

## TV-Tuner IC with Two Separate Oscillators and Mixers, LO Output and Band Switch Input

### Description

This tuner IC requires a power supply of 12 V and performs the function of two separate oscillators and

mixers, dual state band switch and LO output in a small SO16 plastic package.

### Features

- Band A (VHF); low resistance symmetrical mixer input in common-base connection and 2-pin oscillator
- Band B (UHF); low resistance symmetrical mixer input in common-base connection and 4-pin oscillator
- Decoupled symmetrical LO output for frequency divider or PLL, one output is a simultaneous band-switch input
- Voltage stabilization to avoid operating voltage dependency
- ESD protection at all pins except for RF inputs and oscillator pins

### Block Diagram

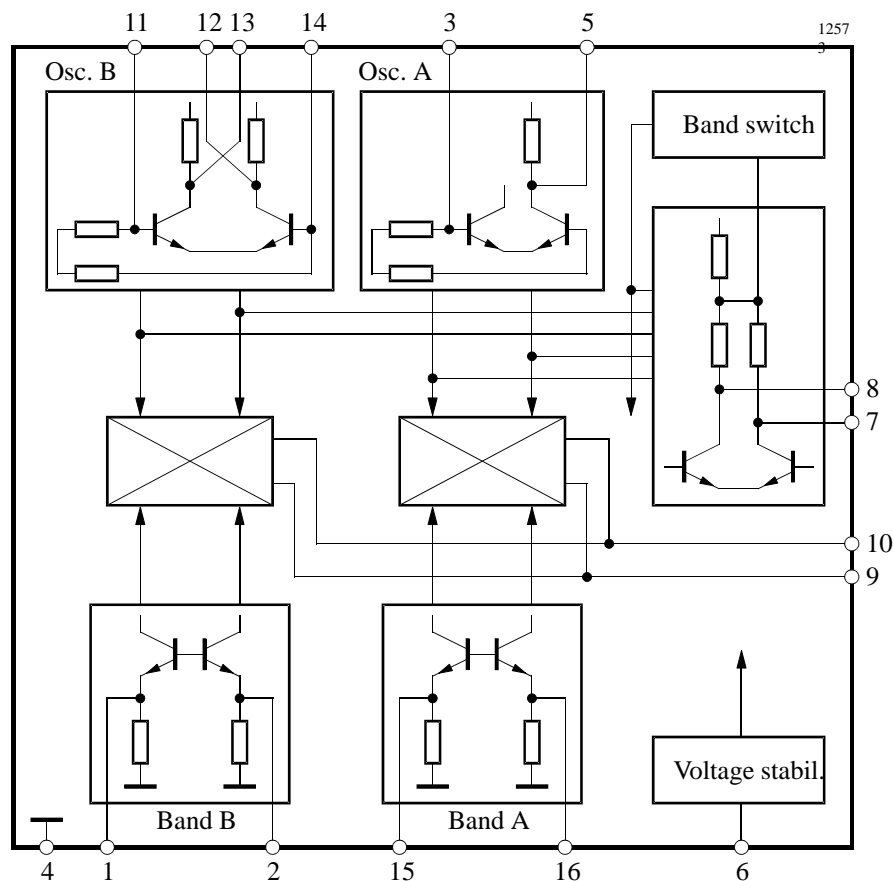


Figure 1. Block diagram

### Ordering Information

Extended Type Number	Package	Remarks
U2321B-AFP	SO16	

## Pin Description

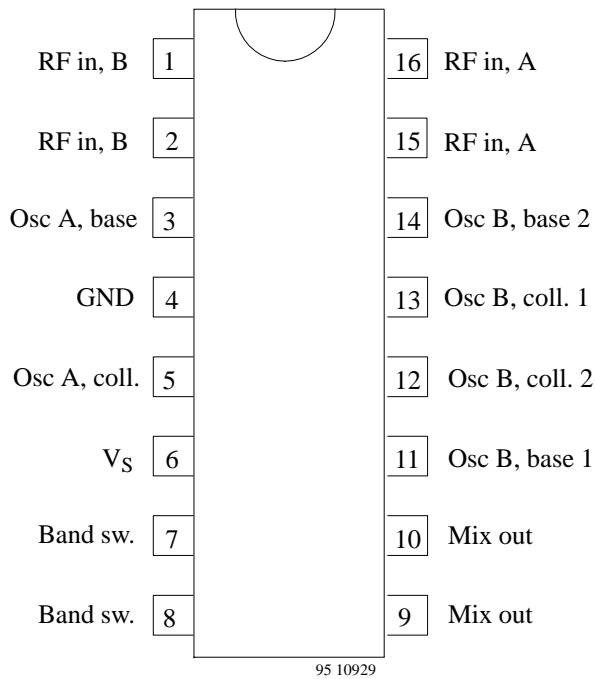


Figure 2. Pinning

Pin	Symbol	Function
1, 2	RF in, B	RF inputs, band B
3	Osc A, base	Oscillator band A, base
4	GND	Ground
5	Osc A, coll.	Oscillator band A, collector
6	V <sub>S</sub>	Supply voltage
7 and/or 8	Band sw.	Band switch input
7, 8		LO outputs
9, 10	Mix out	Mixer outputs, open collector
11	Osc B, base 1	Oscillator band B, base 1 collector 2 collector 1 base 2
12	Osc B, coll. 2	
13	Osc B, coll. 1	
14	Osc B, base 2	
15, 16	RF in, A	RF inputs, band A

## Absolute Maximum Ratings

Reference point Pin 4, unless otherwise specified

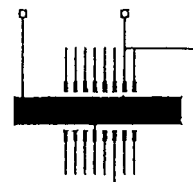
Parameters	Symbol	Value	Unit
Supply voltage	V <sub>S</sub>	13.5	V
Switching current	I <sub>SW</sub>	1	mA
RF inputs	V <sub>e</sub>	5	V
IF outputs	V <sub>IF</sub>	13.5	V
Power dissipation	P <sub>tot</sub>	450	mW
Junction temperature	T <sub>j</sub>	125	°C
Ambient temperature range	T <sub>amb</sub>	-25 to +80	°C
Storage temperature range	T <sub>stg</sub>	-25 to +125	°C

## Thermal Resistance

Junction ambient <sup>1)</sup>

Parameters	Symbol	Typ	Unit
Mounted without glue	R <sub>thJA</sub>	110	K/W
Mounted with glue	R <sub>thJA</sub>	100	K/W

<sup>1)</sup> Measured on a glass fibre printed circuit board 40 x 40 x 1.5 mm<sup>3</sup> with 35 μm Cu coating



R<sub>(th)</sub> SO16 U2321B

## Electrical Characteristics

$T_{amb} = 25^{\circ}\text{C}$ ,  $V_S = 12\text{ V}$ , reference point: Pin 4, unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min	Typ	Max	Unit
Supply voltage	Pin 6	$V_S$	10.8	12.0	13.2	V
Supply current	Pins 6 + 9 + 10	$I_S$		30		mA
Band switch thresholds	Pins 7 + 8 Band B (UHF) Band A (VHF) ( $V_{7/8}$ is approximately 7 V. The current can be taken from one or both pins).	$I_{BAND}$	0	-250	-50	$\mu\text{A}$ $\mu\text{A}$
LO level (per output)	$R_L = 50\ \Omega$ Pins 7, 8	$P_{LO}$	20		27	dBmV
LO output, harmonic spacing (referred to the fundamental wave)			-10			dBc
Crosstalk RF input (sym.) to the LO (sym.) (referred to the fundamental wave of the LO)	$V_e = 150\text{ mV}_{eff}$			-40	-35	dBc

For these LO measurements, the output must also be terminated with a balun ( $2 \times 50\ \Omega$  as input and  $50\ \Omega$  asymmetrical to the measurement receiver). If this circuit configuration is also used for measuring the LO level, the

value obtained is 6 dB higher.

Refer to page 7 for notes and explanations relating to the table above.

## Electrical Characteristics

### Band A

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Frequency range		$f_e$	48		470	MHZ
Input impedance	Pins 15, 16	$s_{11}$	(see figure 1)			
Gain <sup>1)</sup>	VHF -> IF	$V_p$		4		dB
DSB noise factor	$f_e = 50\text{ MHz}$	F		9.5		dB
	$f_e = 450\text{ MHz}$	F		10.0		dB
Signal to noise ratio	$V(e) = 80\text{ dB}\mu\text{V}$ IM 3rd order <sup>2)</sup>	S/N	60			dB
	IM 2nd order <sup>2)</sup>	S/N	60			dB
LO pulling with input signal 80% AM	$f_{mod} = 50\text{ kHz}$ $V(e) = 80\text{ dB}\mu\text{V}$		60			dB
N + 5 pulling				-50		dBc

1) All levels at the VHF and UHF input are available voltages at outputs across  $50\ \Omega$ . The present voltage is therefore not measured at this point.

2) Measured at IF output at test circuit page 5.

## Electrical Characteristics

### Band B

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Frequency range		$f_e$	470		860	MHz
Input impedance	Pin 1, 2	$s_{11}$	(see figure 1)			
Gain <sup>1)</sup>	VHF → IF	$V_p$		4		dB
DSB noise factor	$f_e = 500$ MHz	F		10.5		dB
	$f_e = 800$ MHz	F		11.5		dB
Signal-to-noise ratio	V (e) = 80 dB $\mu$ V					
	IM 3rd order <sup>2)</sup>	S/N	60			dB
	IM 2nd order <sup>2)</sup>	S/N	60			dB
LO pulling with input signal 80% AM	$f_{mod} = 50$ kHz V(e) = 80 dB $\mu$ V		60			dB
N + 5 pulling				-50		dBc

- 1) All levels at the VHF and UHF input are available voltages at outputs across 50  $\Omega$ . The present voltage is therefore not measured at this point.
- 2) Measured at IF output at test circuit page 5.

## Application and Test Circuit

### UHF-Oscillator

D3	BB729
C4	13 p
C5	1 p0
C6	1 p5
L4	1.5 turns 2.0 $\varnothing$

### VHF Oscillator

D1	BB729
D2	BA582
C1	3 p3
C2	1 p2
C3	68 p
L1	1.5 turns 2.5 $\varnothing$
L2	1.5 turns 2.8 $\varnothing$
L3	7.5 turns 2.5 $\varnothing$

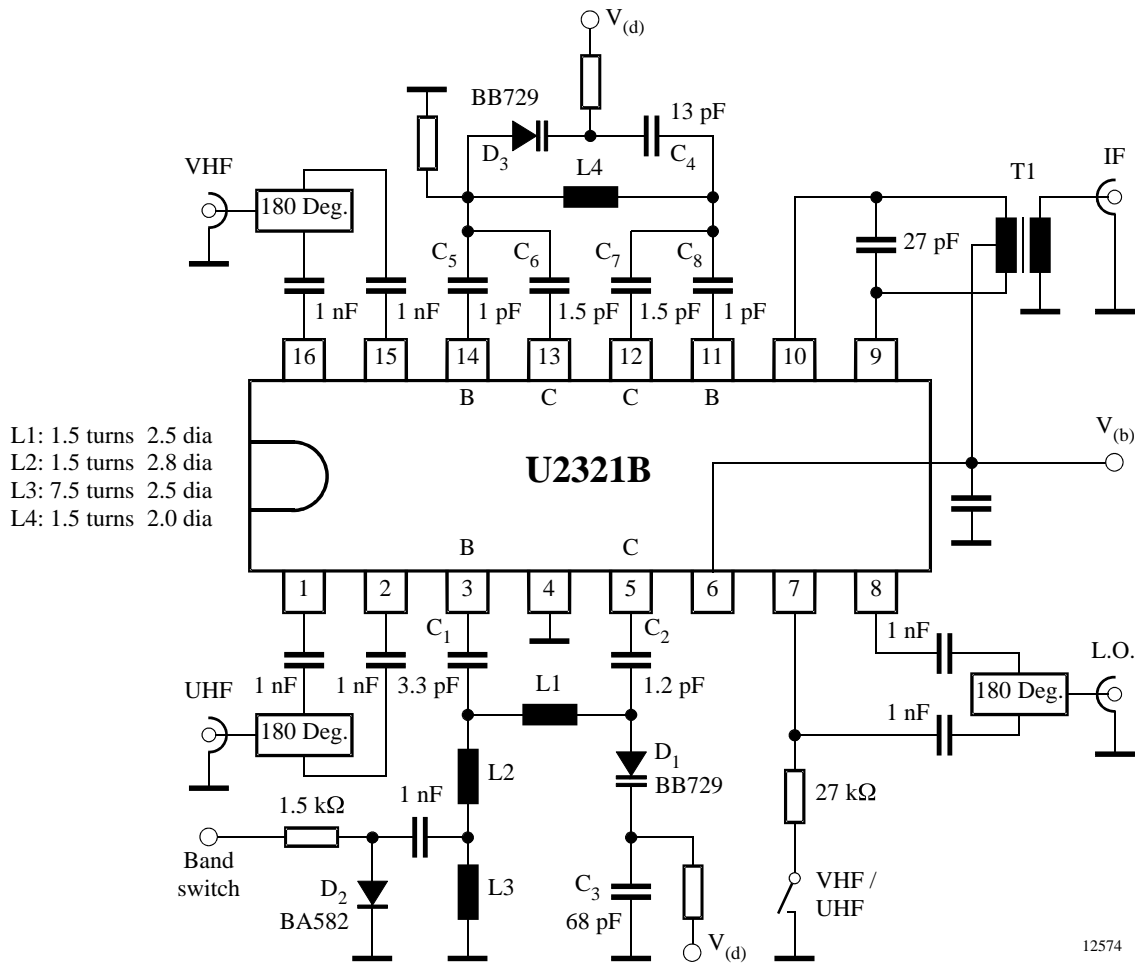


Figure 3.

## Input Impedance $S_{11}$

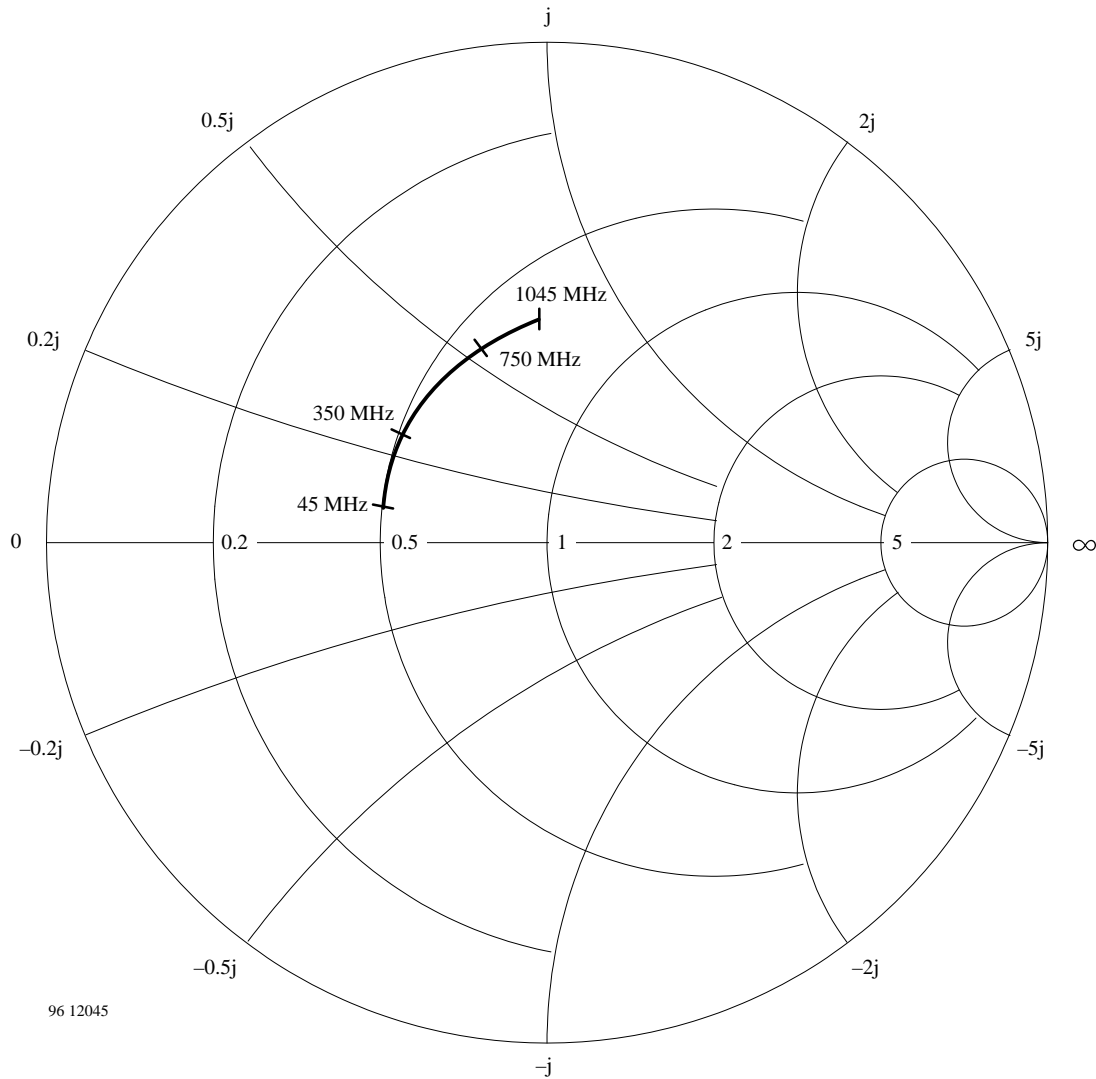


Figure 4. Input impedance  $S_{11}$  of the mixer band A (Pins 15, 16) and band B (Pins 1, 2)

The reference resistance is  $50 \Omega$ . The measuring range is 45 MHz ( [ ] ) to 1045 MHz. Control is symmetrical here. Since the hybrid used has an output resistance of  $100 \Omega$ ,

calibration to this value takes place followed by conversions to  $50 \Omega$ .

**General Notes**

The RF inputs A and B are controlled symmetrically by means of a hybrid with 180 degrees phase rotation. The source impedance is therefore 100 Ω. For RF measurements, all other impedances are 50 Ω.

The baluns used have an impedance of 50 Ω at all ports, meaning that the symmetrical side has an impedance of 100 Ω. The H-9 from the ANZAC company is an example of this. Since this is a power divider, the losses of approximately 3 dB are calculated within the measurement.

Other possibilities which are more simple to achieve may be a 4:1 transformer (disadvantage: at high frequencies > 600 MHz out of optimum) or a 50 Ω cable with a sufficient number of ferrit pearls (disadvantage: at low frequencies out of optimum). However, neither has the impedance of 100 Ω on the symmetrical side.

The double sideband noise factor is stated here, which means that the measurement is performed without RF selection. The source impedance is 100 Ω symmetrical (see above).

The N + 5 pulling is measured with an interference carrier interval of -1.1 MHz with respect to the oscillator frequency. The input level of the utilize carrier and the interference carrier is -27 dBm (80 dBμV) in each case. The interference interval is determined within the intermediate frequency relative to the utilize signal.

**IM 2**

Test conditions IM2:  $f(\text{interference}) = 2 \times f(\text{utilize}) + 0.5 \text{ MHz}$ . Example: utilize frequency = 50 MHz, interference frequency = 100.5 MHz. The amplitude modulated IM2 is shaped within the intermediate frequency at intervals of 0.5 MHz (see figure 5).

**IM 3**

Test conditions IM3: VHF interference carrier level in the range of +6.5 to 7. MHz, UHF in the range of +7 to 9 MHz.

Modulation is declared in the case of an oscillator pulling the interval between the LO utilize signal at the LO output and the impressed interference (see figure 6).

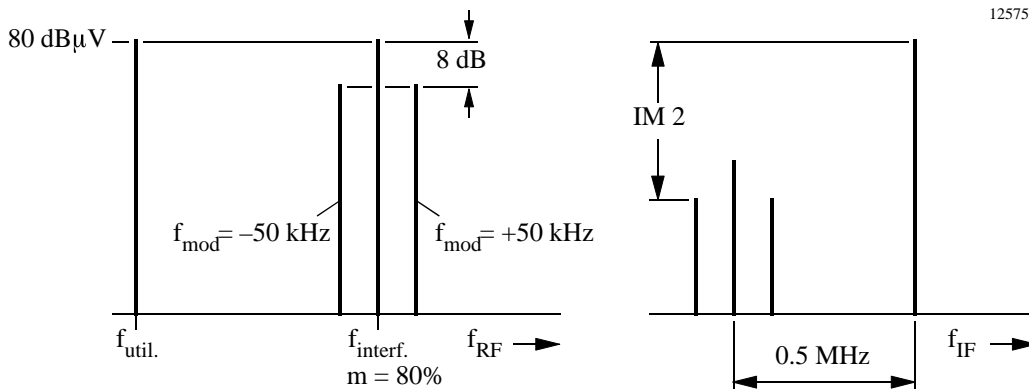


Figure 5. IM2 measurement

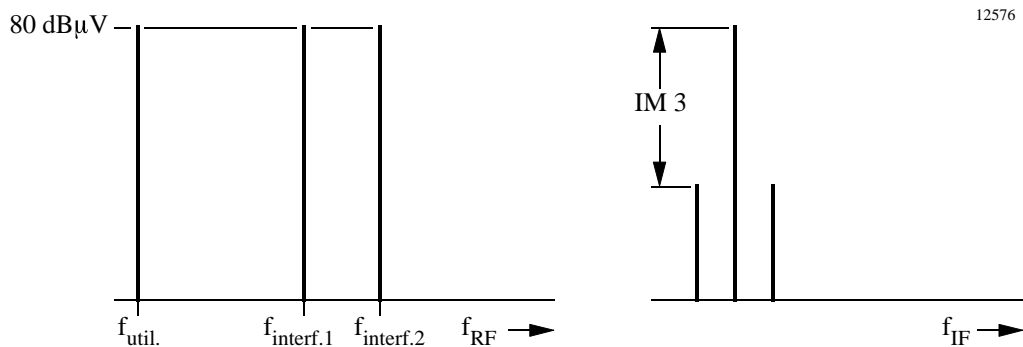
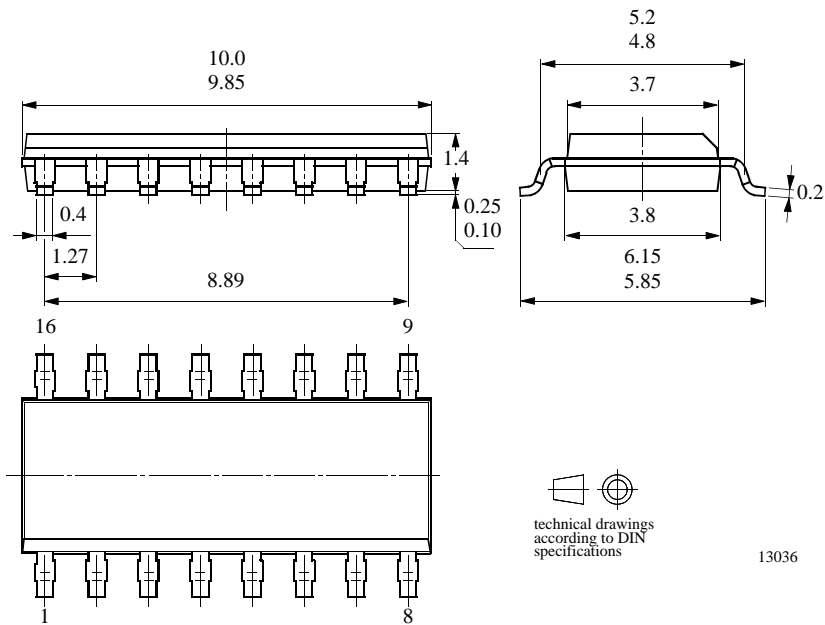


Figure 6. IM3 measurement

## Package Information

Package SO16  
Dimensions in mm



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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 Semiconductor GmbH** 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.

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