

## AM / FM - PLL

### Description

The U4284BM 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 (Radio Data System) applications.

### Features

- Reference oscillator up to 15 MHz
- Two programmable 16 bit dividers adjustable from 2 to 65535
- Fine tuning steps:
  - AM  $\cong$  1 kHz
  - FM  $\cong$  2 kHz
- 4 programmable switching outputs (open drain up to 20 V)
- Few external component requirements due to integrated loop-push-pull stage for AM/FM
- High signal/noise ratio

### Block diagram

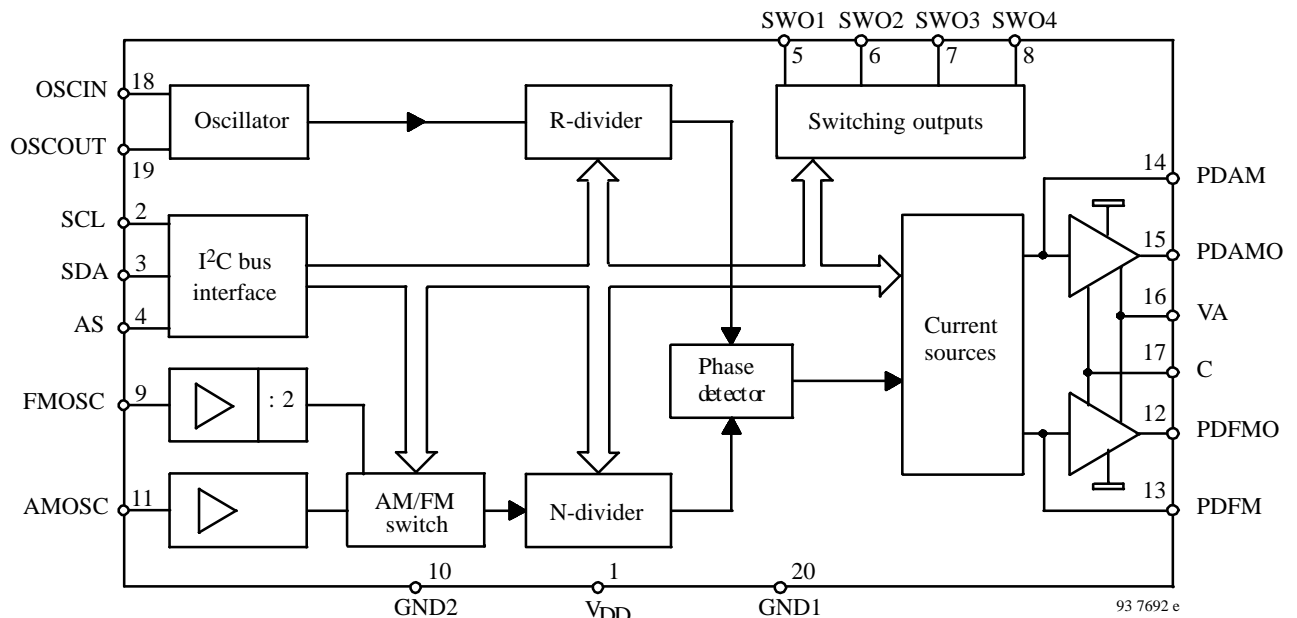
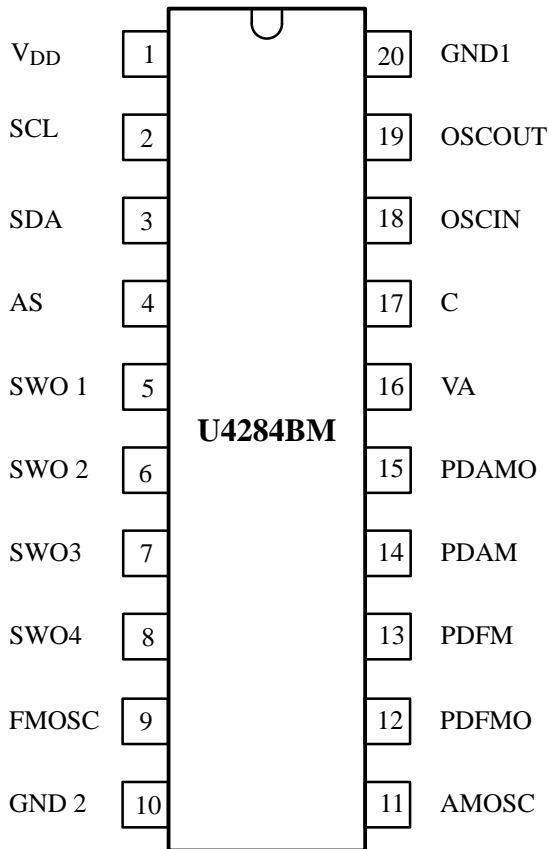


Figure 1

### Pin description



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	SWO3	Switching output 3
8	SWO4	Switching output 4
9	FMOSC	FM oscillator input
10	GND 2	Ground 2 (analogue)
11	AMOSC	AM oscillator input
12	PDFMO	FM analogue output
13	PDFM	FM current output
14	PDAM	AM current output
15	PDAMO	AM analogue output
16	VA	Analogue supply voltage
17	C	Capacitor
18	OSCIN	Oscillator input
19	OSCOUT	Oscillator output
20	GND1	Ground 1 (digital)

93 7713 e

### Functional description

The U4284BM 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 U4284BM 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 U4284BM 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
------------------------	---	---	---	---	---	---	---	---

Subaddress (N-divider)	X	X	X	X	1	1	X	X
------------------------	---	---	---	---	---	---	---	---

	MSB							LSB
Data byte 0 (Status)	SWO1	SWO2	SWO3	SWO4	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						$2^0$
-------------	-------	-----------	--	--	--	--	--	-------

	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		A	Subaddress	A	Data 0	A	Data 1	A	Data 2	A	P
	A7	A0		R-divider								

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

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      Pin 2, 3, 4, 9, 11, 18, 19	$V_I$	-0.3 to $V_{DD} + 0.3$	V
Output current      Pin 3, 5, 6, 7, 8	$I_O$	-1 to +5	mA
Output drain voltage      Pin 5, 6, 7, 8	$V_{OD}$	20	V
Analogue supply voltage      Pin 16	$V_A$	8 to 16	V
With 220 $\Omega$ seriell resistance 2 minutes <sup>2</sup>	$V_A$	24	V
Output current      Pin 12, 15	$I_{AO}$	-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) except Pins 12, 15 and 17	$\pm V_{ESD}$	2000	V

<sup>2</sup> corresponding our application circuit (page 7)

### Thermal resistance

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

## Electrical characteristics

$V_{DD} = 5\text{ V}$ ,  $V_A = 12\text{ V}$ ,  $T_{amb} = 25^\circ\text{C}$ , unless otherwise specified

Parameters	Test conditions / Pin	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	Pin 1	$V_{DD}$	4.5	5.0	5.5	V
Quiescent supply current	AM-mode FM-mode	Pin 1 $I_{DD}$		4.0 8.5	7.0 15.0	mA
<b>FM Input sensitivity, <math>R_G = 50\ \Omega</math> FMOSC</b>						
$f_i = 70$ to $120\text{ MHz}$	Pin 9	$V_{SFM}$	25			mV
$f_i = 120$ to $160\text{ MHz}$	Pin 9	$V_{SFM}$	50			mV
<b>AM Input Sensitivity, <math>R_G = 50\ \Omega</math> AMOSC</b>						
$f_i = 0.5$ to $35\text{ MHz}$	Pin 11	$V_{SAM}$	25			mV
<b>Oscillator Input Sensitivity, <math>R_G = 50\ \Omega</math> OSCIN</b>						
$f_i = 0.1$ to $15\text{ MHz}$	Pin 18	$V_{SOSC}$	100			mV
<b>Switching Output SWO 1, SWO 2, SWO 3, SWO 4 (Open Drain)</b>						
Output voltage LOW	Pin 5, 6, 7, 8 $I_L = 1\text{ mA}$	$V_{SWOL}$		200	400	mV
Output leakage current HIGH	Pin 5, 6, 7, 8 $V_5, V_6, V_7, V_8 = 20\text{ V}$	$I_{OHL}$			100	nA
<b>Phase Detector PDFM</b>						
Output current 1	Pin 13	$\pm I_{PDFM}$	400	500	600	$\mu\text{A}$
Output current 2	Pin 13	$\pm I_{PDFM}$	100	125	150	$\mu\text{A}$
Leakage current	Pin 13	$\pm I_{PDFML}$			20	nA
<b>Phase Detector PDAM</b>						
Output current 1	Pin 14	$\pm I_{PDAM}$	75	100	125	$\mu\text{A}$
Output current 2	Pin 14	$\pm I_{PDAM}$	20	25	30	$\mu\text{A}$
Leakage current	Pin 14	$\pm I_{PDAML}$			20	nA
<b>Analogue Output PDFMO, PDAMO</b>						
Saturation voltage LOW HIGH	Pin 12, 15 $I = 15\text{ mA}$	$V_{satL}$ $V_{satH}$	11.5	200 11.95	400	mV V
<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	Pin 3 $I_{SDA} = 3\text{ mA}$	$V_O$			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 HIGH LOW	$t_H$ $t_L$	4.0 4.7			$\mu\text{s}$ $\mu\text{s}$

Parameters	Test conditions / Pin	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

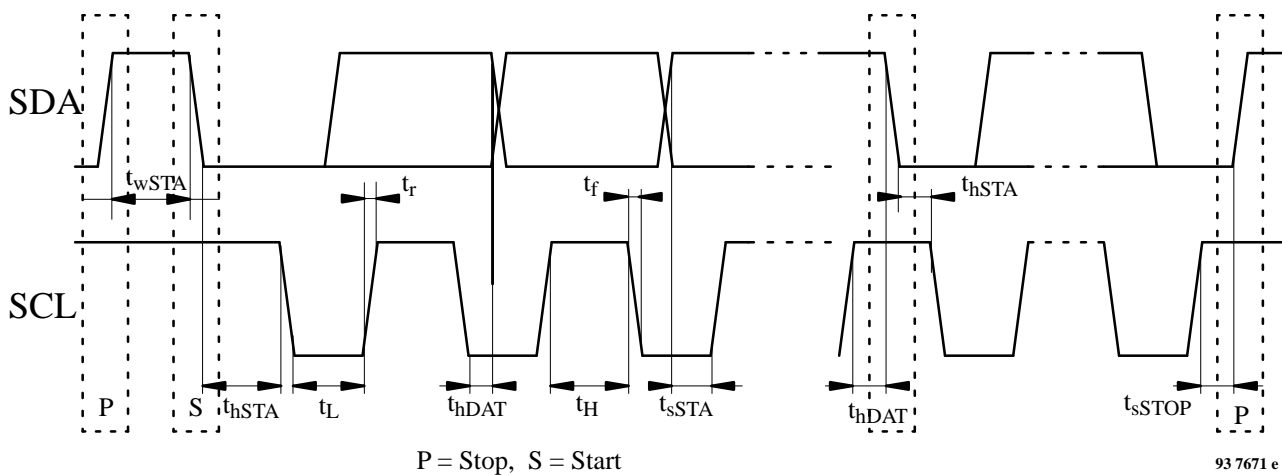
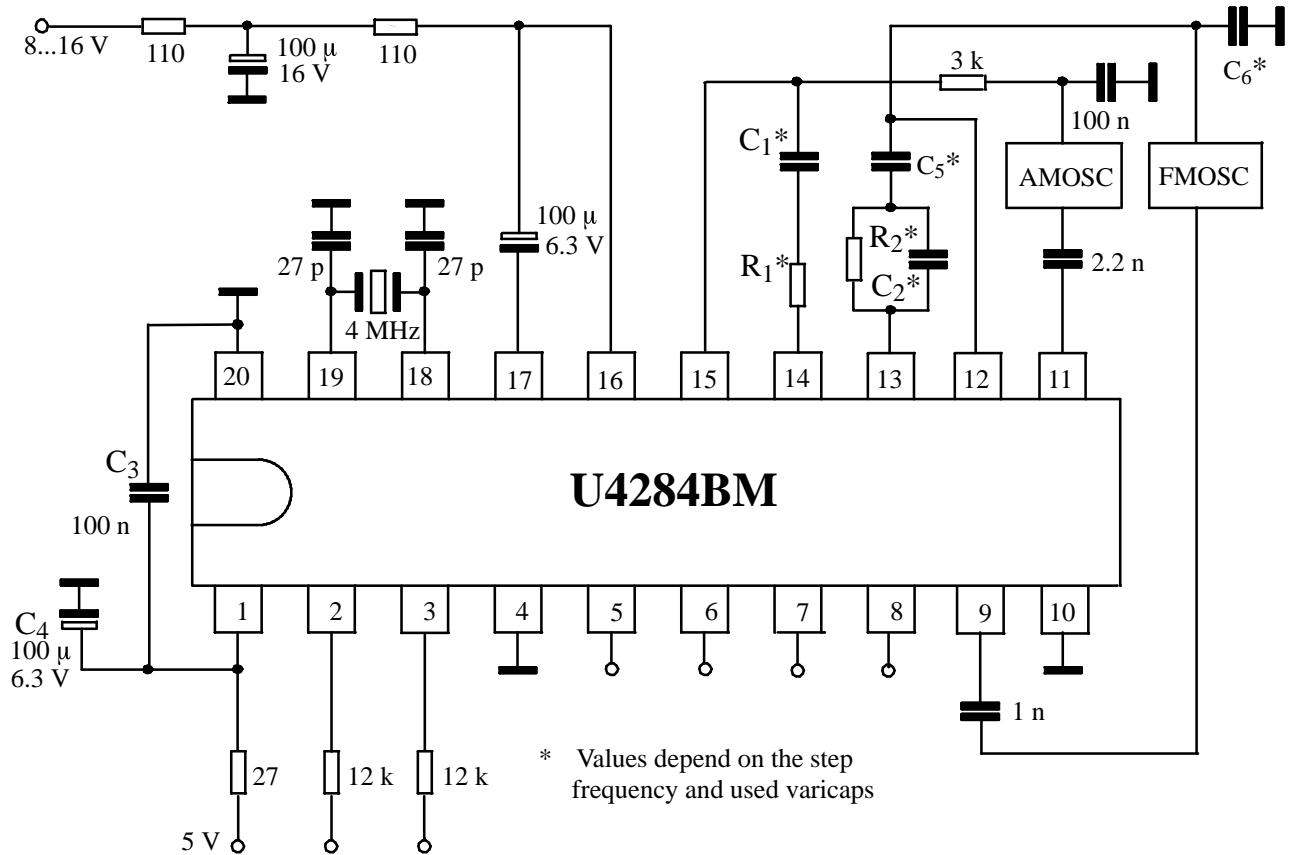


Figure 4

### The following hints are recommended:

- $C_3 = 100 \text{ nF}$  should be very close to Pin 1 ( $V_{DD}$ ) and Pin 20 (GND 1)
- GND 2 (Pin 10 – analogue ground) and GND 1 (Pin 20 – digital ground) must be connected according to figure 6
- 4 MHz quartz must be very close to Pin 18 and Pin 19
- Components of the charge pump ( $C_1/R_1$  for AM and  $C_2/R_2$  for FM) should be very close to Pin 14 with respect to Pin 13.

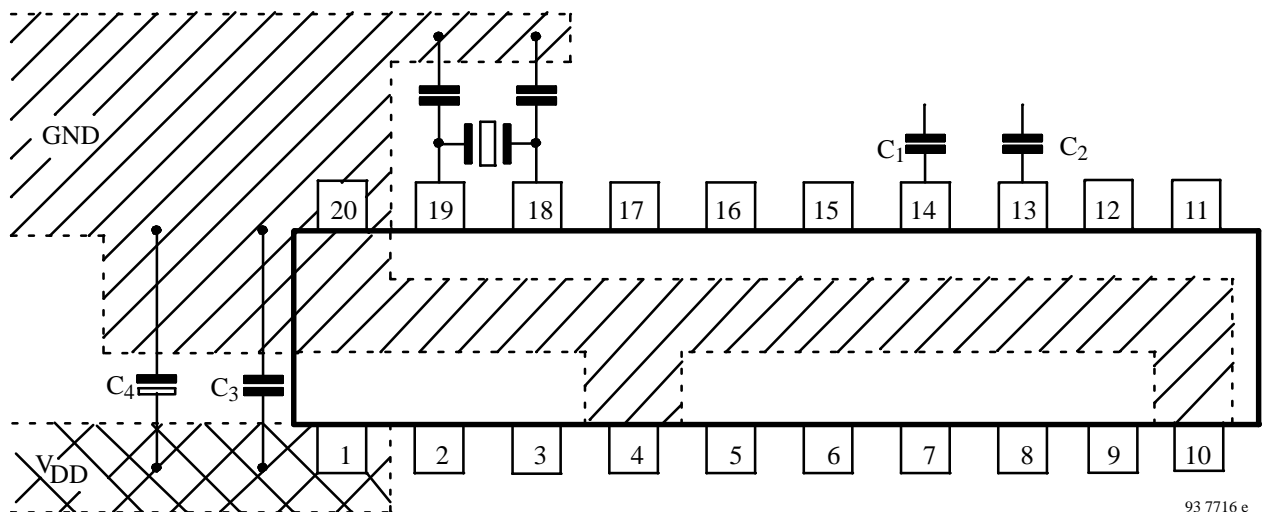
## Application circuit



93 7717 e

Figure 5

## PCB-layout



93 7716 e

Figure 6

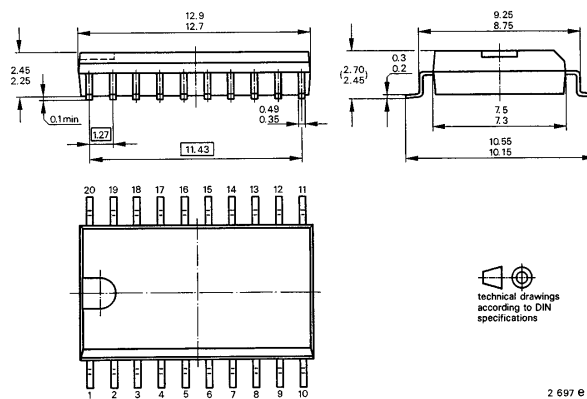
## U4284BM

### Ordering and Package Information

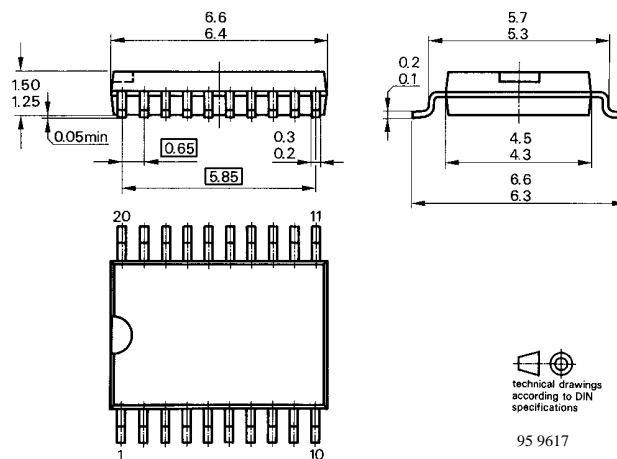
Extended type number	Package	Remarks
U4284BM-BFP	SO 20 plastic	
U4284BM-BFPG3	SO 20 plastic	Taping according to IEC-286-3
U4284BM-BFS	SSO 20 plastic	
U4284BM-BFSG3	SSO 20 plastic	Taping according to IEC-286-3

### Dimensions in mm

Package: SO 20



Package: SSO 20





## 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 and
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.

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

The Montreal Protocol (1987) and its London Amendments (1990) will soon 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 any 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 and
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 and do not contain ozone depleting substances.

**We reserve the right to make changes without further notice to improve technical design.**

Parameters can vary in different applications. All operating parameters must be validated for each customer application by customer. Should Buyer use TEMIC products for any unintended or unauthorized application, 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.

TEMIC TELEFUNKEN microelectronic GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany  
Telephone: 49 (0)7131 67 2831, Fax Number: 49 (0)7131 67 2423