FM/IF SYSTEM
AND MICROCOMPUTER-BASED TUNING INTERFACE

GENERAL DESCRIPTION

The TEA6000 is an FM/IF system circuit intended for microcomputer controlled radio receivers. The circuit includes an AM/FM-IF counter and an analogue-to-digital interface. The i.f. counter generates AM/FM precision tuning and accurate stop information.

Features

- 3-stage IF limiter for driving a ratio detector
- 2-stage level detector with current output
- operational amplifier for active filtering (e.g. multipath detector)
- high resolution frequency counter for FM and AM IF-signals
- time base reference from crystal oscillator or external source (SAA1057)
- serial two wire bidirectional computer interface (I^2C-bus)
- multiplexed 3 bit A/D converter for two input signals
- software controlled sensitivity for both ADC inputs

QUICK REFERENCE DATA

Supply voltages (V_{P1} and V_{P2})	V_P	typ.	8,4	V
Supply current; ($I_{P1} + I_{P2}$)	I_P	typ.	36	mA
FM/IF sensitivity				
at −3 dB before limiting	V_i	typ.	150	μV
Signal to noise ratio for V_i = 10 mV	S/N	typ.	80	dB
Audio output voltage				
Δf = 22,5 kHz; V_i = 1 mV	V_O	typ.	170	mV
Δf = 75 kHz; V_i = 1 mV	V_O	typ.	520	mV
AM suppression at V_i = 10 mV	AMS	typ.	58	dB
Frequency counter sensitivity				
AM (pin 18)	$V_{i(am)}$	typ.	60	μV
FM (pin 16)	$V_{i(fm)}$	typ.	80	μV
Resolution frequency counter				
AM	$f_{s(am)}$	typ.	250	Hz
FM	$f_{s(fm)}$	typ.	6,4	kHz
Power dissipation	P_{tot}	max.	1300	mW
Storage temperature	T_{stg}	−55 to + 150		°C
Operating ambient temperature	T_{amb}	−30 to + 85		°C

PACKAGE OUTLINE

18-lead DIL; plastic (SOT102).

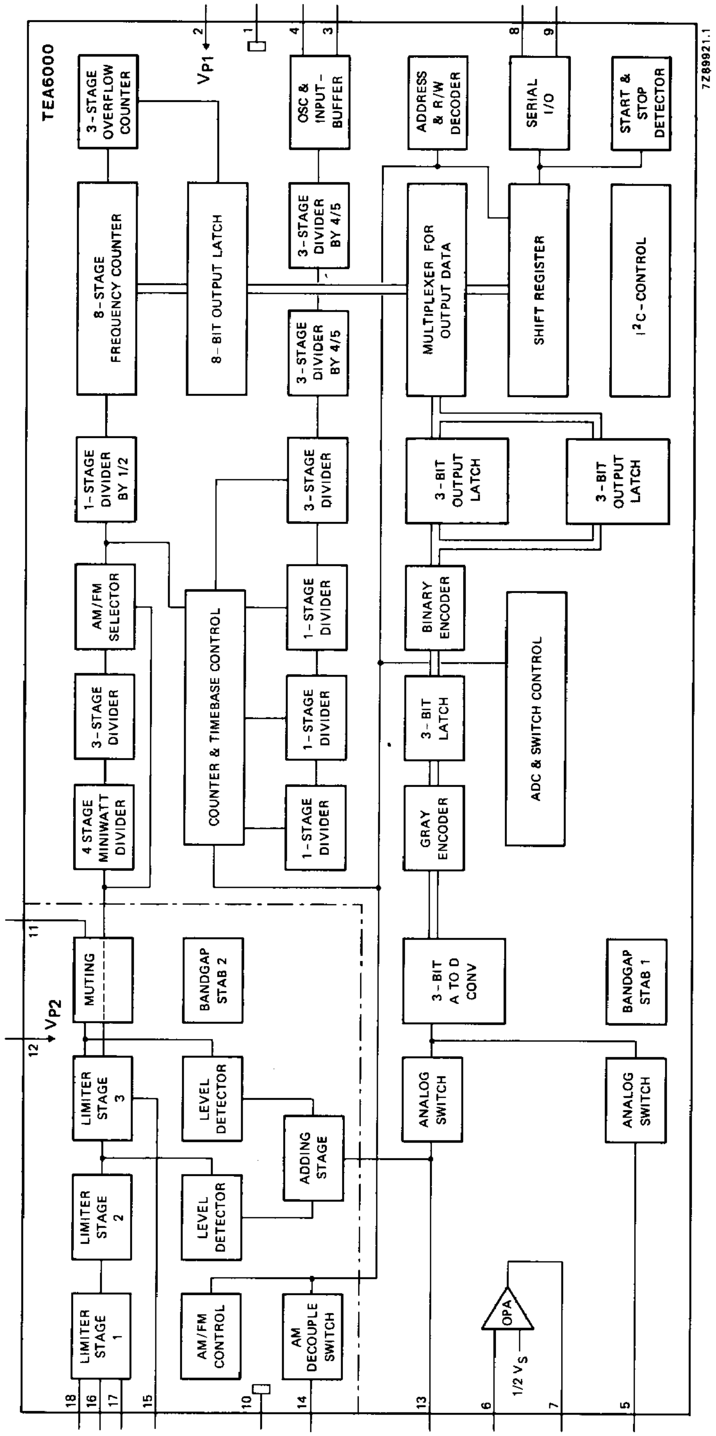


Fig. 1 Block diagram.

FUNCTIONAL DESCRIPTION

The IF SECTION consists of three balanced differential stages with separated FM and AM inputs, directly coupled by emitter followers. The last stage also has separated outputs, which are intended for driving a ratio detector and the frequency measuring system respectively.

The last two stages are coupled via low-value capacitors to two LEVEL DETECTORS which generate a signal-dependent d.c. current for controlling channel separation and frequency response of a stereo decoder, multipath detector circuitry, AGC and the internal ADC.

The IF MUTING circuit has been incorporated to decrease the interstation noise by about 15 dB.

The 3-bit A/D CONVERTER has two inputs, which are selected via two multiplexed analogue switches. One of these switches is internally connected to the level detector output but can also serve as an external input, as the level detector output can be switched off. The outputs of the ADC are converted to a Gray code, latched and reconverted to a binary code to obtain glitch-free output data. The sensitivity of both inputs can be selected independently via software on two levels.

The reference for the ADC is derived from a BAND-GAP STABILIZER circuit. Multipath distortion on FM will generate an AM modulation on the d.c. voltage from the level detectors. This AM modulation can be filtered and rectified to obtain a multipath-dependent d.c. voltage. This voltage can be applied to the other input of the ADC.

To facilitate filtering an OPERATIONAL AMPLIFIER (OPA) is incorporated on the chip. The typical circuit diagram for a multipath filter is given in Fig. 4.

The FREQUENCY COUNTER is preceded by a 7-stage prescaler for FM, and FM/AM selector stage and a divider by 1 or 2. The actual counter is a presetable and resetable 8-stage counter with a 3-stage data disable overflow counter, which can be switched off. The eight significant output bits are situated symmetrically around 10,7 MHz and 460 kHz, when the external timebase source is used (e.g. SAA1057). See Table 1.

The reference for the TIMEBASE is primarily thought to be the SAA1057. This circuit generates from its 4 MHz crystal oscillator a 32 or 40 kHz signal. This signal is buffered and applied to the timebase circuitry (mode I). The circuit diagram for this mode I is given in Fig. 5a.

In the timebase, the selection is made for reference frequency (32 to 40 kHz), FM or AM mode and the width of the measuring window, all under software control. Accuracy ± ½ bit when the window is set to wide (see Fig. 2) and ± 1 bit when set to narrow. A special feature is the synchronization of the measuring cycle with the input DATA of the I^2C-bus, meaning the measuring cycle starts immediately after a "WRITE" instruction via the I^2C-bus.

For those who do not use the SAA1057 as reference, a 2^{15} Hz crystal (32 768 Hz) can be connected to the reference inputs directly, obtaining a quartz-oscillator reference. See Fig. 5b for the circuit diagram for this mode II.

When the circuit is used in mode II a correction has to be made to the values of window width and resolution as the cheap watch crystals differ by about 2,4% from the frequency generated by the SAA1057 (32 768 and 32 000 kHz respectively) See Table 2.

Communication between MUSTI and the microcomputer is accomplished via the two-wire bidirectional I^2C-bus (slave transceiver version); the SDA (serial data) and SCL (serial clock).

To prevent crosstalk between the digital and analogue parts of the circuit the power supply lines are fully isolated.

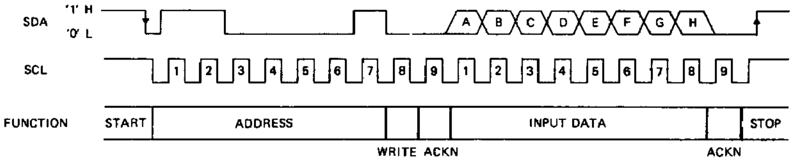


Fig. 2 Input data format waveforms.

Input bits

bit	function	"0"	"1"	reference to Fig. 2
1	reference frequency	32 kHz	40 kHz	A
2	sensitivity ADC2	LOW	HIGH	B
3	sensitivity ADC1	LOW	HIGH	C
4	level detector output	off	on	D
5	AM/FM	AM	FM	E
6	overflow counter	off	on	F
7	measuring window	narrow	wide	G
8	test mode	off	on	H

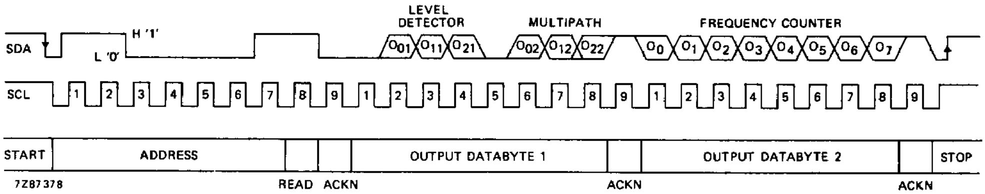


Fig. 3 Output data format waveforms.

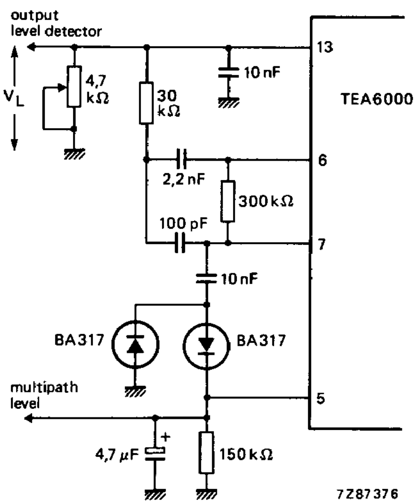


Fig. 4 Multipath detector circuit.

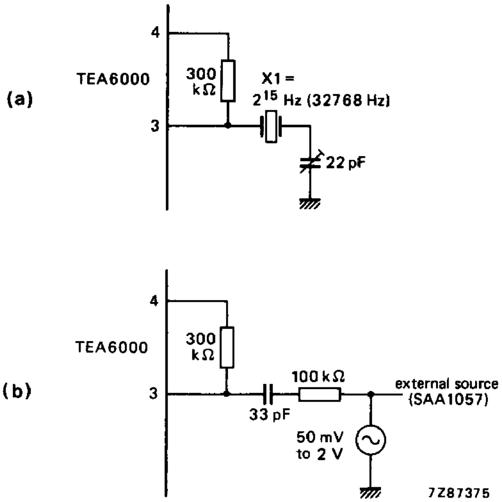


Fig. 5 Oscillator/buffer circuits. X1 = 2^{15} Hz (32 768 Hz).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage			
pin 2	V_{P1}	max.	13,2 V
pin 12	V_{P2}	max.	13,2 V
Power dissipation	P_{tot}	max.	1300 mW
Storage temperature	T_{stg}		−55 to + 150 °C
Operating ambient temperature	T_{amb}		−30 to + 85 °C

THERMAL RESISTANCE

From crystal to ambient $R_{th\ c\text{-}a}$ = 50 K/W

D.C. CHARACTERISTICS

$V_{P1} = V_{P2} = 8{,}4$ V; $T_{amb} = 25$ °C, unless otherwise specified.

parameter	symbol	min.	typ.	max.	unit
Supply voltage					
(pin 2)	V_{P1}	7,6	8,4	9,2	V
(pin 12)	V_{P2}	7,6	8,4	9,2	V
Supply current AM mode					
pin 2	I_{P1}	–	18,5	–	mA
pin 12	I_{P2}	–	17,4	–	mA
Supply current FM mode					
pin 2	I_{P1}	–	19,2	–	mA
pin 12	I_{P2}	–	16,4	–	mA
Power dissipation	P_{tot}	–	350	–	mW

A.C. CHARACTERISTICS (see Fig. 6)

$V_{P1} = V_{P2} = 8{,}4$ V; $V_{16\text{-}10} = 1$ mV; f = 10,7 MHz; Δf = 22,5 kHz; $f_m = 1$ kHz; unless otherwise specified.

parameter	symbol	min.	typ.	max.	unit
Sensitivity					
at −3 dB before limiting	$V_{I(FM)}$	–	150	–	μV
Signal-to-noise ratio, FM input					
V_i = 20 μV	S/N	40	46	–	dB
V_i = 150 μV	S/N	–	64	–	dB
V_i = 1 mV	S/N	–	76	–	dB
V_i = 10 mV	S/N	–	80	–	dB
Noise output voltage					
V_i = 0 V; with muting, switch S1 on	V_{no}	–	55	–	μV
V_i = 0 V; without muting, S1 off	V_{no}	–	420	–	μV
Audio output voltage					
Δf = 22,5 kHz	V_O	–	170	–	mV
Δf = 75 kHz	V_O	–	520	–	mV

A.C. CHARACTERISTICS (continued)

parameter	symbol	min.	typ.	max.	unit
AM suppression					
ratio of the AM output signal referred to the FM signal (m = 0,3)					
V_i = 150 μV	AMS	–	46	–	dB
V_i = 1 mV	AMS	–	62	–	dB
V_i = 10 mV	AMS	–	58	–	dB
V_i = 100 mV	AMS	–	60	–	dB
Level detector output voltage (Fig. 4)					
$R_{13\text{-}10}$ = 4,7 kΩ; V_i = 10 mV, FM mode	V_L	–	6,2	–	V
Level detector output voltage slope					
$R_{13\text{-}10}$ adjusted in FM mode for V_L = 5,5 V at V_i = 10 mV; f = 10,7 MHz					
V_i = 0 V (pin 16)	$V_{L(FM)}$	–	130	–	mV
V_i = 140 μV	$V_{L(FM)}$	–	1,3	–	V
V_i = 1 mV	$V_{L(FM)}$	–	2,7	–	V
V_i = 3 mV	$V_{L(FM)}$	–	4,4	–	V
$R_{13\text{-}10}$ adjusted in FM mode (see above)					
V_i = 0 V, f = 460 kHz (pin 18)	$V_{L(AM)}$	–	200	–	mV
V_i = 1 mV, f = 460 kHz (pin 18)	$V_{L(AM)}$	–	1,4	–	V
V_i = 10 mV, f = 460 kHz (pin 18)	$V_{L(AM)}$	–	2,7	–	V
Frequency counter sensitivity					
AM input voltage (pin 18)	$V_{I(AM)}$	–	60	–	μV
FM input voltage (pin 16)	$V_{I(FM)}$	–	80	–	μV
AM input impedance	R_i	–	30	–	kΩ
BUS inputs					
SDA and SCL (pins 9 and 8)					
input voltage HIGH	V_{IH}	3,0	–	V_{P1}	V
input voltage LOW	V_{IL}	−0,3	–	1,5	V
input current HIGH	I_{IH}	–	–	10	μA
input current LOW	I_{IL}	–	–	10	μA
acknowledge sink current	I_{ack}	–	–	2	mA
maximum input frequency	$f_{i\ max}$	100	–	–	kHz
Output voltage SDA					
HIGH; 4 kΩ to 8,4 V	V_{OH}	8,0	–	–	V
LOW; I = 2 mA	V_{OL}	–	–	0,4	V

parameter	symbol	min.	typ.	max.	unit
A/D converter (pin 5 and 13)					
input resistance	R_i		t.b.f.		kΩ
input capacitance	C_i		t.b.f.		pF
Trip levels, sensitivity bit HIGH					
level 1	V_T	–	0,6	–	V
level 2	V_T	–	1,06	–	V
level 3	V_T	–	1,38	–	V
level 4	V_T	–	1,84	–	V
level 5	V_T	–	2,14	–	V
level 6	V_T	–	2,55	–	V
level 7	V_T	–	2,97	–	V
Trip levels, sensitivity bit LOW					
level 1	V_T	–	0,96	–	V
level 2	V_T	–	1,78	–	V
level 3	V_T	–	2,44	–	V
level 4	V_T	–	3,26	–	V
level 5	V_T	–	3,92	–	V
level 6	V_T	–	4,63	–	V
level 7	V_T	–	5,38	–	V
Crystal oscillator (see Fig. 5)					
reference frequency	f_{ref}	32	32,768	40	kHz
temperature coefficient	TC		t.b.f.		10^{-6}
input resistance	R_i		t.b.f.		kΩ
input capacitance	C_i		t.b.f.		pF
Operational amplifier (pins 6 and 7)					
voltage gain	G_V	–	10^4	–	
input bias current	I_{bias}	–	30	100	nA
output sink current at V_O = 1 V	I_O	–	0,2	–	mA
output source current at V_O = 7,4 V	I_O	5,5	10	–	mA
output voltage swing	$V_{7(p-p)}$	–	5,5	–	V
Frequency measuring system (see pages 8 and 9)					
measuring windows; f_{ref} = 32 or 40 kHz					
AM					
window "0" (LOW)	t_{gate}	–	4	–	ms
window "1" (HIGH)	t_{gate}	–	8	–	ms
FM					
window "0" (LOW)	t_{gate}	–	20	–	ms
window "1" (HIGH)	t_{gate}	–	40	–	ms
resolution frequency counter					
AM	$f_{s(am)}$	–	250	–	Hz
FM	$f_{s(fm)}$	–	6,4	–	kHz

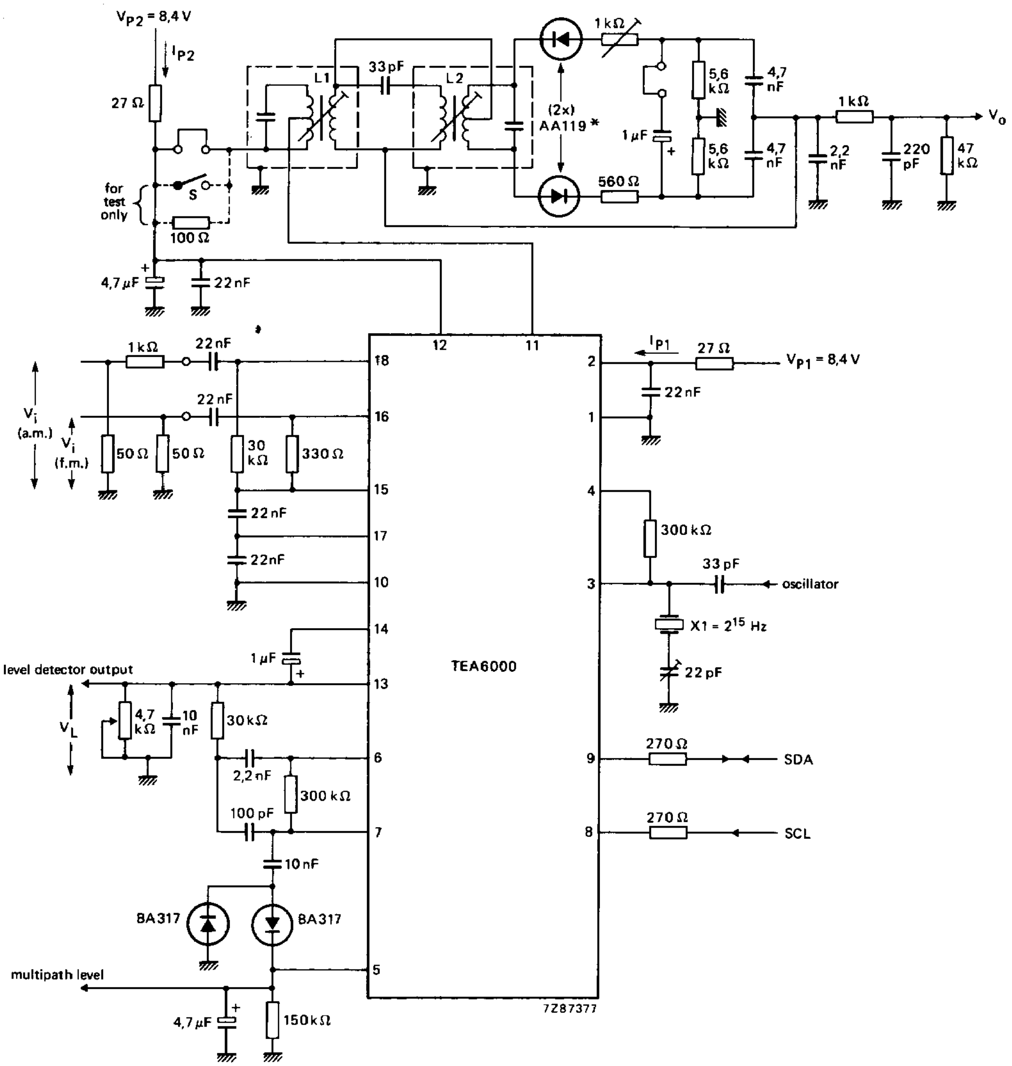
t_{gate} has to be multiplied by 32 000/32 768 for a f_{ref} of 2^{15} Hz.
f_s has to be multiplied by 32 768/32 000 for a f_{ref} of 2^{15} Hz.

TABLE 1 REFERENCE FREQUENCY 32 000 Hz (SAA1057)

AM (kHz)	READ OUT	FM (MHz)	AM (kHz)	READ OUT	FM (MHz)	AM (kHz)	READ OUT	FM (MHz)	AM (kHz)	READ OUT	FM (MHz)	AM (kHz)	READ OUT	FM (MHz)
428.25	'00'	9.888	441.00	'33'	10.214	453.75	'66'	10.541	466.50	'99'	10.867	479.25	'CC'	11.194
428.50	'01'	9.894	441.25	'34'	10.221	454.00	'67'	10.547	466.75	'9A'	10.874	479.50	'CD'	11.200
428.75	'02'	9.901	441.50	'35'	10.227	454.25	'68'	10.554	467.00	'9B'	10.880	479.75	'CE'	11.206
429.00	'03'	9.907	441.75	'36'	10.234	454.50	'69'	10.560	467.25	'9C'	10.886	480.00	'CF'	11.213
429.25	'04'	9.914	442.00	'37'	10.240	454.75	'6A'	10.566	467.50	'9D'	10.893	480.25	'D0'	11.219
429.50	'05'	9.920	442.25	'38'	10.246	455.00	'6B'	10.573	467.75	'9E'	10.899	480.50	'D1'	11.226
429.75	'06'	9.926	442.50	'39'	10.253	455.25	'6C'	10.579	468.00	'9F'	10.906	480.75	'D2'	11.232
430.00	'07'	9.933	442.75	'3A'	10.259	455.50	'6D'	10.586	468.25	'A0'	10.912	481.00	'D3'	11.238
430.25	'08'	9.939	443.00	'3B'	10.266	455.75	'6E'	10.592	468.50	'A1'	10.918	481.25	'D4'	11.245
430.50	'09'	9.946	443.25	'3C'	10.272	456.00	'6F'	10.598	468.75	'A2'	10.925	481.50	'D5'	11.251
430.75	'0A'	9.952	443.50	'3D'	10.278	456.25	'70'	10.605	469.00	'A3'	10.931	481.75	'D6'	11.258
431.00	'0B'	9.958	443.75	'3E'	10.285	456.50	'71'	10.611	469.25	'A4'	10.938	482.00	'D7'	11.264
431.25	'0C'	9.965	444.00	'3F'	10.291	456.75	'72'	10.618	469.50	'A5'	10.944	482.25	'D8'	11.270
431.50	'0D'	9.971	444.25	'40'	10.298	457.00	'73'	10.624	469.75	'A6'	10.950	482.50	'D9'	11.277
431.75	'0E'	9.978	444.50	'41'	10.304	457.25	'74'	10.630	470.00	'A7'	10.957	482.75	'DA'	11.283
432.00	'0F'	9.984	444.75	'42'	10.310	457.50	'75'	10.637	470.25	'A8'	10.963	483.00	'DB'	11.290
432.25	'10'	9.990	445.00	'43'	10.317	457.75	'76'	10.643	470.50	'A9'	10.970	483.25	'DC'	11.296
432.50	'11'	9.997	445.25	'44'	10.323	458.00	'77'	10.650	470.75	'AA'	10.976	483.50	'DD'	11.302
432.75	'12'	10.003	445.50	'45'	10.330	458.25	'78'	10.656	471.00	'AB'	10.982	483.75	'DE'	11.309
433.00	'13'	10.010	445.75	'46'	10.336	458.50	'79'	10.662	471.25	'AC'	10.989	484.00	'DF'	11.315
433.25	'14'	10.016	446.00	'47'	10.342	458.75	'7A'	10.669	471.50	'AD'	10.995	484.25	'E0'	11.322
433.50	'15'	10.022	446.25	'48'	10.349	459.00	'7B'	10.675	471.75	'AE'	11.002	484.50	'E1'	11.328
433.75	'16'	10.029	446.50	'49'	10.355	459.25	'7C'	10.682	472.00	'AF'	11.008	484.75	'E2'	11.334
434.00	'17'	10.035	446.75	'4A'	10.362	459.50	'7D'	10.688	472.25	'B0'	11.014	485.00	'E3'	11.341
434.25	'18'	10.042	447.00	'4B'	10.368	459.75	'7E'	10.694	472.50	'B1'	11.021	485.25	'E4'	11.347
434.50	'19'	10.048	447.25	'4C'	10.374	460.00	'7F'	10.701	472.75	'B2'	11.027	485.50	'E5'	11.354
434.75	'1A'	10.054	447.50	'4D'	10.381	460.25	'80'	10.707	473.00	'B3'	11.034	485.75	'E6'	11.360
435.00	'1B'	10.061	447.75	'4E'	10.387	460.50	'81'	10.714	473.25	'B4'	11.040	486.00	'E7'	11.366
435.25	'1C'	10.067	448.00	'4F'	10.394	460.75	'82'	10.720	473.50	'B5'	11.046	486.25	'E8'	11.373
435.50	'1D'	10.074	448.25	'50'	10.400	461.00	'83'	10.726	473.75	'B6'	11.053	486.50	'E9'	11.379
435.75	'1E'	10.080	448.50	'51'	10.406	461.25	'84'	10.733	474.00	'B7'	11.059	486.75	'EA'	11.386
436.00	'1F'	10.086	448.75	'52'	10.413	461.50	'85'	10.739	474.25	'B8'	11.066	487.00	'EB'	11.392
436.25	'20'	10.093	449.00	'53'	10.419	461.75	'86'	10.746	474.50	'B9'	11.072	487.25	'EC'	11.398
436.50	'21'	10.099	449.25	'54'	10.426	462.00	'87'	10.752	474.75	'BA'	11.078	487.50	'ED'	11.405
436.75	'22'	10.106	449.50	'55'	10.432	462.25	'88'	10.758	475.00	'BB'	11.085	487.75	'EE'	11.411
437.00	'23'	10.112	449.75	'56'	10.438	462.50	'89'	10.765	475.25	'BC'	11.091	488.00	'EF'	11.418
437.25	'24'	10.118	450.00	'57'	10.445	462.75	'8A'	10.771	475.50	'BD'	11.098	488.25	'F0'	11.424
437.50	'25'	10.125	450.25	'58'	10.451	463.00	'8B'	10.778	475.75	'BE'	11.104	488.50	'F1'	11.430
437.75	'26'	10.131	450.50	'59'	10.458	463.25	'8C'	10.784	476.00	'BF'	11.110	488.75	'F2'	11.437
438.00	'27'	10.138	450.75	'5A'	10.464	463.50	'8D'	10.790	476.25	'C0'	11.117	489.00	'F3'	11.443
438.25	'28'	10.144	451.00	'5B'	10.470	463.75	'8E'	10.797	476.50	'C1'	11.123	489.25	'F4'	11.450
438.50	'29'	10.150	451.25	'5C'	10.477	464.00	'8F'	10.803	476.75	'C2'	11.130	489.50	'F5'	11.456
438.75	'2A'	10.157	451.50	'5D'	10.483	464.25	'90'	10.810	477.00	'C3'	11.136	489.75	'F6'	11.462
439.00	'2B'	10.163	451.75	'5E'	10.490	464.50	'91'	10.816	477.25	'C4'	11.142	490.00	'F7'	11.469
439.25	'2C'	10.170	452.00	'5F'	10.496	464.75	'92'	10.822	477.50	'C5'	11.149	490.25	'F8'	11.475
439.50	'2D'	10.176	452.25	'60'	10.502	465.00	'93'	10.829	477.75	'C6'	11.155	490.50	'F9'	11.482
439.75	'2E'	10.182	452.50	'61'	10.509	465.25	'94'	10.835	478.00	'C7'	11.162	490.75	'FA'	11.488
440.00	'2F'	10.189	452.75	'62'	10.515	465.50	'95'	10.842	478.25	'C8'	11.168	491.00	'FB'	11.494
440.25	'30'	10.195	453.00	'63'	10.522	465.75	'96'	10.848	478.50	'C9'	11.174	491.25	'FC'	11.501
440.50	'31'	10.202	453.25	'64'	10.528	466.00	'97'	10.854	478.75	'CA'	11.181	491.50	'FD'	11.507
440.75	'32'	10.208	453.50	'65'	10.534	466.25	'98'	10.861	479.00	'CB'	11.187	491.75	'FE'	11.514

TABLE 2 REFERENCE FREQUENCY 32 768 Hz (2^{15} Hz)

AM (kHz)	READ OUT	FM (MHz)	AM (kHz)	READ OUT	FM (MHz)	AM (kHz)	READ OUT	FM (MHz)	AM (kHz)	READ OUT	FM (HMz)	AM (kHz)	READ OUT	FM (MHz)
438.53	'00'	10.125	451.58	'33'	10.460	464.64	'66'	10.794	477.70	'99'	11.128	490.75	'CC'	11.462
438.78	'01'	10.132	451.84	'34'	10.466	464.90	'67'	10.800	477.95	'9A'	11.135	491.01	'CD'	11.469
439.04	'02'	10.138	452.10	'35'	10.473	465.15	'68'	10.807	478.21	'9B'	11.141	491.26	'CE'	11.475
439.30	'03'	10.145	452.35	'36'	10.479	465.41	'69'	10.813	478.46	'9C'	11.148	491.52	'CF'	11.482
439.55	'04'	10.152	452.61	'37'	10.486	465.66	'6A'	10.820	478.72	'9D'	11.154	491.78	'D0'	11.488
439.81	'05'	10.158	452.86	'38'	10.492	465.92	'6B'	10.827	478.98	'9E'	11.161	492.03	'D1'	11.495
440.06	'06'	10.165	453.12	'39'	10.499	466.18	'6C'	10.833	479.23	'9F'	11.167	492.29	'D2'	11.502
440.32	'07'	10.171	453.38	'3A'	10.505	466.43	'6D'	10.840	479.49	'A0'	11.174	492.54	'D3'	11.508
440.58	'08'	10.178	453.63	'3B'	10.512	466.69	'6E'	10.846	479.74	'A1'	11.180	492.80	'D4'	11.515
440.83	'09'	10.184	453.89	'3C'	10.519	466.94	'6F'	10.853	480.00	'A2'	11.187	493.06	'D5'	11.521
441.09	'0A'	10.191	454.14	'3D'	10.525	467.20	'70'	10.859	480.26	'A3'	11.194	493.31	'D6'	11.528
441.34	'0B'	10.197	454.40	'3E'	10.532	467.46	'71'	10.866	480.51	'A4'	11.200	493.57	'D7'	11.534
441.60	'0C'	10.204	454.66	'3F'	10.538	467.71	'72'	10.872	480.77	'A5'	11.207	493.82	'D8'	11.541
441.86	'0D'	10.211	454.91	'40'	10.545	467.97	'73'	10.879	481.02	'A6'	11.213	494.08	'D9'	11.547
442.11	'0E'	10.217	455.17	'41'	10.551	468.22	'74'	10.886	481.28	'A7'	11.220	494.34	'DA'	11.554
442.37	'0F'	10.224	455.42	'42'	10.558	468.48	'75'	10.892	481.54	'A8'	11.226	494.59	'DB'	11.561
442.62	'10'	10.230	455.68	'43'	10.564	468.74	'76'	10.899	481.79	'A9'	11.233	494.85	'DC'	11.567
442.88	'11'	10.237	455.94	'44'	10.571	468.99	'77'	10.905	482.05	'AA'	11.239	495.10	'DD'	11.574
443.14	'12'	10.243	456.19	'45'	10.578	469.25	'78'	10.912	482.30	'AB'	11.246	495.36	'DE'	11.580
443.39	'13'	10.250	456.45	'46'	10.584	469.50	'79'	10.918	482.56	'AC'	11.253	495.62	'DF'	11.587
443.65	'14'	10.256	456.70	'47'	10.591	469.76	'7A'	10.925	482.82	'AD'	11.259	495.87	'E0'	11.593
443.90	'15'	10.263	456.96	'48'	10.597	470.02	'7B'	10.931	483.07	'AE'	11.266	496.13	'E1'	11.600
444.16	'16'	10.269	457.22	'49'	10.604	470.27	'7C'	10.938	483.33	'AF'	11.272	496.38	'E2'	11.606
444.42	'17'	10.276	457.47	'4A'	10.610	470.53	'7D'	10.945	483.58	'B0'	11.279	496.64	'E3'	11.613
444.67	'18'	10.283	457.73	'4B'	10.617	470.78	'7E'	10.951	483.84	'B1'	11.285	496.90	'E4'	11.620
444.93	'19'	10.289	457.98	'4C'	10.623	471.04	'7F'	10.958	484.10	'B2'	11.292	497.15	'E5'	11.626
445.18	'1A'	10.296	458.24	'4D'	10.630	471.30	'80'	10.964	484.35	'B3'	11.298	497.41	'E6'	11.633
445.44	'1B'	10.302	458.50	'4E'	10.636	471.55	'81'	10.971	484.61	'B4'	11.305	497.66	'E7'	11.639
445.70	'1C'	10.309	458.75	'4F'	10.643	471.81	'82'	10.977	484.86	'B5'	11.312	497.92	'E8'	11.646
445.95	'1D'	10.315	459.01	'50'	10.650	472.06	'83'	10.984	485.12	'B6'	11.318	498.18	'E9'	11.652
446.21	'1E'	10.322	459.26	'51'	10.656	472.32	'84'	10.990	485.38	'B7'	11.325	498.43	'EA'	11.659
446.46	'1F'	10.328	459.52	'52'	10.663	472.58	'85'	10.997	485.63	'B8'	11.331	498.69	'EB'	11.665
446.72	'20'	10.335	459.78	'53'	10.669	472.83	'86'	11.003	485.89	'B9'	11.338	498.94	'EC'	11.672
446.98	'21'	10.342	460.03	'54'	10.676	473.09	'87'	11.010	486.14	'BA'	11.344	499.20	'ED'	11.679
447.23	'22'	10.348	460.29	'55'	10.682	473.34	'88'	11.017	486.40	'BB'	11.351	499.46	'EE'	11.685
447.49	'23'	10.355	460.54	'56'	10.689	473.60	'89'	11.023	486.66	'BC'	11.357	499.71	'EF'	11.692
447.74	'24'	10.361	460.80	'57'	10.695	473.86	'8A'	11.030	486.91	'BD'	11.364	499.97	'F0'	11.698
448.00	'25'	10.368	461.06	'58'	10.702	474.11	'8B'	11.036	487.17	'BE'	11.370	500.22	'F1'	11.705
448.26	'26'	10.374	461.31	'59'	10.709	474.37	'8C'	11.043	487.42	'BF'	11.377	500.48	'F2'	11.711
448.51	'27'	10.381	461.57	'5A'	10.715	474.62	'8D'	11.049	487.68	'C0'	11.384	500.74	'F3'	11.718
448.77	'28'	10.387	461.82	'5B'	10.722	474.88	'8E'	11.056	487.94	'C1'	11.390	500.99	'F4'	11.724
449.02	'29'	10.394	462.08	'5C'	10.728	475.14	'8F'	11.062	488.19	'C2'	11.397	501.25	'F5'	11.731
449.28	'2A'	10.401	462.34	'5D'	10.735	475.39	'90'	11.069	488.45	'C3'	11.403	501.50	'F6'	11.737
449.54	'2B'	10.407	462.59	'5E'	10.741	475.65	'91'	11.076	488.70	'C4'	11.410	501.76	'F7'	11.744
449.79	'2C'	10.414	462.85	'5F'	10.748	475.90	'92'	11.082	488.96	'C5'	11.416	502.02	'F8'	11.751
450.05	'2D'	10.420	463.10	'60'	10.754	476.16	'93'	11.089	489.22	'C6'	11.423	502.27	'F9'	11.757
450.30	'2E'	10.427	463.36	'61'	10.761	476.42	'94'	11.095	489.47	'C7'	11.429	502.53	'FA'	11.764
450.56	'2F'	10.433	463.62	'62'	10.768	476.67	'95'	11.102	489.73	'C8'	11.436	502.78	'FB'	11.770
450.82	'30'	10.440	463.87	'63'	10.774	476.93	'96'	11.108	489.98	'C9'	11.443	503.04	'FC'	11.777
451.07	'31'	10.446	464.13	'64'	10.781	477.18	'97'	11.115	490.24	'CA'	11.449	503.30	'FD'	11.783
451.33	'32'	10.453	464.38	'65'	10.787	477.44	'98'	11.121	490.50	'CB'	11.456	503.55	'FE'	11.790



L1 = 3122 138 2021/TOKO 85 ACS-4238 A
L2 = 3122 138 2022/TOKO 85 ACS-4260 SEJ

Fig. 6 MUSTI test and application circuit.
Germanium diodes AA119 are required in the test circuit only.
In a complete FM channel (inclusive FM front end) the silicon diodes BA281 are recommended.

S open = without muting
S closed = with muting
} for measuring purpose only.

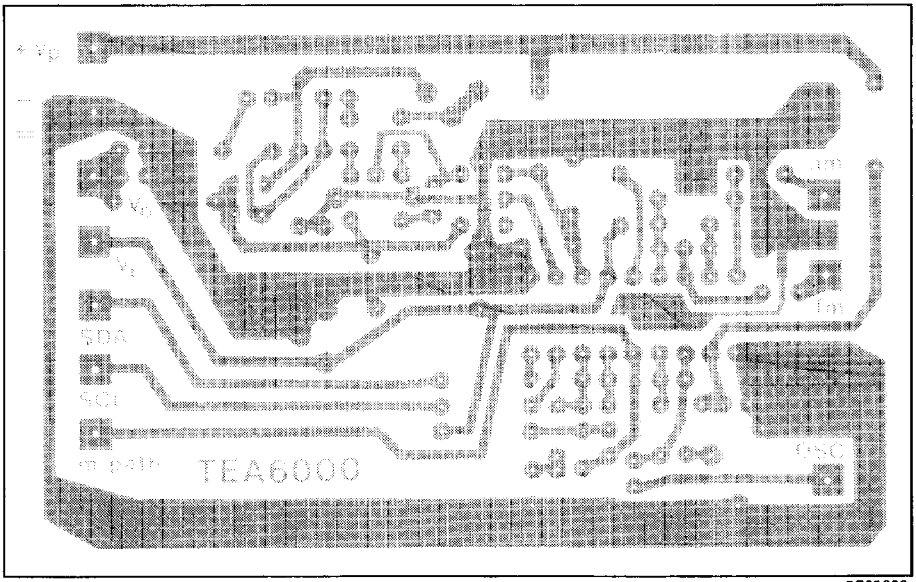


Fig. 7 Track side of printed-circuit board.

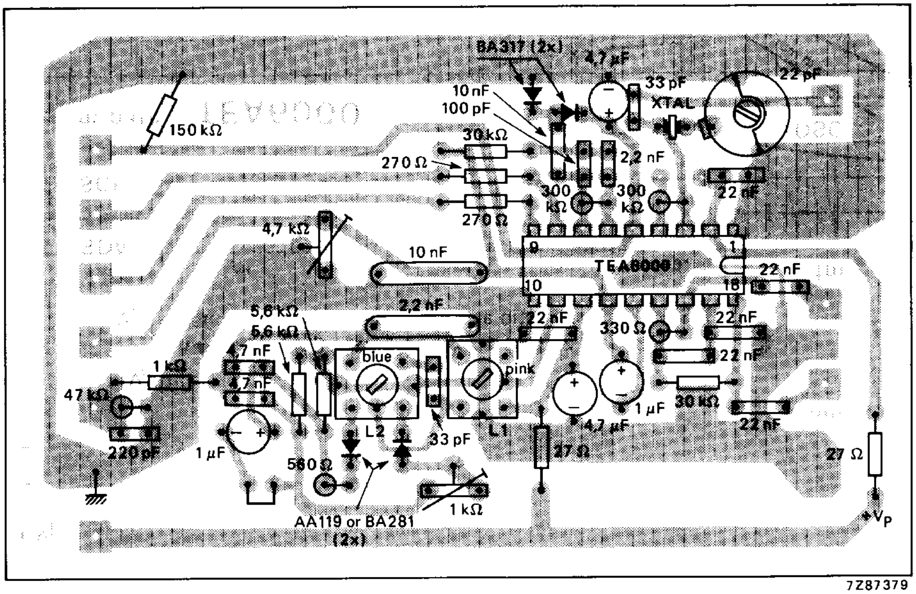


Fig. 8 Component side of printed-circuit board.

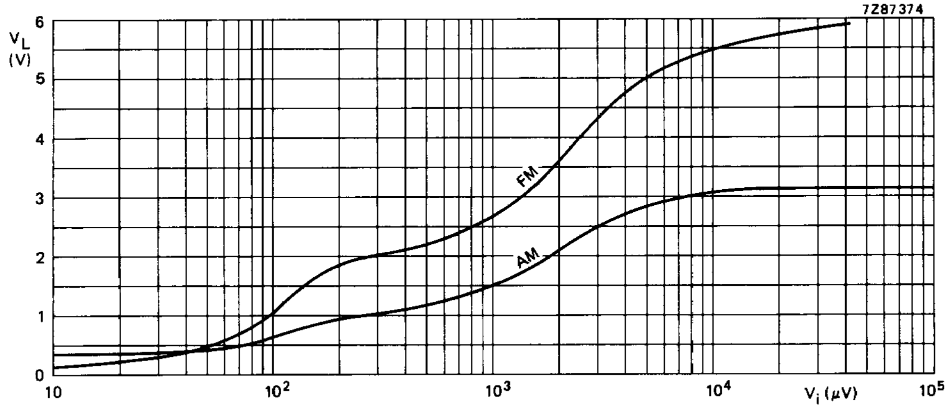


Fig. 9 Level detector output as a function of input voltage.

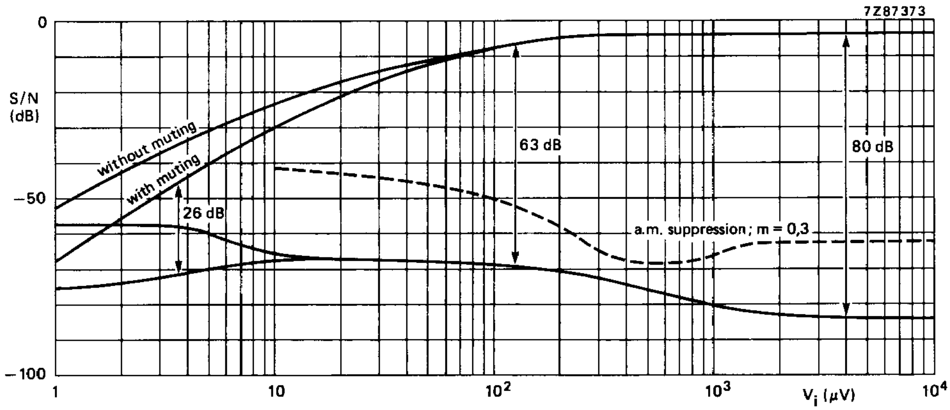


Fig. 10 Signal-to-noise ratio as a function of FM input voltage.
f_i = 10,7 MHz; Δf = 22,5 kHz; f_{mod} = 1 kHz; 0 dB = 245 mV.