

AM / FM - PLL

Description

The U4289BM 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 an I^2C bus. The device is designed for all frequency synthesizer applications in radio receivers, as well as RDS ($\bf Radio \ Data \ System$) applications.

Features

- Reference oscillator up to 15 MHz
- Two programmable 16 bit dividers adjustable from 2 to 65535
- High signal/noise ratio

• Fine tuning steps:

 $AM \ge 1 \text{ kHz}$ $FM \ge 2 \text{ kHz}$

 Few external component required due to integrated loop-push-pull stage for AM/FM

Ordering and Package Information

Extended Type Number	Package	Remarks
U4289BM-AFP	SO16 plastic	
U4289BM-AFPG3	SO16 plastic	Taping according to IEC-286-3

Block Diagram

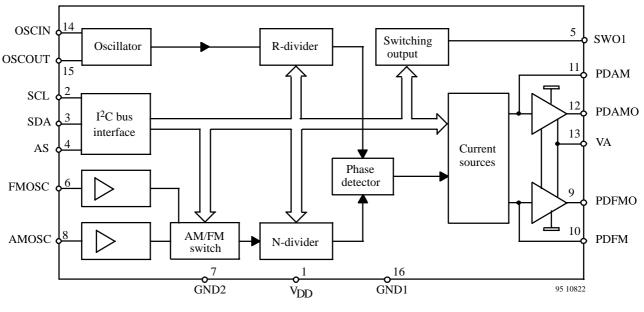
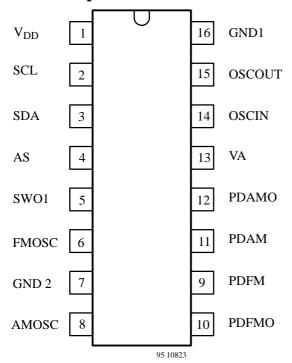


Figure 1.



Pin Description



Pin	Symbol	Function
1	V_{DD}	Supply voltage
2	SCL	I ² C bus clock
3	SDA	I ² C bus data
4	AS	Address selection
5	SWO1	Switching output
6	FMOSC	FM oscillator input
7	GND 2	Ground 2 (analogue)
8	AMOSC	AM oscillator input
9	PDFMO	FM analogue output
10	PDFM	FM current output
11	PDAM	AM current output
12	PDAMO	AM analogue output
13	VA	Analogue supply voltage
14	OSCIN	Oscillator input
15	OSCOUT	Oscillator output
16	GND1	Ground 1 (digital)

Functional Description

The U4289BM is controlled via the 2-wire I²C bus. For programming there are one module address byte, two subaddress bytes and five data bytes.

The module address contains a programmable address bit A 1 which with address select input AS (Pin 4) makes it possible to operate two U4289BM 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 one of the data bytes is transmitted first. If subaddress of R-divider is transmitted, the sequence of the next data bytes is DB 0 (Status), DB 1 and DB 2.

If subaddress of N-divider is transmitted, the sequence of the next data bytes is DB 3 and DB 4. The bit organisation of the module address, subaddress and 5 data bytes are shown in figure 2.

Each transmission on the I²C bus begins with the "START"- condition and has to be ended by the "STOP"-condition (see figure 3).

The integrated circuit U4289BM has two separate inputs for AM and FM oscillator. Pre-amplified AM and FM signals are fed to the 16 bit N-divider via AM/FM switch. AM/FM switch is controlled by software. Tuning steps can be selected by 16 bit R-divider. Further there is a digital memory phase detector. There are two separate current sources for AM and FM amplifier (charge pump) as given in electrical characterisitics. It allows independent adjustment of gain, whereby providing high current for high speed tuning and low current for stable tuning.



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
	MSB							LSB
Data byte 0 (Status)	SWO1				AM/ FM	PD ANA	PD POL	PD CUR
	D7	D6	D5	D4	D3	D2	D1	D0
			•	•				
Data byte 1	215			R-di	vider			28
Data byte 2	27	R-divider						
Data byte 3	215			N-di	vider			28
Data byte 4	27			N-di	vider			20

	LOW	HIGH
AM/FM	FM-operation	AM-operation
PD – ANA	PD analogue	TEST
PD – POL	Negative polarity	Positive polarity
PD – CUR	Output current 2	Output current 1

Figure 2.

U4289BM



Transmission Protocol

	MSB	LSB										
S	 Add	lress	Α	Subaddress	A	Data 0	A	Data 1	A	Data 2	A	P
	A7	A0		R-divider								

	MSB	LSB								
S	A7	ddress A0	A	Subaddress N–divider	A	Data 3	A	Data 4	A	P
	1			1, 01,1001				Α		

S = Start P = Stop A = Acknowledge

Figure 3.

Absolute Maximum Ratings

]	Parameters	Symbol	Value	Unit
Supply voltage	Pin 1	V_{DD}	-0.3 to +6	V
Input voltage	Pins 2, 3, 4, 6, 8, 14 and 15	V _I	-0.3 to $V_{DD} + 0.3$	V
Output current	Pins 3 and 5	I_{O}	-1 to +5	mA
Output drain voltage	Pin 5	V _{OD}	15	V
Analogue supply voltage with 220 Ω seriell resista	e Pin 13 ance 2 minutes ¹⁾	$egin{array}{c} V_A \ V_A \end{array}$	6 to 15 24	V V
Output current	Pins 9 and 12	I_{AO}	-1 to +20	mA
Ambient temperature ran	nge	T _{amb}	-30 to +85	°C
Storage temperature rang	ge	T _{stg}	-40 to +125	°C
Junction temperature		Tj	125	°C
	nodified MIL STD 883 D ly pins connected together)	± V _{ESD}	1000	V

¹⁾ corresponding our application circuit (page 7)

Thermal Resistance

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



Electrical Characteristics

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

	Parameters	Test conditions	/ Pin	Symbol	Min.	Тур.	Max.	Unit
FM input sensitivity, R _G = 50 Ω FMOSC Fig. 70 to 120 MHz Pin 6 V _{SFM} 40 MV _{rms} MV _{rms} Fig. 160 MHz Pin 6 V _{SFM} 150 MV _{rms} MI _{put sensitivity, R_G = 50 Ω AMOSC Fig. 0.6 to 35 MHz Pin 18 V_{SAM} 40 MV_{rms} MV_{rms} Oscillator input sensitivity, R_G = 50 Ω OSCIN Fig. 0.1 to 15 MHz Pin 14 V_{SOSC} 100 MV_{rms} MV_{rms} Oscillator input sensitivity, R_G = 50 Ω OSCIN Fig. 0.1 to 15 MHz Pin 10 ElpDem How the sensitivity How the sensitivity}	Supply voltage		Pin 1	V_{DD}	4.5	5.0	5.5	V
FM input sensitivity, $R_G = 50 \Omega$ FMOSC $Pin 6$ V_{SFM} 40 mV_{rms} $f_1 = 70 to 120 MHz$ $Pin 6$ V_{SFM} 150 mV_{rms} AM input sensitivity, $R_G = 50 \Omega$ AMOSC mV_{rms} mV_{rms} $f_1 = 0.6 to 35 MHz$ $Pin 18$ V_{SAM} 40 mV_{rms} Oscillator input sensitivity, $R_G = 50 \Omega$ OSCIN mV_{rms} mV_{rms} mV_{rms} Phase detector PDFM mV_{rms} mV_{rms} mV_{rms} Output current 1 $pin 10$ $\pm 1p_{DFM}$ ± 1600 2000 2400 μA Output current 2 $pin 10$ $\pm 1p_{DFM}$ ± 1600 2000 2400 μA Dutput current 2 $pin 10$ $\pm 1p_{DFM}$ ± 1600 2000 2400 μA Dutput current 1 $pin 10$ $\pm 1p_{DAM}$ ± 100 ± 1000 ± 1000 ± 1000 ± 1000 ± 1000 ± 1000 ± 10000 ± 10000 ± 10000 ± 100000 ± 1000000 ± 100000000 ± 1000000000000 <	Quiescent supply current	AM-mode	Pin 1	I_{DD}		4.0	7.0	mA
Fig. = 70 to 120 MHz		<u> </u>				4.0	7.0	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	FM input sensitivity, $R_G =$	50 Ω FMOSC						
AM input sensitivity, R _G = 50 Ω AMOSC f₁ = 0.6 to 35 MHz Pin 8 V _{SAM} 40 mV _{rms} mV _{rms}	$f_i = 70 \text{ to } 120 \text{ MHz}$		Pin 6	V _{SFM}	40			mV_{rms}
	$f_i = 160 \text{ MHz}$		Pin 6	V _{SFM}	150			mV _{rms}
Secillator input sensitivity, R _G = 50 Ω OSCIN f ₁ = 0.1 to 15 MHz Pin 14 V _{SOSC} 100 MV _{mss} MV _{mss}	AM input sensitivity, $R_G =$	50 Ω AMOSC						
Pin 14	$f_i = 0.6$ to 35 MHz		Pin 8	V_{SAM}	40			mV_{rms}
Phase detector PDFM	Oscillator input sensitivity,	$R_G = 50 \Omega OSCIN$						
Output current 1 Pin 10 Pin 10 Pin 10 ± I _{PDFM} ± I _{PDFM} ± I _{PDFM} 1600 ± 500 2400 ± 400 μA ± I _{PDFM} ± I _{PDFM} 200 ± 400 μA ± I _{PDFM} ± I _{PDFM} 200 ± 400 μA ± I _{PDFM} ± I _{PDFM} 200 ± 400 μA ± I _{PDFM} ± I _{PDFM} 200 ± 240 μA ± I _{PDFM} ± I _{PDFM} 200 ± 240 μA ± I _{PDFM} ± I _{PDFM} 400 50 60 μA ± I _{PDFM} ± I _{PDFM} 40 50 60 μA ± I _{PDFM} ± I _{PDFM} 40 50 60 μA ± I _{PDFM} ± I _{PDFM} 40 50 60 μA ± I _{PDFM} ± I _{PDFM} 40 50 60 μA ± I _{PDFM} ± I _{PDFM} ± I _{PDFM} 40 50 60 μA ± I _{PDFM} ± I _{PDF}	$f_i = 0.1$ to 15 MHz		Pin 14	V _{SOSC}	100			mV_{rms}
Output current 2 Pin 10 ± I _{PDFM} 400 500 600 μA Leakage current Pin 10 ± I _{PDFML} 20 nA Phase detector PDAM Output current 1 Pin 11 ± I _{PDAM} 160 200 240 μA Output current 2 Pin 11 ± I _{PDAM} 40 50 60 μA Leakage current Pin 11 ± I _{PDAM} 40 50 60 μA Leakage current Pin 11 ± I _{PDAM} 40 50 60 μA Leakage current Pin 11 ± I _{PDAM} 40 50 60 μA Leakage current Pin 21 ± I _{PDAM} 40 50 40 mA Leakage current Pin 31 * I _{PDAM} 40 20 nA * N * N * N * N * N * N * N * N * N * N * N * N * N * N * N * N * N *	Phase detector PDFM							
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Output current 1		Pin 10	± I _{PDFM}	1600	2000	2400	μΑ
Phase detector PDAM Output current 1 Output current 2 Output current 2 Pin 11 Pin 11 ± I _{PDAM} ± I _{PDAM} 40 50 60 μA Leakage current Porton PDAMO Pin 11 ± I _{PDAM} 40 50 60 μA Leakage current Porton PDAMO Vasatt I I _{PDAM} V Satt Condition V Satt Condition V Satt V	Output current 2			± I _{PDFM}	400	500	600	μA
Output current 1 Output current 2 Pin 11 Pin 11 Pin 11 $\pm I_{PDAM} \\ \pm I_{PD$	Leakage current		Pin 10	$\pm I_{PDFML}$			20	nA
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Phase detector PDAM							
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$						200	240	μΑ
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Output current 2		Pin 11	$\pm I_{PDAM}$	40	50		μΑ
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			Pin 11	$\pm I_{PDAML}$			20	nA
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		PDAMO					1	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			and 12					
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		I = 15 mA		V _{sat} L	0.5		400	
$ \begin{array}{ c c c c c c } \hline \text{Input voltage} \\ HIGH \\ LOW \\ \hline \hline \\ \text{Output voltage} \\ \text{Acknowledge LOW} \\ \hline \\ \text{Clock frequency} \\ \hline \\ \text{Pin 2} \\ \hline \\ \text{Pin 2} \\ \hline \\ \text{Pin 2} \\ \hline \\ \text{Start condition} \\ \hline \\ \text{Start condition} \\ \hline \\ \text{Hold time} \\ \hline \\ \text{Start condition} \\ \hline \\ $				v _{satH}	9.5	9.95		V
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		D: 2	2 14	X7				1
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		Pins 2,	3 and 4	V _{iBUS}	3.0		Van	V
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$								
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			Pin 3				1.5	•
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		$I_{SDA} = 3 \text{ mA}$	1 111 5	V_{0}			0.4	V
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		SDIT	Pin 2				100	kHz
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		Pins	2 and 3				1	μs
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Fall time SDA, SCL	Pins	2 and 3				300	·
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				1				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	HIGH			t _H				μs
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	LOW	LOW			4.7			μs
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$,			1	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	l .			t _{sSTA}				μs
Time space $^{1)}$ t_{wSTA} $^{4.7}$ μs $^{4.7}$ Hold time Start condition t_{hSTA} $^{4.0}$ μs								
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Stop condition			t _{sSTOP}	4.7			μs
Hold time Start condition t_{hSTA} 4.0 μs	Time space 17			tcm	47			US
Start condition t _{hSTA} 4.0 µs	Hold time	l		WSIA	,		l	I Pio
115171				ti. cm.	4.0			II S
	DATA			t _{hDAT}	0			μs

This is a space of time where the bus must be free from data transmission and before a new transmission can be started.



Bus Timing

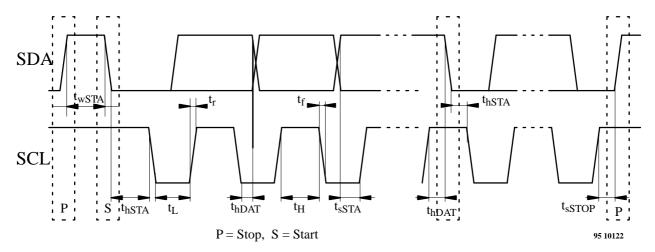


Figure 4.

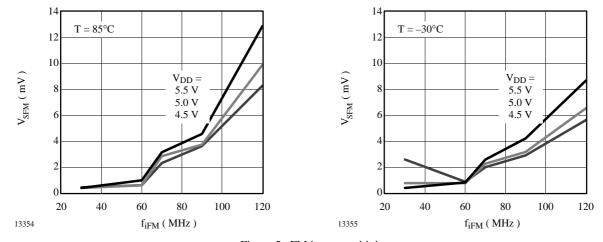


Figure 5. FM input sensitivity

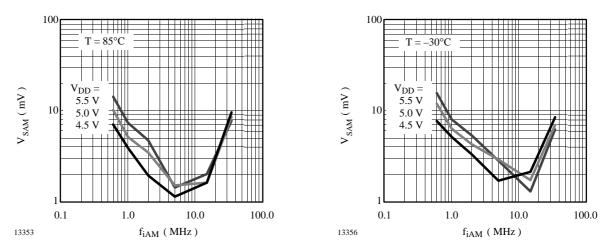


Figure 6. AM input sensitivity

Application Circuit

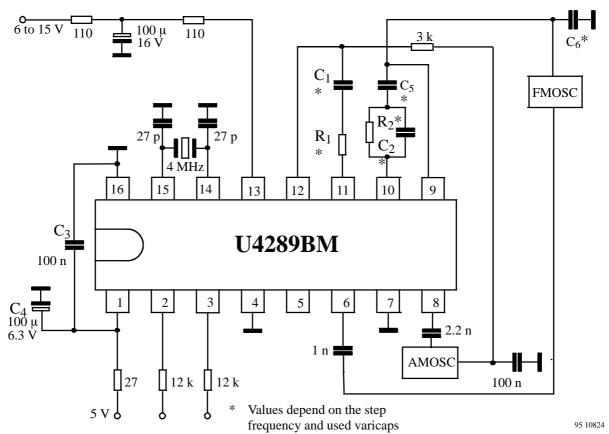


Figure 7.



Recommendations for Applications

- $C_3 = 100 \text{ nF}$ should be very close to Pin 1 (V_{DD}) and Pin 16 (GND 1)
- GND 2 (Pin 7 analog ground) and GND 1 (Pin 16 digital ground) must be connected according to figure 8
- 4 MHz crystal must be very close to Pin 14 and Pin 15
- Components of the charge pump (C₁/R₁ for AM and C₂/R₂ for FM) should be very close to Pin 11 with respect to Pin 10.

PCB-Layout

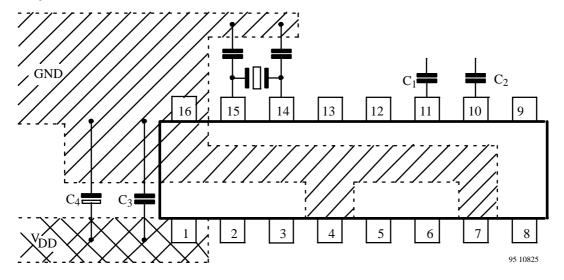
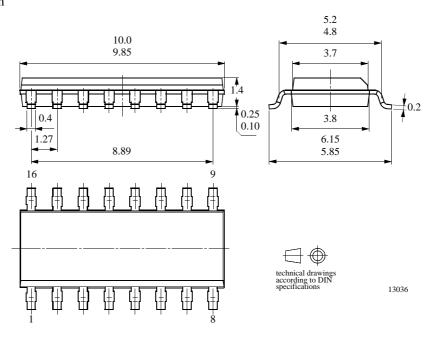


Figure 8.



Package Information

Package SO16 Dimensions in mm



U4289BM



Ozone Depleting Substances Policy Statement

It is the policy of TEMIC TELEFUNKEN microelectronic GmbH to

- 1. Meet all present and future national and international statutory requirements.
- 2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

TEMIC TELEFUNKEN microelectronic GmbH semiconductor division has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

- 1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
- 2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
- 3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

TEMIC can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

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Parameters can vary in different applications. All operating parameters must be validated for each customer application by the customer. Should the buyer use TEMIC products for any unintended or unauthorized application, the buyer shall indemnify TEMIC against all claims, costs, damages, and expenses, arising out of, directly or indirectly, any claim of personal damage, injury or death associated with such unintended or unauthorized use.

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