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).

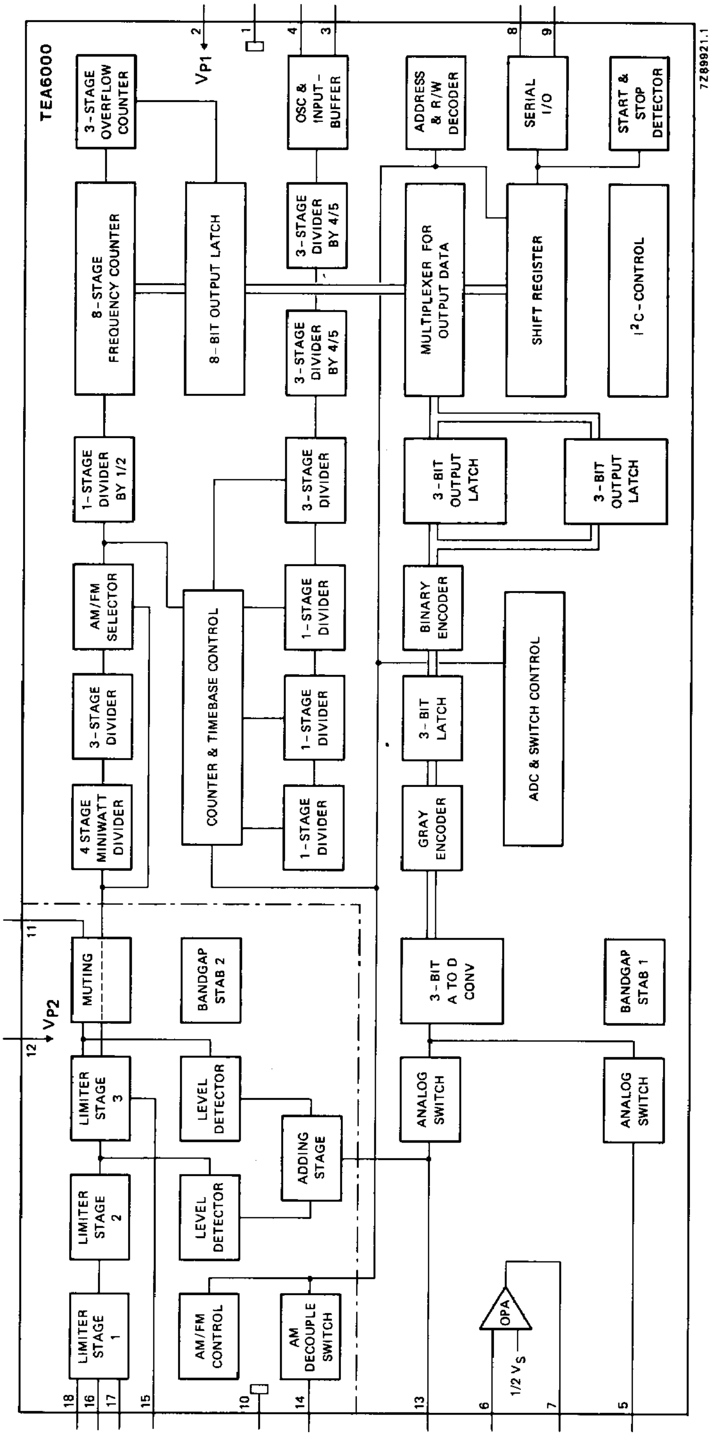


Fig. 1 Block diagram.

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.

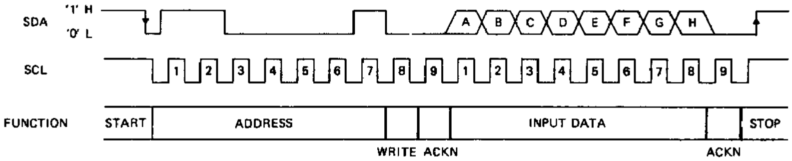


Fig. 2 Input data format waveforms.

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

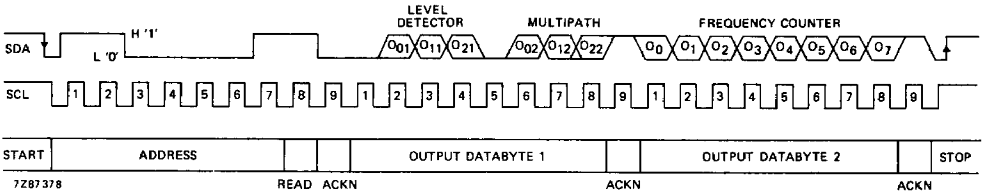


Fig. 3 Output data format waveforms.

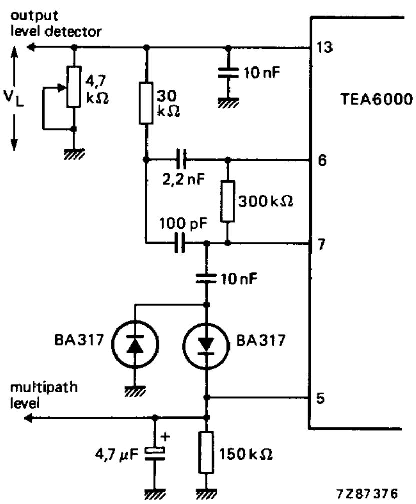


Fig. 4 Multipath detector circuit.

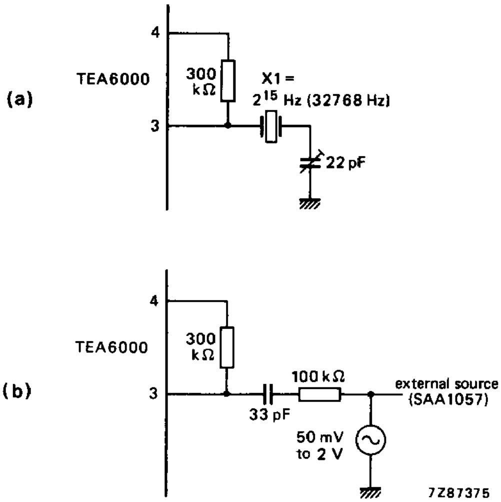


Fig. 5 Oscillator/buffer circuits.
X1 = 2^{15} Hz (32 768 Hz).

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)

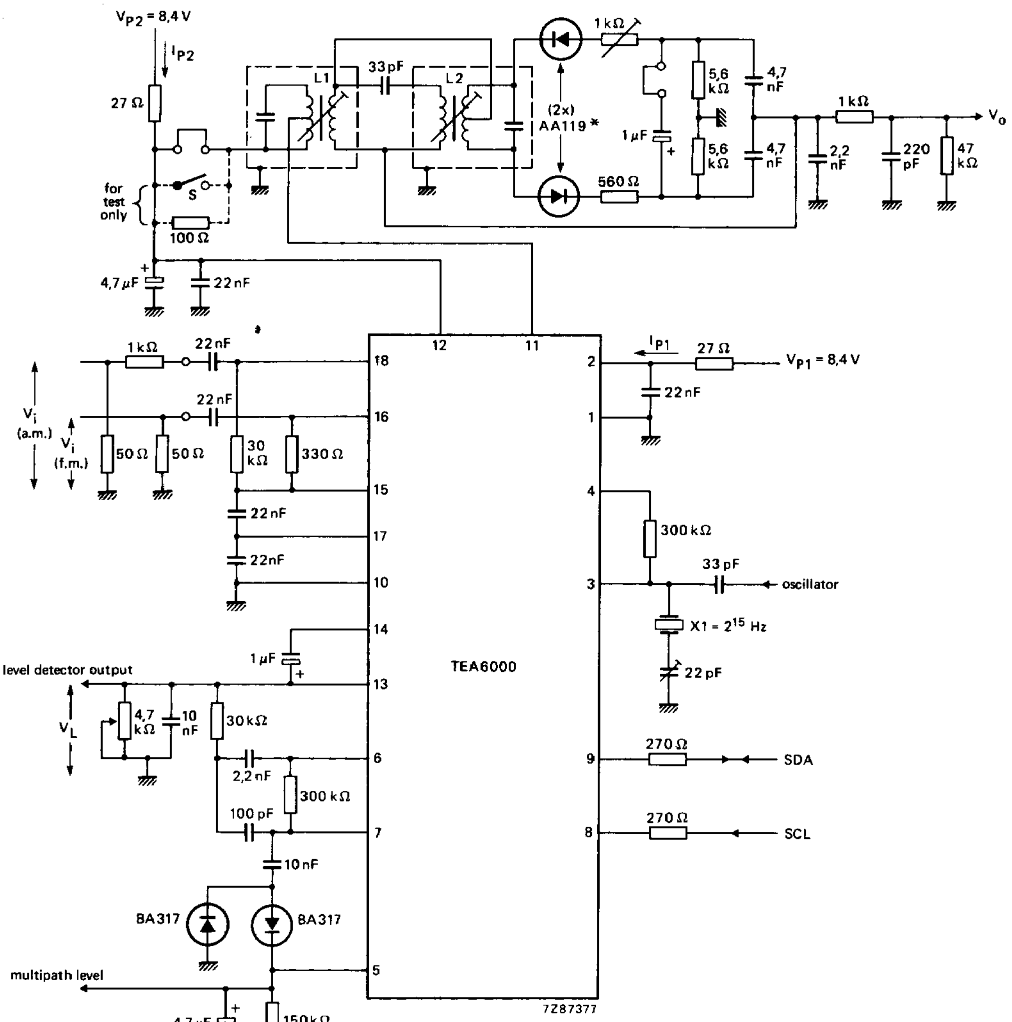
AM (kHz)	READ OUT	FM (MHz)
438.53	'00'	10.125
438.78	'01'	10.132
439.04	'02'	10.138
439.30	'03'	10.145
439.55	'04'	10.152
439.81	'05'	10.158
440.06	'06'	10.165
440.32	'07'	10.171
440.58	'08'	10.178
440.83	'09'	10.184
441.09	'0A'	10.191
441.34	'0B'	10.197
441.60	'0C'	10.204
441.86	'0D'	10.211
442.11	'0E'	10.217
442.37	'0F'	10.224
442.62	'10'	10.230
442.88	'11'	10.237
443.14	'12'	10.243
443.39	'13'	10.250
443.65	'14'	10.256
443.90	'15'	10.263
444.16	'16'	10.269
444.42	'17'	10.276
444.67	'18'	10.283
444.93	'19'	10.289
445.18	'1A'	10.296
445.44	'1B'	10.302
445.70	'1C'	10.309
445.95	'1D'	10.315
446.21	'1E'	10.322
446.46	'1F'	10.328
446.72	'20'	10.335
446.98	'21'	10.342
447.23	'22'	10.348
447.49	'23'	10.355
447.74	'24'	10.361
448.00	'25'	10.368
448.26	'26'	10.374
448.51	'27'	10.381
448.77	'28'	10.387
449.02	'29'	10.394
449.28	'2A'	10.401
449.54	'2B'	10.407
449.79	'2C'	10.414
450.05	'2D'	10.420
450.30	'2E'	10.427
450.56	'2F'	10.433
450.82	'30'	10.440
451.07	'31'	10.446
451.33	'32'	10.453

AM (kHz)	READ OUT	FM (MHz)
451.59	'33'	10.460
451.84	'34'	10.466
452.10	'35'	10.473
452.35	'36'	10.479
452.61	'37'	10.486
452.86	'38'	10.492
453.12	'39'	10.499
453.38	'3A'	10.505
453.63	'3B'	10.512
453.89	'3C'	10.519
454.14	'3D'	10.525
454.40	'3E'	10.532
454.66	'3F'	10.538
454.91	'40'	10.545
455.17	'41'	10.551
455.42	'42'	10.558
455.68	'43'	10.564
455.94	'44'	10.571
456.19	'45'	10.578
456.45	'46'	10.584
456.70	'47'	10.591
456.96	'48'	10.597
457.22	'49'	10.604
457.47	'4A'	10.610
457.73	'4B'	10.617
457.98	'4C'	10.623
458.24	'4D'	10.630
458.50	'4E'	10.636
458.75	'4F'	10.643
459.01	'50'	10.650
459.26	'51'	10.656
459.52	'52'	10.663
459.78	'53'	10.669
460.03	'54'	10.676
460.29	'55'	10.682
460.54	'56'	10.689
460.80	'57'	10.695
461.06	'58'	10.702
461.31	'59'	10.709
461.57	'5A'	10.715
461.82	'5B'	10.722
462.08	'5C'	10.728
462.34	'5D'	10.735
462.59	'5E'	10.741
462.85	'5F'	10.748
463.10	'60'	10.754
463.36	'61'	10.761
463.62	'62'	10.768
463.87	'63'	10.774
464.13	'64'	10.781
464.38	'65'	10.787

AM (kHz)	READ OUT	FM (MHz)
464.64	'66'	10.794
464.90	'67'	10.800
465.15	'68'	10.807
465.41	'69'	10.813
465.66	'6A'	10.820
465.92	'6B'	10.827
466.18	'6C'	10.833
466.43	'6D'	10.840
466.69	'6E'	10.846
466.94	'6F'	10.853
467.20	'70'	10.859
467.46	'71'	10.866
467.71	'72'	10.872
467.97	'73'	10.879
468.22	'74'	10.886
468.48	'75'	10.892
468.74	'76'	10.899
468.99	'77'	10.905
469.25	'78'	10.912
469.50	'79'	10.918
469.76	'7A'	10.925
470.02	'7B'	10.931
470.27	'7C'	10.938
470.53	'7D'	10.945
470.78	'7E'	10.951
471.04	'7F'	10.958
471.30	'80'	10.964
471.55	'81'	10.971
471.81	'82'	10.977
472.06	'83'	10.984
472.32	'84'	10.990
472.58	'85'	10.997
472.83	'86'	11.003
473.09	'87'	11.010
473.34	'88'	11.017
473.60	'89'	11.023
473.86	'8A'	11.030
474.11	'8B'	11.036
474.37	'8C'	11.043
474.62	'8D'	11.049
474.88	'8E'	11.056
475.14	'8F'	11.062
475.39	'90'	11.069
475.65	'91'	11.076
475.90	'92'	11.082
476.16	'93'	11.089
476.42	'94'	11.095
476.67	'95'	11.102
476.93	'96'	11.108
477.18	'97'	11.115
477.44	'98'	11.121

AM (kHz)	READ OUT	FM (HMz)
477.70	'99'	11.128
477.95	'9A'	11.135
478.21	'9B'	11.141
478.46	'9C'	11.148
478.72	'9D'	11.154
478.98	'9E'	11.161
479.23	'9F'	11.167
479.49	'A0'	11.174
479.74	'A1'	11.180
480.00	'A2'	11.187
480.26	'A3'	11.194
480.51	'A4'	11.200
480.77	'A5'	11.207
481.02	'A6'	11.213
481.28	'A7'	11.220
481.54	'A8'	11.226
481.79	'A9'	11.233
482.05	'AA'	11.239
482.30	'AB'	11.246
482.56	'AC'	11.253
482.82	'AD'	11.259
483.07	'AE'	11.266
483.33	'AF'	11.272
483.58	'B0'	11.279
483.84	'B1'	11.285
484.10	'B2'	11.292
484.35	'B3'	11.298
484.61	'B4'	11.305
484.86	'B5'	11.312
485.12	'B6'	11.318
485.38	'B7'	11.325
485.63	'B8'	11.331
485.89	'B9'	11.338
486.14	'BA'	11.344
486.40	'BB'	11.351
486.66	'BC'	11.357
486.91	'BD'	11.364
487.17	'BE'	11.370
487.42	'BF'	11.377
487.68	'C0'	11.384
487.94	'C1'	11.390
488.19	'C2'	11.397
488.45	'C3'	11.403
488.70	'C4'	11.410
488.96	'C5'	11.416
489.22	'C6'	11.423
489.47	'C7'	11.429
489.73	'C8'	11.436
489.98	'C9'	11.443
490.24	'CA'	11.449
490.50	'CB'	11.456

AM (kHz)	READ OUT	FM (MHz)
490.75	'CC'	11.462
491.01	'CD'	11.469
491.26	'CE'	11.475
491.52	'CF'	11.482
491.78	'D0'	11.488
492.03	'D1'	11.495
492.29	'D2'	11.502
492.54	'D3'	11.508
492.80	'D4'	11.515
493.06	'D5'	11.521
493.31	'D6'	11.528
493.57	'D7'	11.534
493.82	'D8'	11.541
494.08	'D9'	11.547
494.34	'DA'	11.554
494.59	'DB'	11.561
494.85	'DC'	11.567
495.10	'DD'	11.574
495.36	'DE'	11.580
495.62	'DF'	11.587
495.87	'E0'	11.593
496.13	'E1'	11.600
496.38	'E2'	11.606
496.64	'E3'	11.613
496.90	'E4'	11.620
497.15	'E5'	11.626
497.41	'E6'	11.633
497.66	'E7'	11.639
497.92	'E8'	11.646
498.18	'E9'	11.652
498.43	'EA'	11.659
498.69	'EB'	11.665
498.94	'EC'	11.672
499.20	'ED'	11.679
499.46	'EE'	11.685
499.71	'EF'	11.692
499.97	'F0'	11.698
500.22	'F1'	11.705
500.48	'F2'	11.711
500.74	'F3'	11.718
500.99	'F4'	11.724
501.25	'F5'	11.731
501.50	'F6'	11.737
501.76	'F7'	11.744
502.02	'F8'	11.751
502.27	'F9'	11.757
502.53	'FA'	11.764
502.78	'FB'	11.770
503.04	'FC'	11.777
503.30	'FD'	11.783
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 } for measuring purpose only.
S closed = with muting }

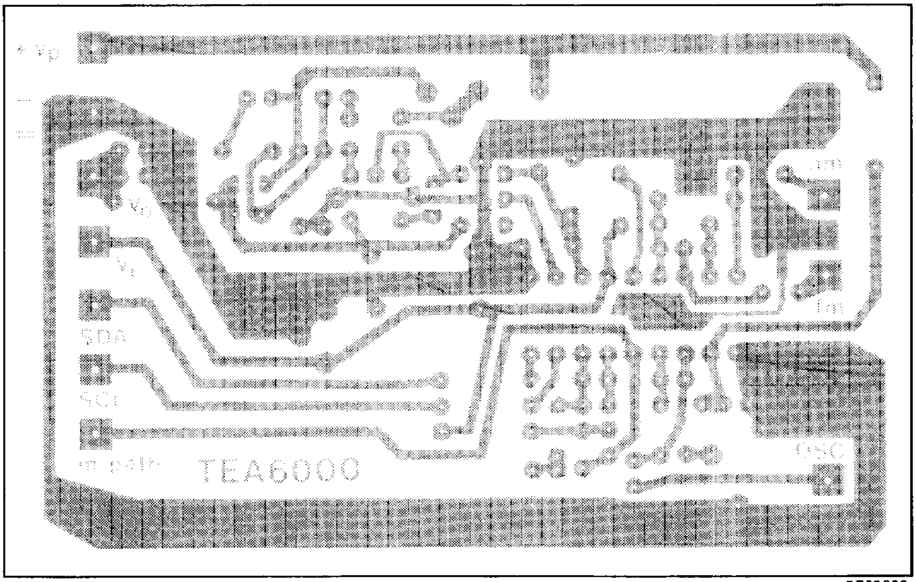


Fig. 7 Track side of printed-circuit board.

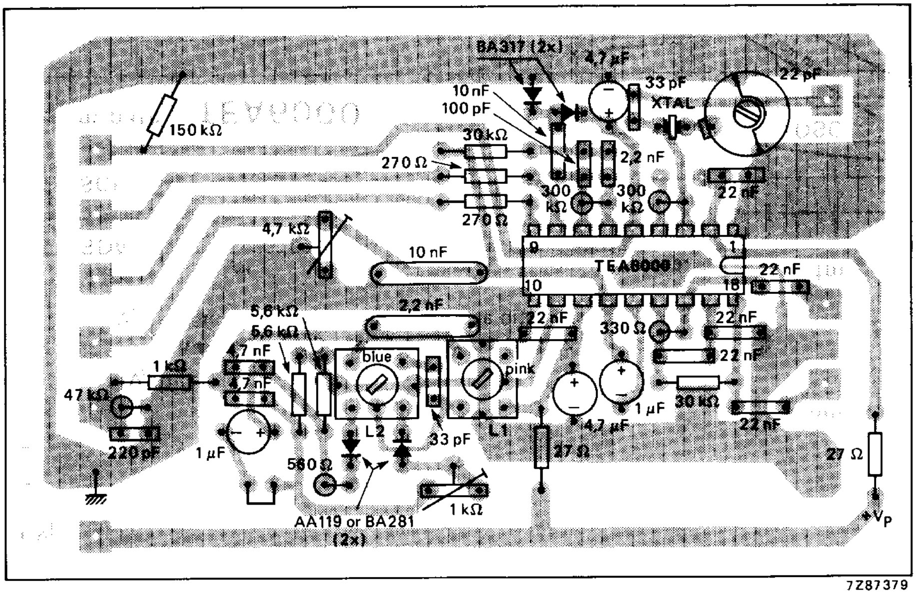


Fig. 8 Component side of printed-circuit board.

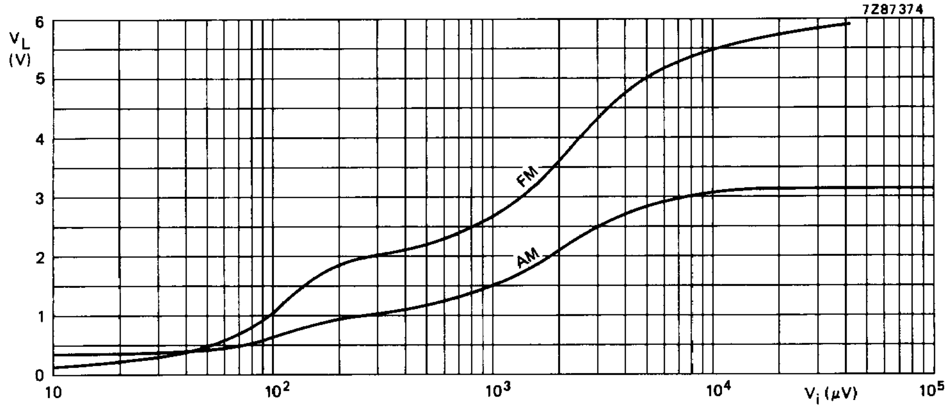


Fig. 9 Level detector output as a function of input voltage.

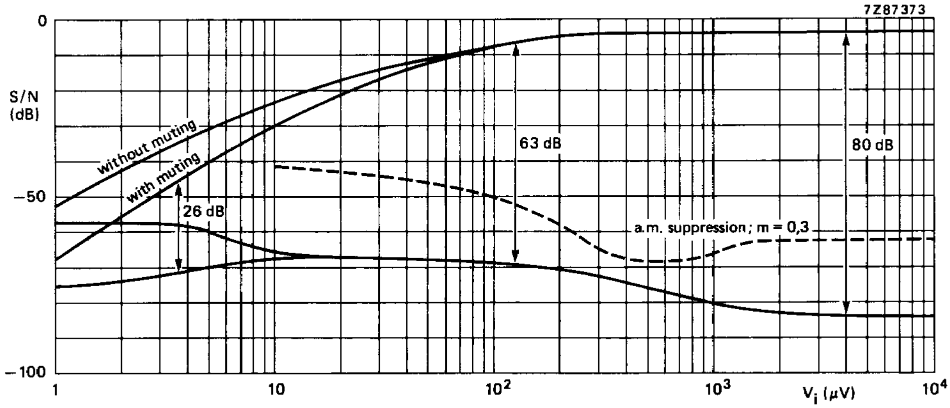


Fig. 10 Signal-to-noise ratio as a function of FM input voltage.
f_i = 10,7 MHz; Δf = 22,5 kHz; f_{mod} = 1 kHz; 0 dB = 245 mV.