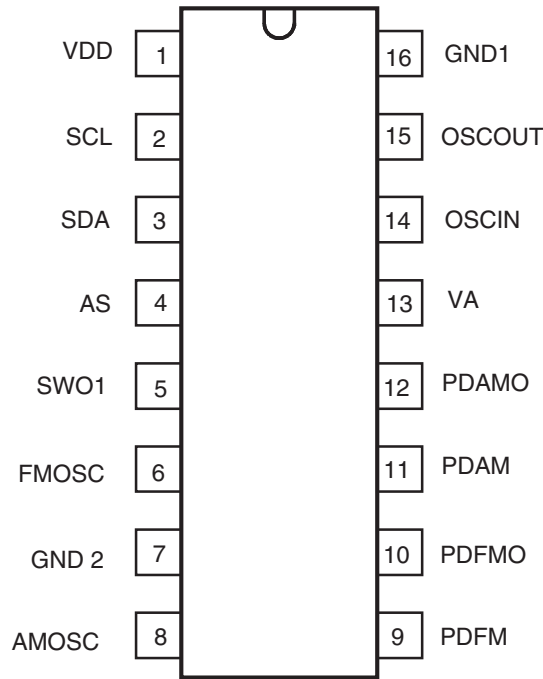


Table 2-1. Pin Description

Pin	Symbol	Function
1	VDD	Supply voltage
2	SCL	Bus clock
3	SDA	Bus data
4	AS	Address selection
5	SWO1	Switching output
6	FMOSC	FM oscillator input
7	GND2	Ground 2 (analog)
8	AMOSC	AM oscillator input
9	PDFM	FM current output
10	PDFMO	FM analog output
11	PDAM	AM current output
12	PDAMO	AM analog output
13	VA	Analog supply voltage
14	OSCIN	Oscillator input
15	OSCOUT	Oscillator output
16	GND1	Ground 1 (digital)

### 3. Functional Description

The ATR4289 is controlled via the 2-wire bus. One module-address byte, two subaddress bytes and five data bytes enable programming.

The module address contains a programmable address bit A 1, which (along with address select input AS, pin 4), enables the operation of two ATR4289 devices in one system. If bit A 1 is identical with the status of the address select input AS, the chip is selected.

The subaddress determines which of the data bytes is transmitted first. If the subaddress of the R divider is transmitted, the sequence of the next data bytes is DB 0 (Status), DB 1 and DB 2. If the subaddress of the N divider is transmitted, the sequence of the next data bytes is DB 3 and DB 4. The bit organization of the module address, subaddress and 5 data bytes is shown in [Table 7-1 on page 8](#).

Each transmission on the bus begins with the *START* condition and has to be ended by the *STOP* condition (see [Table 8-1 on page 8](#), “[Transmission Protocol](#)”).

The integrated circuit ATR4289 has two separate inputs for the AM and FM oscillators. Pre-amplified AM and FM signals are fed to the 16-bit R divider via the AM/FM switch. The AM/FM switch is software controlled. Tuning steps can be selected by the 16-bit R divider.

Furthermore, the device provides a digital memory phase detector and two separate current sources for the AM and FM amplifier (charge pump) as given in the Table “[Electrical Characteristics](#)” on [page 5](#). It allows independent gain adjustment, providing high current for high-speed tuning and low current for stable tuning.

## 4. Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Parameters	Pins	Symbol	Value	Unit
Supply voltage	1	$V_{DD}$	-0.3 to +6	V
Input voltage	2, 3, 4, 6, 8, 14, 15	$V_I$	-0.3 to $V_{DD} + 0.3$	V
Output current	3, 5	$I_O$	-1 to +5	mA
Output drain voltage	5	$V_{OD}$	15	V
Analog supply voltage with 220 $\Omega$ serial resistance 2 minutes <sup>(1)</sup>	13	$V_A$	6 to 15	V
		$V_A$	24	V
Output current	9, 12	$I_{AO}$	-1 to +20	mA
Ambient temperature range		$T_{amb}$	-30 to +85	°C
Storage temperature range		$T_{stg}$	-40 to +125	°C
Junction temperature		$T_j$	125	°C
Electrostatic handling (modified MIL STD 883 D method 3015.7: all supply pins connected together)		$\pm V_{ESD}$	1000	V

Note: 1. Corresponding to the application circuit ([Figure 9-1 on page 9](#))

## 5. Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient	$R_{thJA}$	160	K/W

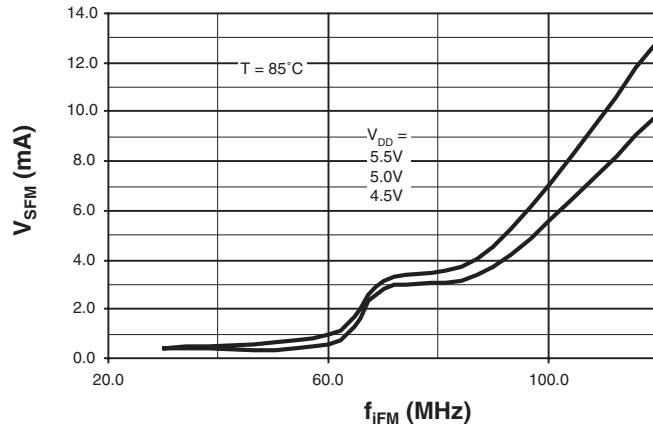
## 6. Electrical Characteristics

$V_{DD} = 5V$ ,  $V_A = 10V$ ,  $T_{amb} = 25^{\circ}C$ , unless otherwise specified

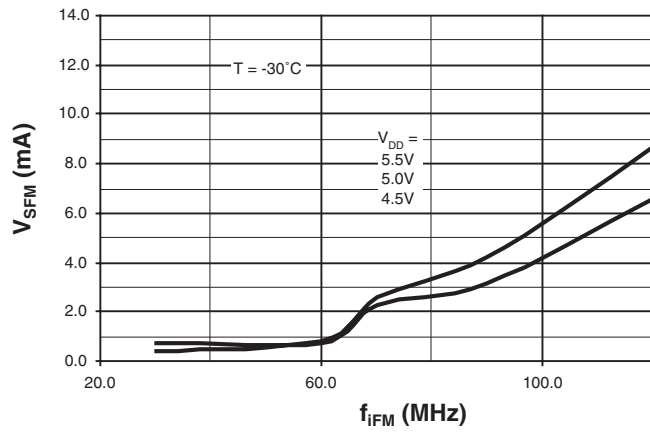
Parameters	Test Conditions	Pins	Symbol	Min.	Typ.	Max.	Unit
Supply voltage		1	$V_{DD}$	4.5	5.0	5.5	V
Quiescent supply current	AM mode/FM mode	1	$I_{DD}$		4.0	7.0	mA
FM input sensitivity, $R_G = 50\Omega$ , FMOSC	$f_i = 70$ MHz to 120 MHz	6	$V_{SFM}$	40			mV <sub>rms</sub>
	$f_i = 160$ MHz	6	$V_{SFM}$	150			mV <sub>rms</sub>
AM input sensitivity, $R_G = 50\Omega$ , AMOSC	$f_i = 0.6$ MHz to 35 MHz	8	$V_{SAM}$	40			mV <sub>rms</sub>
Oscillator input sensitivity, $R_G = 50\Omega$ , OSCIN	$f_i = 0.1$ MHz to 15 MHz	14	$V_{SOSC}$	100			mV <sub>rms</sub>
<b>Phase Detector PDFM</b>							
Output current 1		10	$\pm I_{PDFM}$	1600	2000	2400	$\mu A$
Output current 2		10	$\pm I_{PDFM}$	400	500	600	$\mu A$
Leakage current		10	$\pm I_{PDFML}$			20	nA
<b>Phase Detector PDAM</b>							
Output current 1		11	$\pm I_{PDAM}$	160	200	240	$\mu A$
Output current 2		11	$\pm I_{PDAM}$	40	50	60	$\mu A$
Leakage current		11	$\pm I_{PDAML}$			20	$\mu A$
<b>Analog Output PDFMO, PDAMO</b>							
Saturation voltage LOW	$I = 15$ mA	9, 12	$V_{satL}$		200	400	mW
Saturation voltage HIGH	$I = 15$ mA	9, 12	$V_{satH}$	9.5	9.95		V
<b>Bus SCL, SDA, AS</b>							
Input voltage HIGH		2, 3, 4	$V_{IBUS}$	3.0		$V_{DD}$	V
Input voltage LOW		2, 3, 4	$V_{IBUS}$	0		1.5	V
Output voltage acknowledge LOW	$I_{SDA} = 3$ mA	3	$V_O$			0.4	V
Clock frequency		2	$f_{SCL}$			100	kHz
Rise time SDA, SCL		2, 3	$t_r$			1	$\mu s$
Fall time SDA, SCL		2, 3	$t_f$			300	ns
Period of SCL HIGH		2	$t_H$	4.0			$\mu s$
Period of SCL LOW		2	$t_L$	4.7			$\mu s$
<b>Set-up Time</b>							
Start condition			$t_{sSTA}$	4.7			$\mu s$
Data			$t_{sDAT}$	250			$\mu s$
Stop condition			$t_{sSTOP}$	4.7			$\mu s$
Time space <sup>(1)</sup>			$t_{wSTA}$	4.7			$\mu s$
<b>Hold Time</b>							
Start condition			$t_{hSTA}$	4.0			$\mu s$
Data			$t_{hDAT}$	0			$\mu s$

Note: 1. This is a period of time where the bus must be free from data transmission before a new transmission can be started.

**Figure 6-1.** FM Input Sensitivity,  $T_{amb} = +85^{\circ}\text{C}$



**Figure 6-2.** FM Input Sensitivity,  $T_{amb} = -30^{\circ}\text{C}$



**Figure 6-3.** AM Input Sensitivity,  $T_{amb} = +85^{\circ}\text{C}$

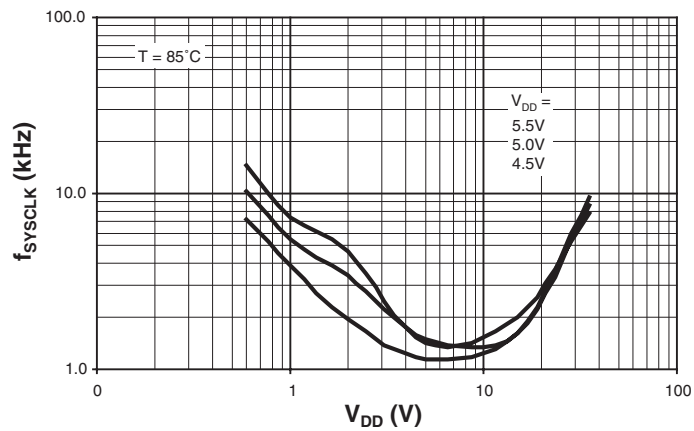


Figure 6-4. AM Input Sensitivity,  $T_{amb} = -30^{\circ}\text{C}$

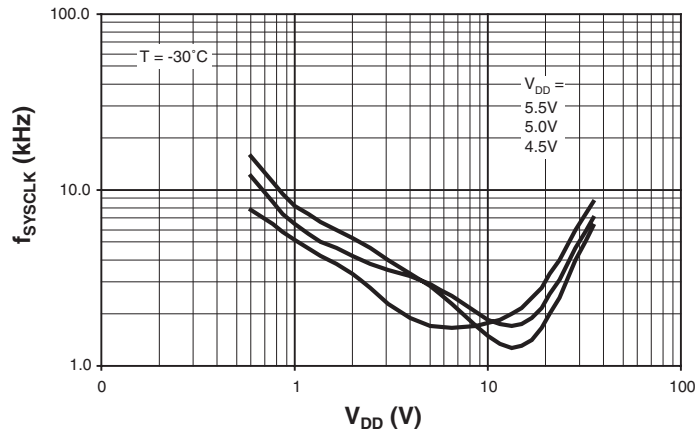
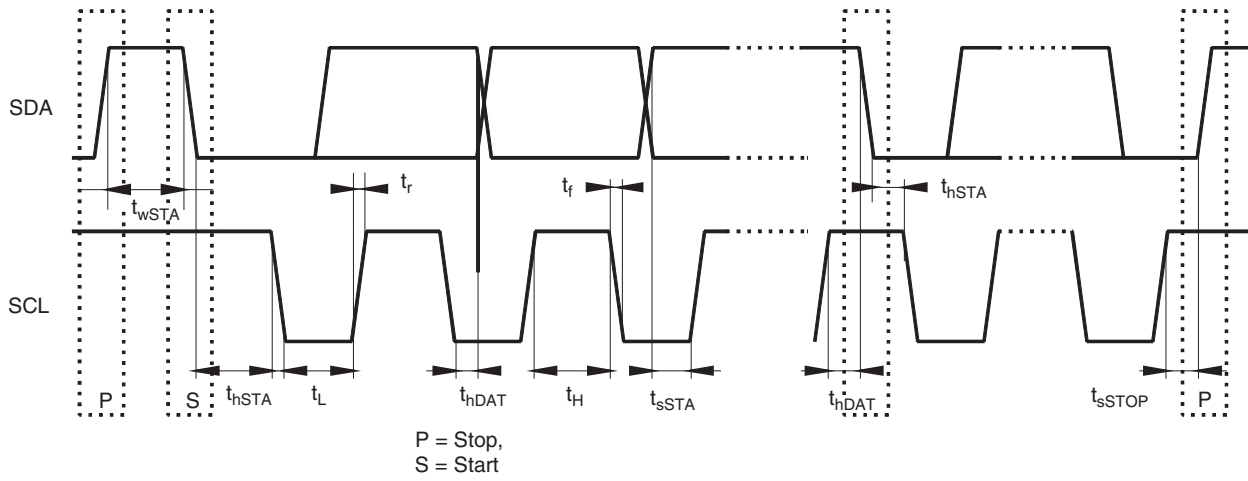


Figure 6-5. Bus Timing





## 7. Bit Organization

**Table 7-1.** Bit Organization

	MSB							LSB
Module address	1	1	0	0	1	0	0/1	0
	A7	A6	A5	A4	A3	A2	A1	A0
Subaddress (R-divider)	X	X	X	0	0	1	X	X
Subaddress (N-divider)	X	X	X	X	1	1	X	X
Data byte 0 (Status)	SWO1				AM/FM	PD - ANA	PD - POL	PD - CUR
	D7	D6	D5	D4	D3	D2	D1	D0
Data byte 1	$2^{15}$	R divider						$2^8$
Data byte 2	$2^7$	R divider						$2^0$
Data byte 3	$2^{15}$	N divider						$2^8$
Data byte 4	$2^7$	N divider						$2^0$

**Table 7-2.** Function Mode

Bit Description	Mode	LOW	HIGH
D3	AM/FM	FM operation	AM operation
D2	PD - ANA	PD analog	TEST
D1	PD - POL	Negative polarity	Positive polarity
D0	PD - CUR	Output current 2	Output current 1

## 8. Transmission Protocol

**Table 8-1.** Transmission Protocol

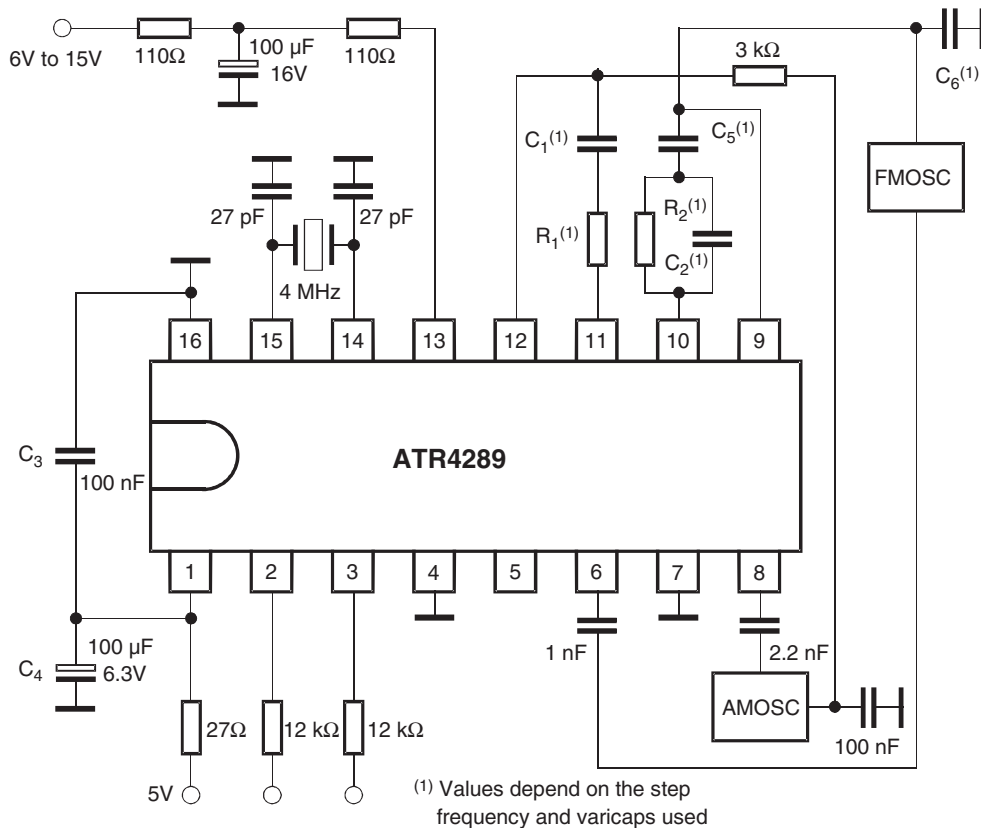
	MSB	LSB										
S	Address		A	Subaddress	A	Data 0	A	Data 1	A	Data 2	A	P
	A0	A7		R divider								

	MSB	LSB									
S	Address		A	Subaddress	A	Data 3	A	Data 4	A	P	
	A0	A7		N divider							

Note: S = Start, P = Stop, A = Acknowledge

## 9. Application

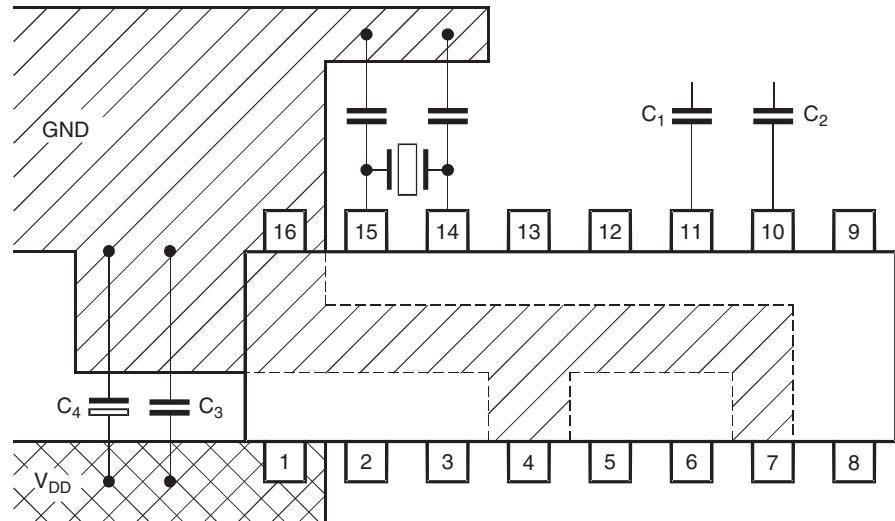
Figure 9-1. Application Circuit



## 9.1 Recommendations for Applications

- $C_3 = 100 \text{ nF}$  should be very close to pin 1 ( $V_{DD}$ ) and pin 16 (GND1)
- GND2 (pin 7, analog ground) and GND1 (pin 16, digital ground) must be connected as shown in [Figure 9-1](#)
- 4 MHz crystal must be very close to pin 14 and pin 15
- Components of the charge pump ( $C_1 / R_1$  for AM and  $C_2 / R_2$  for FM) should be very close to pin 11 with respect to pin 10.

**Figure 9-2.** PCB Layout

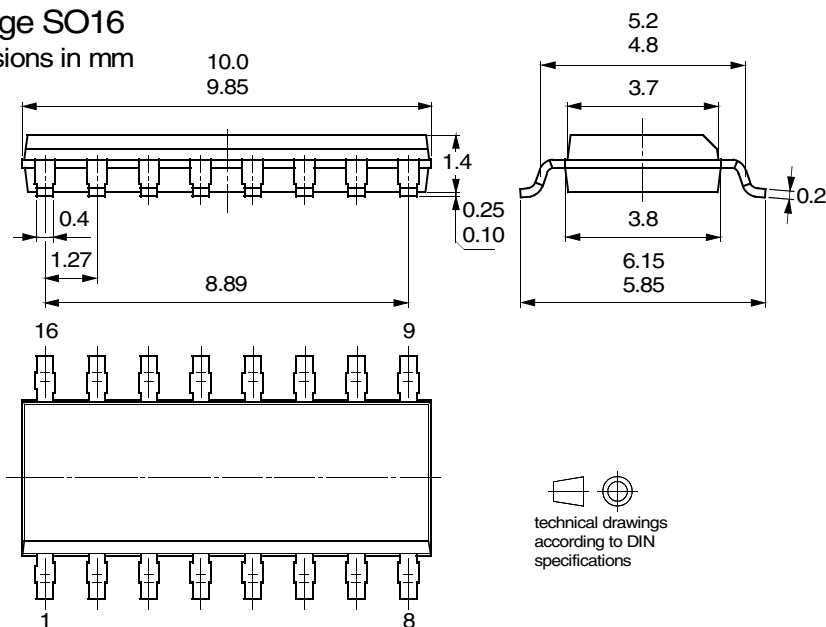


## 10. Ordering Information

Extended Type Number	Package	Remarks
ATR4289-TBSY	SO16 plastic	Pb-free
ATR4289-TBQY	SO16 plastic	Taping according to IEC-286-3, Pb-free

## 11. Package Information

Package SO16  
Dimensions in mm





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