

## AM / FM-PLL

### Description

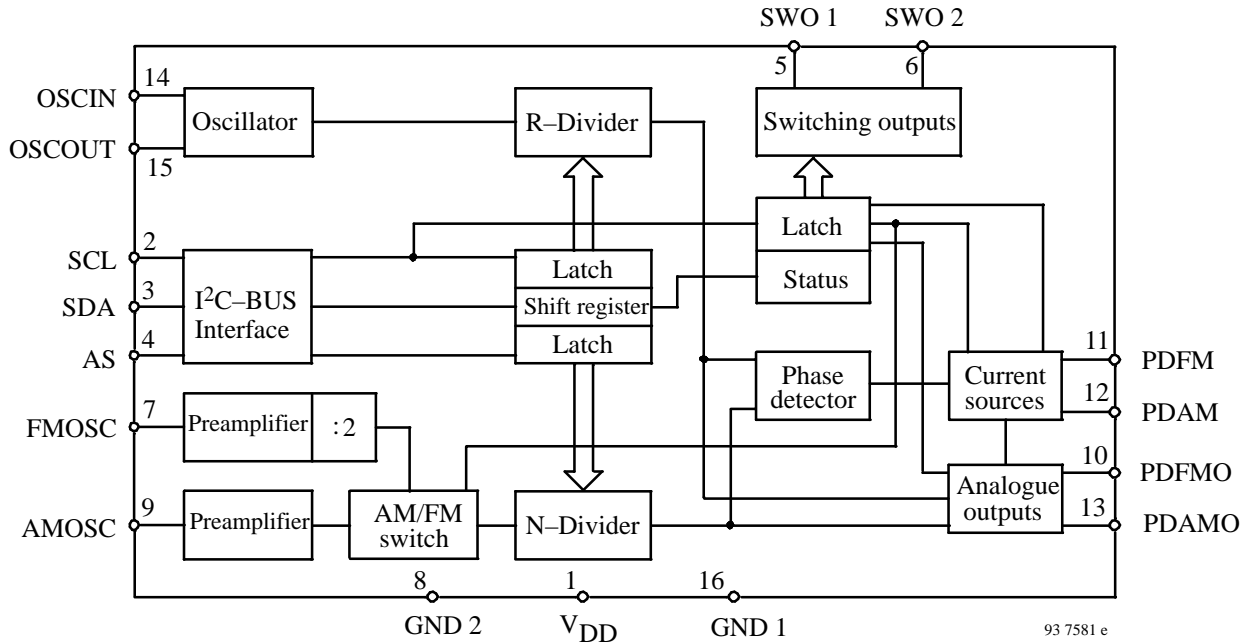
The U4286BM is an integrated circuit in BICMOS technology for frequency synthesizer. It performs all the functions of a PLL radio tuning system and is controlled by I<sup>2</sup>C bus. The device is designed for all frequency

synthesizer applications of radio receivers, as well as RDS ( **R**adio **D**ata **S**ystem ) applications.

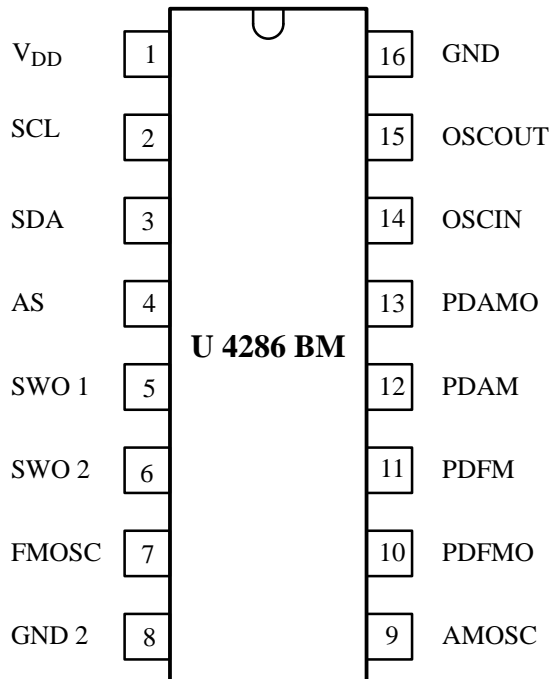
### Features

- 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
- Two programmable switching outputs (open drain up to 20 V)
- Few external component requirements due to integrated loop-transistor for AM/FM
- High signal/ noise ratio

### Block Diagram



## Pin Description



94 7908 e

Pin	Symbol	Function
1	V <sub>DD</sub>	Supply voltage
2	SCL	I <sup>2</sup> C bus clock
3	SDA	I <sup>2</sup> C bus data
4	AS	Address selection
5	SWO 1	Switching output 1
6	SWO 2	Switching output 2
7	FMOSC	FM oscillator input
8	GND 2	Ground 2 (analog)
9	AMOSC	AM oscillator input
10	PDFMO	FM analogue output
11	PDFM	FM current output
12	PDAM	AM current output
13	PDAMO	AM analogue output
14	OSCIN	Oscillator input
15	OSCOUT	Oscillator output
16	GND 1	Ground 1 (digital)

## Functional Description

The U4286BM is controlled via the 2-wire I<sup>2</sup>C 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 U4286BM-B 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 I<sup>2</sup>C bus begins with the "START"- condition and has to be ended by the "STOP"- condition (see figure 3).

The integrated circuit U4286BM has two separate inputs for AM and FM oscillator. Pre-amplified AM signal is directed to the 16 bit N-divider via AM/ FM switch, whereas (pre-amplified) FM signal is first divided by a fixed prescaler (:2). 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 characteristics. It allows independent adjustment of gain, whereby providing high current for high speed tuning and low current for stable tuning.

## Bit Organisation

	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	X	0	1	X	X
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Subaddress (N-divider)	X	X	X	X	1	1	X	X
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	MSB							LSB
Data byte 0 (Status)	X	SWO1	SWO2	X	AM/ FM	PD ANA	PD POL	PD CUR
	D7	D6	D5	D4	D3	D2	D1	D0

Data byte 1	$2^{15}$	R-divider						$2^8$
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Data byte 2	$2^7$	R-divider						$2^0$
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Data byte 3	$2^{15}$	N-divider						$2^8$
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Data byte 4	$2^7$	N-divider						$2^0$
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	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.

## Transmission protocol

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

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

S = Start    P = Stop    A = Acknowledge

Figure 3.

## Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Supply voltage      Pin 1	$V_{DD}$	-0 to +6	V
Input voltage      Pin 2, 3, 4, 7, 9, 14, 15	$V_I$	-0.3 to $V_{DD} + 0.3$	V
Output current      Pin 3, 5, 6	$I_O$	-1 to +5	mA
Output drain voltage      Pin 5, 6	$V_{OD}$	20	V
Output voltage      Pin 10, 13	$V_{AO}$	15	V
Output current      Pin 10, 13	$I_{AO}$	-1 to +20	mA
Ambient temperature range	$T_{amb}$	-25 to +85	°C
Storage temperature range	$T_{stg}$	-40 to +125	°C
Junction temperature	$T_j$	125	°C
Electrostatic handling (MIL Standard 883C)	$\pm V_{ESD}$	2000	V

## Thermal Resistance

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

## Electrical Characteristics

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

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	Pin 1	$V_{DD}$	4.5	5.0	5.5	V
Quiescent supply current	Pin 1	$I_{DD}$		6.0	11.6	mA
<b>FM Input Sensitivity, <math>R_G = 50\ \Omega</math> FMOSC</b>						
$f_i = 70$ to $120\text{ MHz}$	Pin 7	$V_{SFM}$	25			mV
$f_i = 120$ to $130\text{ MHz}$	Pin 7	$V_{SFM}$	50			mV
<b>AM Input Sensitivity, <math>R_G = 50\ \Omega</math> AMOSC</b>						
$f_i = 0.5$ to $35\text{ MHz}$	Pin 9	$V_{SAM}$	25			mV
<b>Oscillator Input Sensitivity, <math>R_G = 50\ \Omega</math> OSCIN</b>						
$f_i = 0.1$ to $15\text{ MHz}$	Pin 14	$V_{SOSC}$	100			mV
<b>Switching Output SWO 1, SWO 2 (Open Drain)</b>						
Output voltage LOW	Pin 5, 6 $I_L = 1\text{ mA}$	$V_{SWOL}$		200	400	mV
Output leakage current HIGH	Pin 5, 6 $V_5, V_6 = 20\text{ V}$	$I_{OHL}$		20	100	nA
<b>Phase Detector PDFM</b>						
Output current 1	Pin 11	$\pm I_{PDFM}$	400	500	600	$\mu\text{A}$
Output current 2	Pin 11	$\pm I_{PDFM}$	100	125	150	$\mu\text{A}$
<b>Phase Detector PDAM</b>						
Output current 1	Pin 12	$\pm I_{PDAM}$	75	100	125	$\mu\text{A}$
Output current 2	Pin 12	$\pm I_{PDAM}$	20	25	30	$\mu\text{A}$
<b>Analogue Output PDFMO, PDAMO</b>						
Saturation voltage	$I = 15\text{ mA}$ Pin 10, 13	$V_{sat}$		270	400	mV
Leakage current	Pin 10, 13	$I_{LEAK}$			1	$\mu\text{A}$
<b>I<sup>2</sup>C Bus SCL, SDA, AS</b>						
Input voltage HIGH LOW	Pin 2, 3, 4	$V_{iBUS}$	3.0 0		$V_{DD}$ 1.5	V V
Output voltage Acknowledge LOW	$I_{SDA} = 3\text{ mA}$ Pin 3	$V_O$			0.4	V
Clock frequency	Pin 2	$f_{SCL}$			100	kHz
Rise time SDA, SCL	Pin 2, 3	$t_r$			1	$\mu\text{s}$
Fall time SDA, SCL	Pin 2, 3	$t_f$			300	ns
Period of SCL HIGH LOW	Pin 2	$t_H$ $t_L$	4.0 4.7			$\mu\text{s}$ $\mu\text{s}$

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
<b>Setup Time</b>						
Start condition		$t_{sSTA}$	4.7			$\mu s$
Data		$t_{sDAT}$	250			ns
Stop condition		$t_{sSTOP}$	4.7			$\mu s$
Time the bus must be free before a new transmission can be started		$t_{wSTA}$	4.7			$\mu s$
<b>Hold time</b>						
Start condition		$t_{hSTA}$	4.0			$\mu s$
DATA		$t_{hDAT}$	0			$\mu s$

## Bus Timing

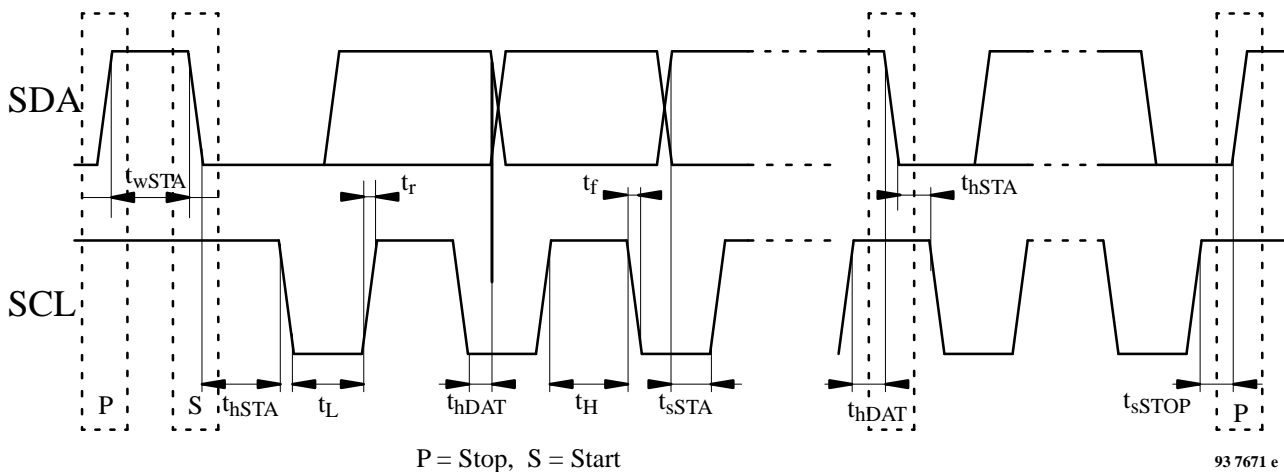
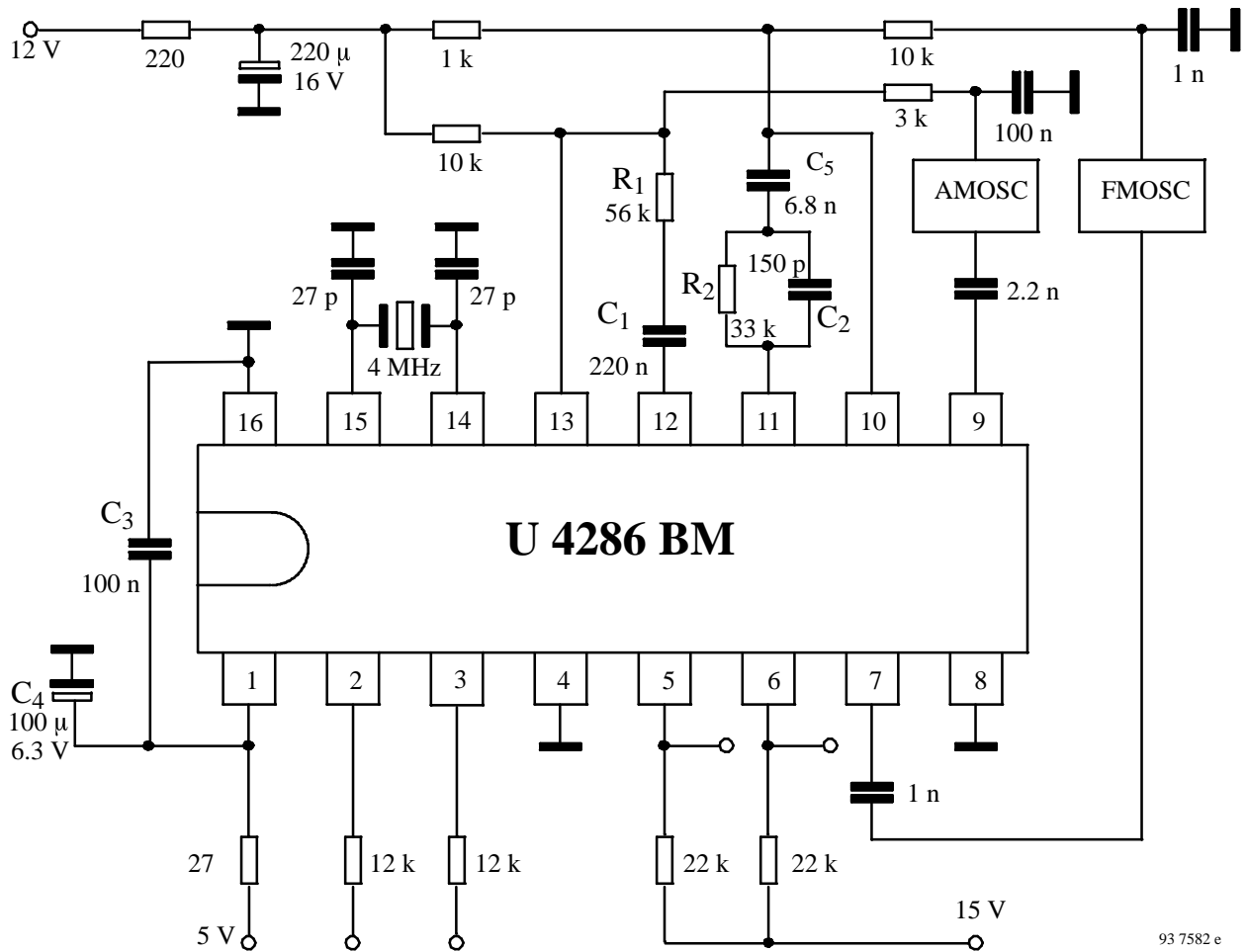


Figure 4.

## The Following Hints are Recommended:

- $C_3 = 100 \text{ nF}$  should be very close to Pin 1 ( $V_{DD}$ ) and Pin 16 (GND 1)
- 4 MHz quartz 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 12 with respect to Pin 11.
- GND 2 (Pin 8 – analog ground) and GND 1 (Pin 16 – digital ground) must be connected according to Figure 6

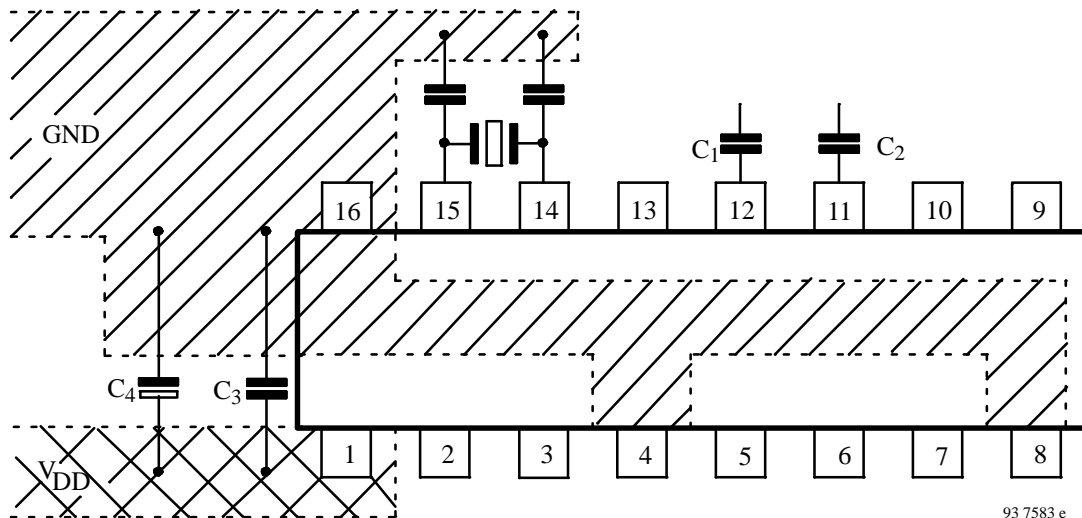
## Application Circuit



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Figure 5.

## PCB-Layout



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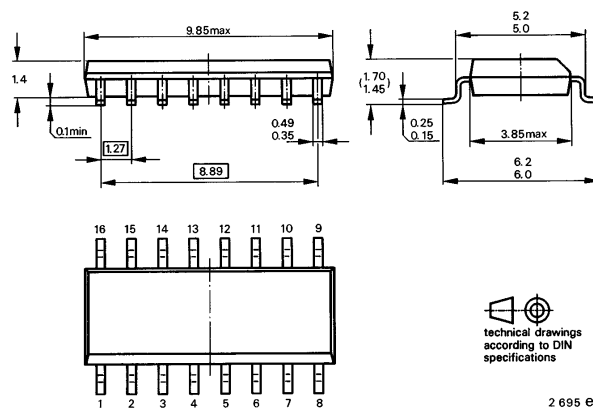
Figure 6.

## Ordering and Package Information

Extended Type Number	Package	Remarks
U4286BM-BFP	SO16 plastic	
U4286BM-BFPG3	SO16 plastic	Taping according to IEC-286-3

## Dimensions in mm

Package: SO16





## Ozone Depleting Substances Policy Statement

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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).

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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.

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