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 (**R**adio **D**ata **S**ystem) 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 ≧ 1 kHz
  FM ≧ 2 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

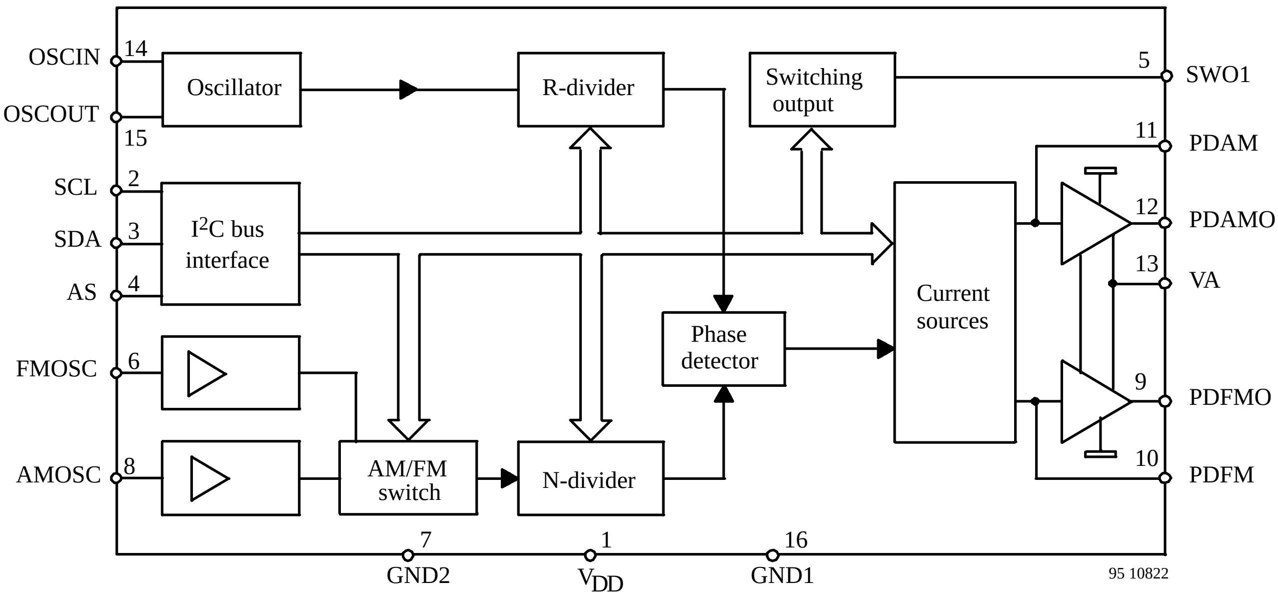
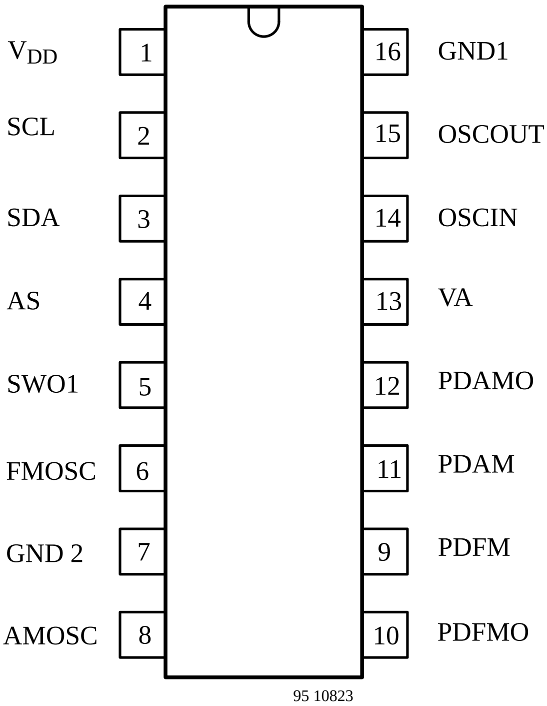


Figure 1.

Pin Description



Pin	Symbol	Function
1	V_{DD}	Supply voltage
2	SCL	I^2C bus clock
3	SDA	I^2C 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 I^2C 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 I^2C 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	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 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}	–0.3 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 resistance 2 minutes [1)]	Pin 13	V_A V_A	6 to 15 24	V V
Output current	Pins 9 and 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

[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 V, V_A = 10 V, T_{amb} = 25°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 Pin 1 FM-mode	I_{DD}		4.0 4.0	7.0 7.0	mA
FM input sensitivity, R_G = 50 Ω FMOSC						
f_i = 70 to 120 MHz	Pin 6	V_{SFM}	40			mV_{rms}
f_i = 160 MHz	Pin 6	V_{SFM}	150			mV_{rms}
AM input sensitivity, R_G = 50 Ω AMOSC						
f_i = 0.6 to 35 MHz	Pin 8	V_{SAM}	40			mV_{rms}
Oscillator input sensitivity, R_G = 50 Ω OSCIN						
f_i = 0.1 to 15 MHz	Pin 14	V_{SOSC}	100			mV_{rms}
Phase detector PDFM						
Output current 1 Output current 2	Pin 10 Pin 10	$\pm I_{PDFM}$ $\pm I_{PDFM}$	1600 400	2000 500	2400 600	µA µA
Leakage current	Pin 10	$\pm I_{PDFML}$			20	nA
Phase detector PDAM						
Output current 1 Output current 2	Pin 11 Pin 11	$\pm I_{PDAM}$ $\pm I_{PDAM}$	160 40	200 50	240 60	µA µA
Leakage current	Pin 11	$\pm I_{PDAML}$			20	nA
Analogue output PDFMO, PDAMO						
Saturation voltage LOW HIGH	Pins 9 and 12 I = 15 mA	 V_{satL} V_{satH}	 9.5	 200 9.95	 400	 mV V
I^2C bus SCL, SDA, AS						
Input voltage HIGH LOW	Pins 2, 3 and 4	V_{iBUS}	 3.0 0		 V_{DD} 1.5	 V V
Output voltage Acknowledge LOW	Pin 3 I_{SDA} = 3 mA	 V_O			 0.4	 V
Clock frequency	Pin 2	f_{SCL}			100	kHz
Rise time SDA, SCL	Pins 2 and 3	t_r			1	µs
Fall time SDA, SCL	Pins 2 and 3	t_f			300	ns
Period of SCL HIGH LOW	Pin 2 HIGH LOW	 t_H t_L	 4.0 4.7			 µs µs
Setup time						
Start condition Data Stop condition Time space 1)		t_{sSTA} t_{sDAT} t_{sSTOP} t_{wSTA}	4.7 250 4.7 4.7			µs ns µs µs
Hold time						
Start condition DATA		t_{hSTA} t_{hDAT}	4.0 0			µs µs

1) 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

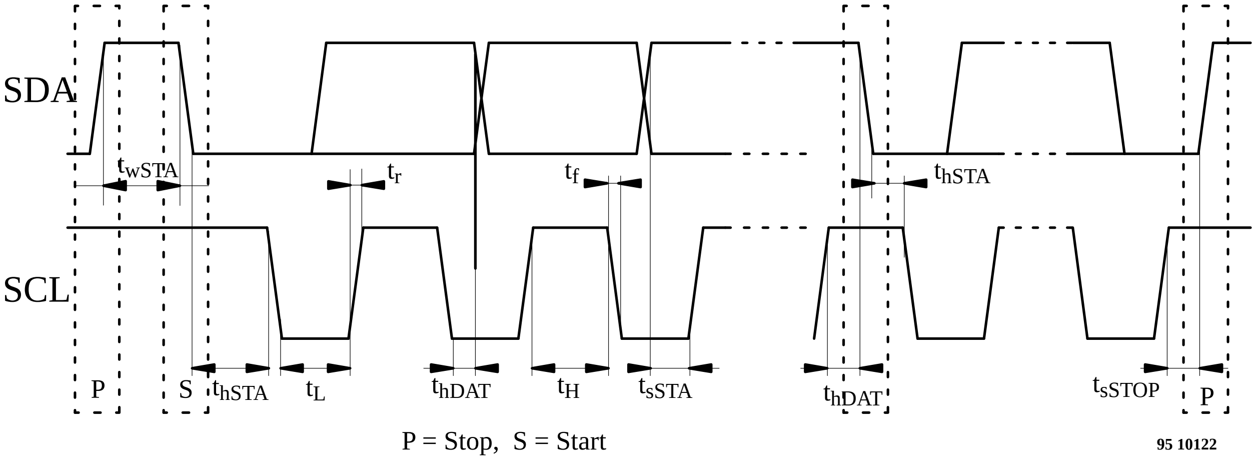


Figure 4.

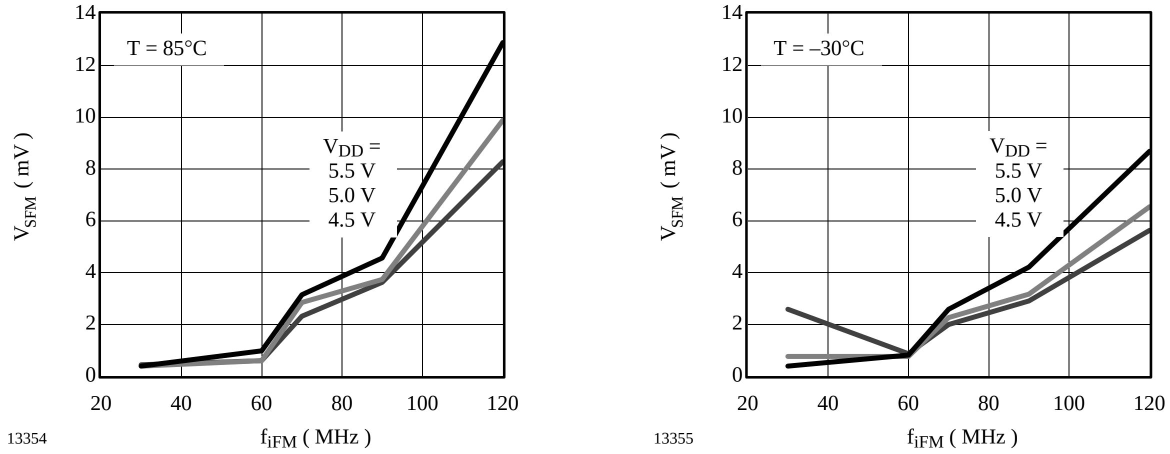


Figure 5. FM input sensitivity

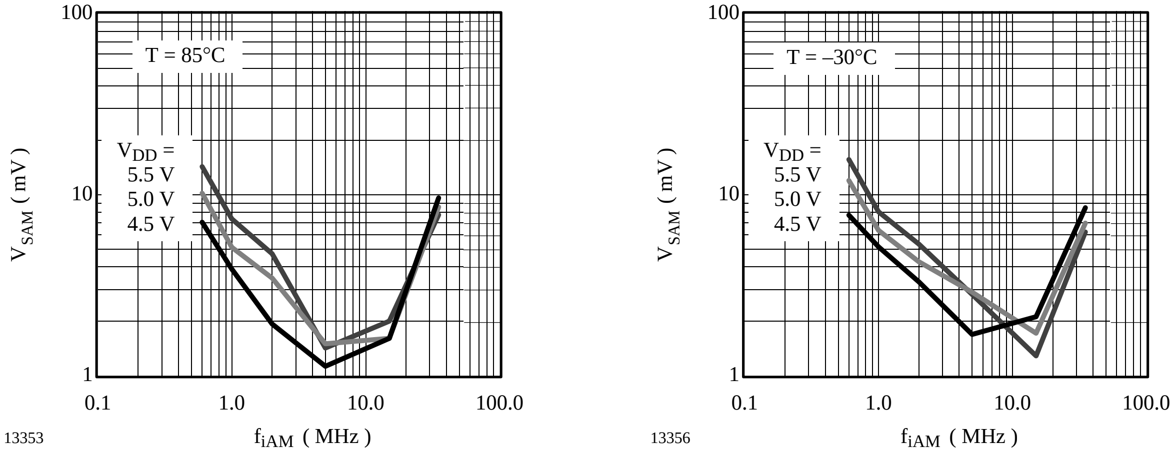


Figure 6. AM input sensitivity

Application Circuit

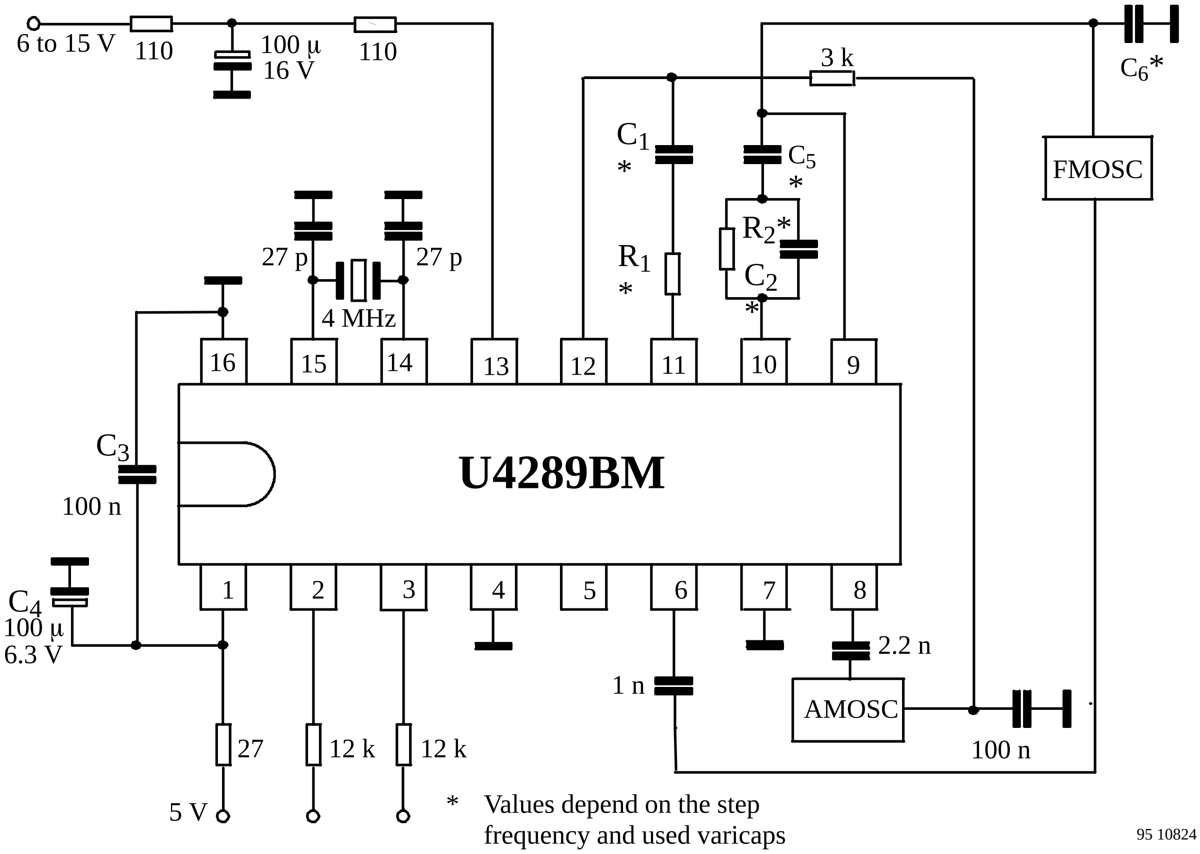


Figure 7.

Recommendations for Applications

- C_3 = 100 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 (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.

PCB-Layout

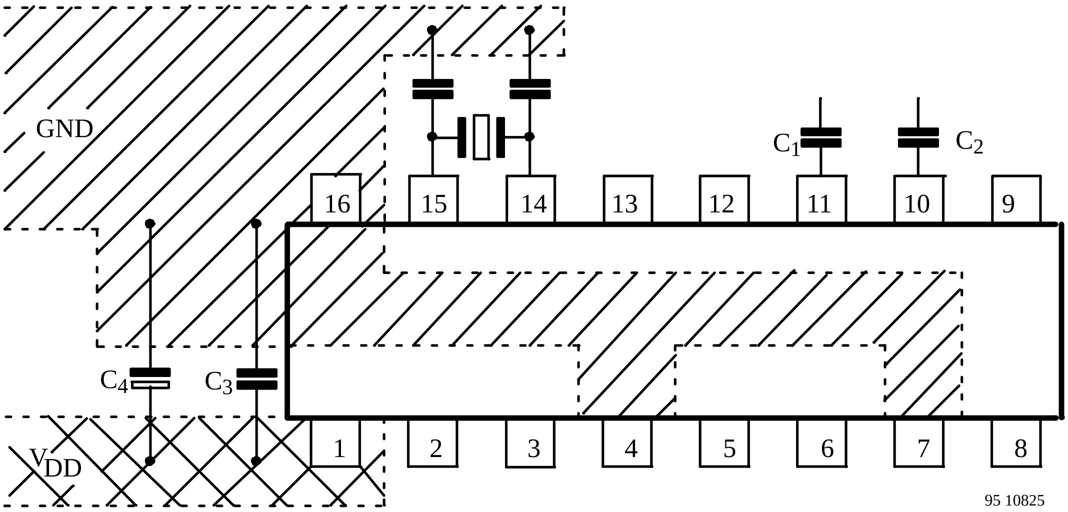
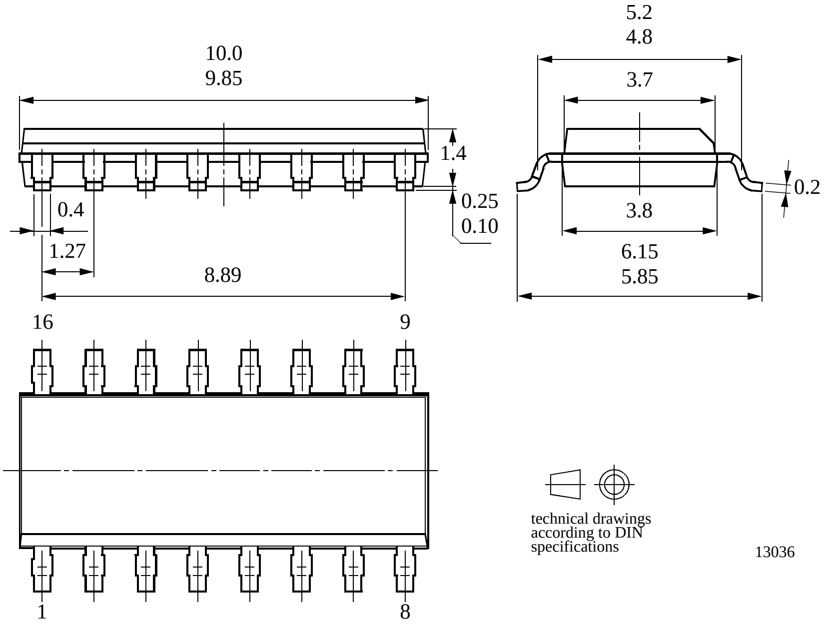


Figure 8.

Package Information

Package SO16

Dimensions in mm



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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