DATA SHEET

OM5610
Matchbox global FM tuner

Preliminary specification
Supersedes data of 1997 Feb 07
File under Integrated Circuits, IC01

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Matchbox global FM tuner OM5610

FEATURES

- Local/DX switching to improve large signal handling on FM when an outdoor antenna or cable network is connected
- MPX-RDS signal available
- The module meets the *"FCC regulations"*
- Small size.

ORDERING INFORMATION

UNIT	FREQUENCY (MHz)	BUS
OM5610	87.5 to 108	3-wire bus

GENERAL DESCRIPTION

The OM5610 is a global FM-radio tuner (except Japan) which includes a brand new concept in tuning techniques. The new tuning concept combines the advantages of hand tuning together with electronic facilities and features.

TOP VIEW

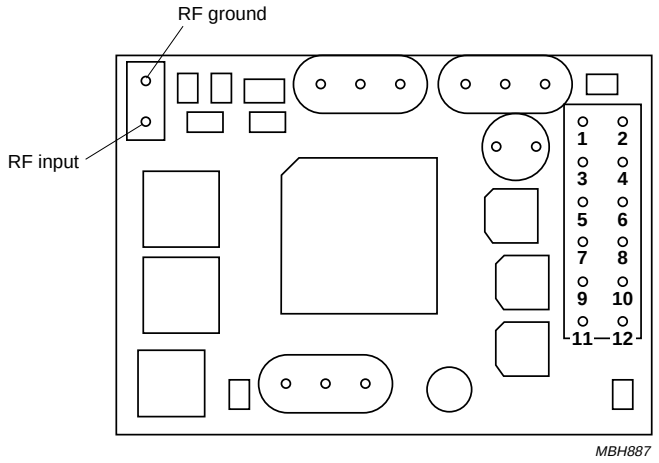


Fig.1 OM5610 connectors.

PINNING

PIN	DESCRIPTION
1	ground
2	ground
3	WREN
4	CLCK
5	STEREO
6	DATA
7	supply voltage (+5 V)
8	supply voltage (+12 V)
9	audio right output
10	ground
11	audio left output
12	MPX-RDS

FUNCTIONAL DESCRIPTION

The OM5610 is an integrated FM stereo radio circuit including digital tuning and control functions.

The radio

The radio circuit incorporates a tuned RF stage, a double balanced mixer, a one-pin oscillator and is designed for distributed IF ceramic filters. The FM quadrature detector uses a ceramic resonator.

The PLL stereo decoder incorporates a signal dependent stereo-blend circuit and a soft-mute circuit.

Tuning

The tuning-concept of Self Tuned Radio (STR) is based on FUZZY LOGIC: it mimics hand tuning (hand tuning is a combination of coarse and fine tuning to the qualitatively best frequency position). As a consequence the tuning system is very fast.

The tuning algorithm, which is controlled by a sequential circuit, is completely integrated; so there are only a few external components needed.

The bus and the microcontroller can be kept very simple. The bus only consists of three wires (CLCK, DATA and WREN). The microcontroller must basically give two instructions:

- Preset operation
- Search operation.

PRESET OPERATION

In preset mode, the microcontroller has to load information such as frequency band, frequency and mono/stereo. This information has to be sent via the bus to the tuner.
The internal algorithm controls the tuning sequence as follows:

1. The information is loaded into a shift register, a last-station memory and the counter.
2. The Automatic Frequency Control (AFC) is switched-off.
3. The counter starts counting the frequency and the tuning voltage is varied until the real frequency roughly equals the desired frequency.
4. The AFC is then switched on and the real frequency is more precisely tuned to the actual IF frequency.
5. After the AFC has tuned the real frequency to the desired frequency an in-lock signal is generated; then the counter is switched off. In order to get a reliable in-lock signal, there are two parameters measured: the field strength and the S-curve.
6. The field strength indicates the strength of the station and by looking at the S-curve the system can detect an in-lock situation.

In the event of fading or pulling the in-lock signal becomes logic 0 and the synthesizer will be switched on again (maintaining last station) and the algorithm will be repeated.

SEARCH OPERATION

During a search operation, the only action the microcontroller has to take is: sending the desired band plus the direction and the search sensitivity level to the tuner. The search operation is performed by the charge pump until an in-lock signal is generated (combination of measuring the field strength and the S-curve). By looking at the S-curve the system can distinguish false in-locks from real in-locks (false in-locks occur on the wrong slope of the S-curve). The AFC then fine tunes to the station. The frequency of the found station will be counted by the counter and written into the last-station memory and the shift register of the counter. At this time the frequency is available in the shift register and can be read by the microcontroller. The microcontroller decides whether the frequency is within the desired frequency band. If so, this frequency can be stored under a preset and if not, a new search action should be started.

Description of the bus

The OM5610 radio has a bus which consists of three wires, as shown in Table 1.

Table 1 Bus signals

SIGNAL	DESCRIPTION	PIN
CLCK	software driven clock input	4
DATA	data input/output	6
WREN	write/read-input	3

These three signals, together with the mono/stereo pin (STEREO; pin 5), communicate with the microcontroller. The mono/stereo indicator has two functions, which are controlled by the CLCK, as shown in Table 2.

Table 2 Bus-clock functions

CLCK	STEREO (PIN 5)	RESULT
LOW	LOW	stereo
LOW	HIGH	mono
HIGH	LOW	tuned
HIGH	HIGH	not tuned

The OM5610 has a 25-bit shift register; see Table 3 for an explanation of the shift register bits.

If in search mode no transmitter can be found, all frequency bits of the shift register are set to logic 0.

The bus protocol is depicted in Figs 2 and 3 and 4.

Table 3 Explanation of the shift register bits

BIT	DESCRIPTION	LOGIC STATE	RESULT
S.24 (MSB)	search start/end	0	after a search when a station is found or after a preset
		1	during the search action
D.23	search up/down	0	indicates if the radio has to search down
		1	indicates if the radio has to search up
M.22	mono/stereo	0	stereo is allowed
		1	mono is required (radio switched to forced mono)
B0.21	band	0	selects FM band
B1.20	band	0	selects FM band
P0.19	local/DX	0	local
		1	DX
P1.18	not used	0	
S0.17	search-level of station	see Table 4	determines the locking field strength during a search operation
S1.16			
15	dummy	0	buffer
F.14 to F.0 (LSB)	frequency	–	determine the tuning frequency of the radio; see Table 5 for the bit values

Table 4 Truth table for bits 16 and 17

S0.17	S1.16	SEARCH LEVEL FM (μV)
0	0	>15
1	0	>35
0	1	>75
1	1	>300

Table 5 Values for bits F.14 to F.0

BIT	BIT VALUE	FM VALUE(1) (kHz)
F.14	2^{14}	–
F.13	2^{13}	102400
F.12	2^{12}	51200
F.11	2^{11}	25600
F.10	2^{10}	12800
F.9	2^{9}	6400
F.8	2^{8}	3200
F.7	2^{7}	1600
F.6	2^{6}	800
F.5	2^{5}	400
F.4	2^{4}	200
F.3	2^{3}	100
F.2	2^{2}	50
F.1	2^{1}	25
F.0	2^{0}	12.5

Note

1. FM value of the affected oscillators:
   a) FM VALUE = FM-RF + FM-IF.

READING DATA

While WREN is LOW data can be read by the microcontroller. At a rising edge of the CLCK, data is shifted out of the register. This data is available from the point where the CLCK is HIGH until the next rising edge of the CLCK occurs (see Fig.2).

To read the entire shift register 24 clock pulses are necessary.

WRITING DATA

While WREN is HIGH the microcontroller can transmit data to the OM5610 (hard mute is active). At a rising edge of the CLCK, the register shifts and accepts one bit into LSB. At CLCK LOW the microcontroller writes data (see Fig.3).

To write the entire shift register 25 clock pulses are necessary.

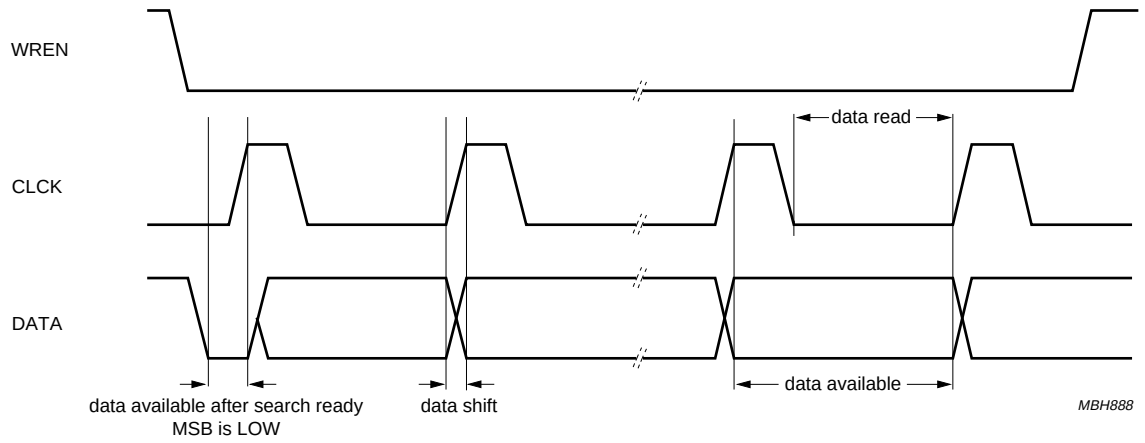


Fig.2 Read data.

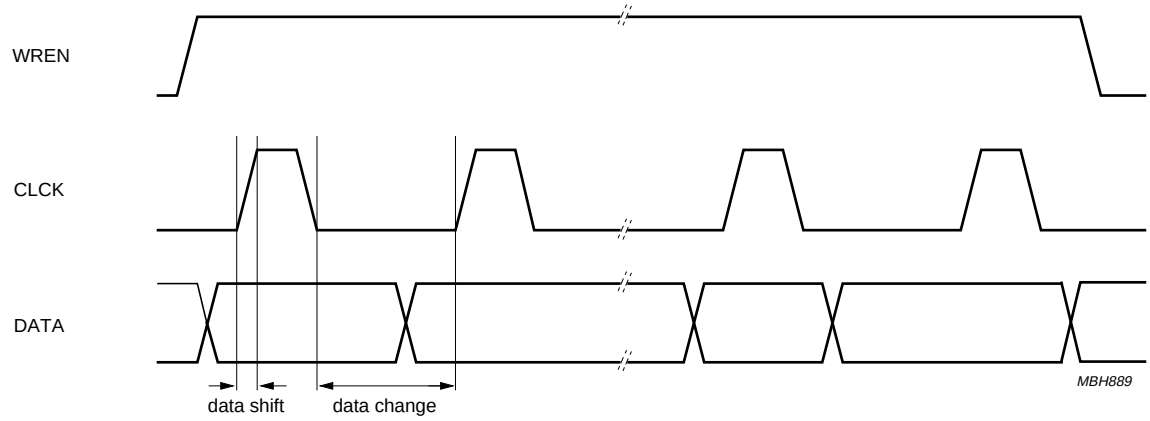


Fig.3 Write data.

BUS TIMING

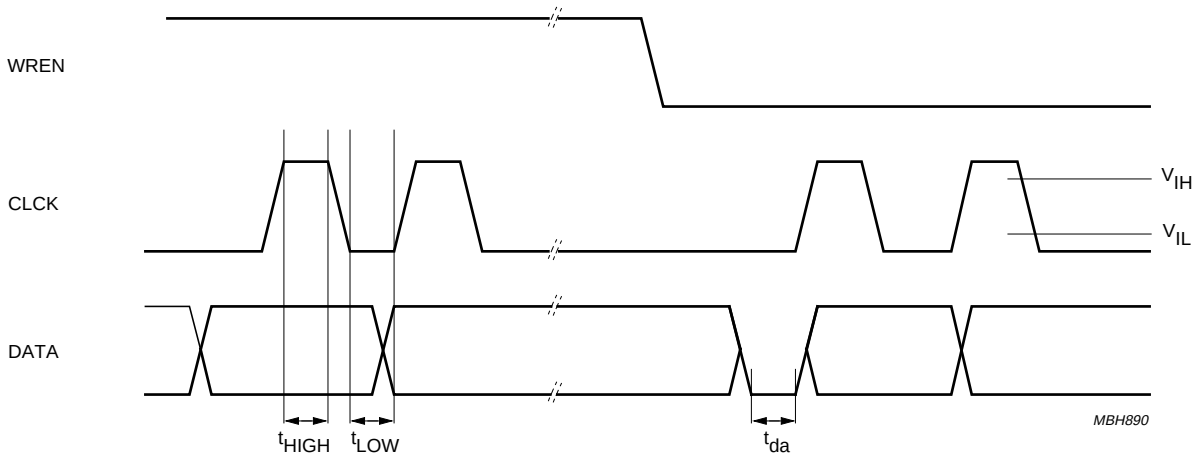


Fig.4 Bus timing.

Table 6 Digital inputs

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
Digital inputs				
V_{IH}	HIGH level input voltage	1.4	–	V
V_{IL}	LOW level input voltage	–	0.6	V
Timing				
f_{clk}	clock frequency	–	300	kHz
t_{HIGH}	clock HIGH time	1.67	–	µs
t_{LOW}	clock LOW time	1.67	–	µs
t_{da}	shift register available after ‘search ready’	–	14	µs

INTERFACE

- Digital driving: 3-wire bus
- Audio output: typical 160 mV RMS for Δf = 75 kHz (unloaded; Z_o = 5 kΩ)
- Supply voltages:
  - Pin 7: 5 V ±10% current ≤25 mA
  - Pin 8: 9 to 12 V, current ≤2 mA, ripple ≤1 V
- MPX-RDS: DC coupled (load ≥39 kΩ), amplitude typical 150 mV (Δf = 75 kHz)
- RF input connector: 2-pin connector, to be driven from a 75 Ω source
- 12 pin connector.

LIMITING VALUES

IEC publication 68-1; full specification; EMC behaviour: the module is designed to be FCC friendly (part 15).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
RH	relative humidity		25	85	%
T_{amb}	operating ambient temperature	functional operation	–10	+60	°C
T_{stg}	storage temperature		–20	+70	°C
$V_{es(pc)}$	electrostatic handling for pin connector	note 1	–	2	kV
		note 2	–	300	V
$V_{es(RFc)}$	electrostatic handling for RF connector	note 3	–	4	kV
		note 4	–	500	V

Notes

1. Class B: human body model (1.5 kΩ, 100 pF).
2. Class B: charge device model (0 Ω, 200 pF).
3. Class A: human body model (1.5 kΩ, 100 pF).
4. Class A: charge device model (0 Ω, 200 pF).

CHARACTERISTICS

RF signal generator impedance = 50 Ω; dummy used (see Fig.5); RF levels are EMF/2; Δf = 75 kHz; f_i = 98 MHz; f_{mod} = 1 kHz; left and right audio output; audio filter = 22 Hz to 15 kHz; temperature range = 15 to 35 °C.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
FM mono						
Φ_{lim}	3 dB limiting sensitivity	$V_{9,\ 11}$ = –3 dB; $V_{9,\ 11}$ = 0 dB at V_{FMi} > 100 μV	–	5.5	7.5	μV
Φ_{RF}	RF sensitivity	(S + N)/N = 26 dB	–	3.5	5	μV
S/N	signal-to-noise ratio	V_{FMi} = 1 mV	–	68	–	dB
f_L	lower audio frequency bandwidth limit	measured lower limit (–3 dB); f_{ref} = 1 kHz; measured with pre-emphasis	–	40	70	Hz
f_H	upper audio frequency bandwidth limit	measured upper limit (–3 dB); f_{ref} = 1 kHz; measured with pre-emphasis	12.5	14	–	kHz
α_{AM}	AM suppression	AM modulation m = 30%; f_{AF} = 1 kHz	40	50	–	dB
THD	total harmonic distortion		–	1.5	3	%
V_{FMi}	search sensitivity	search stop bits S0.17 and S1.16 = 0	–	15	–	μV
α_{RF}	RF attenuation in local mode		15	20	30	dB
V_{FM}	audio output voltage level	V_{FMi} = 1 mV; unloaded	–	160	–	mV
FM stereo						
S/N	signal-to-noise ratio	V_{FMi} = 1 mV	60	63	–	dB
α_{cs}	channel separation	f_{AF} = 1 kHz; V_{FMi} = 1 mV	22	28	–	dB
$\lvert\Delta I_O\rvert$	channel imbalance	f_{AF} = 1 kHz; V_{FMi} = 1 mV	–	0.5	3	dB
α	stereo blend function	V_{FMi} = 100 μV	5	10	–	dB
THD	total harmonic distortion		–	–	3	%

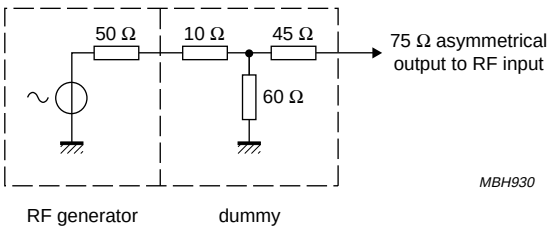
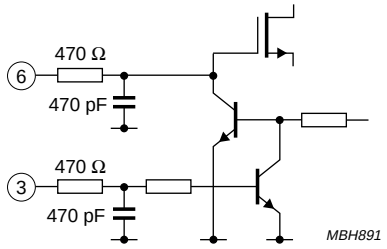
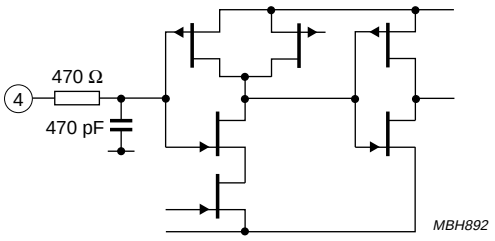
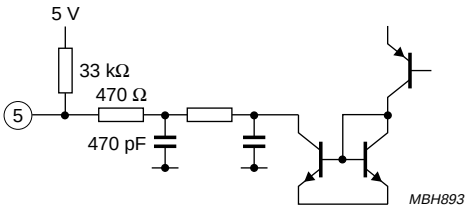
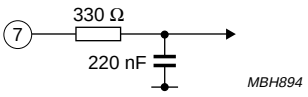
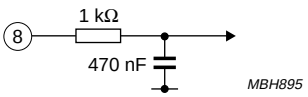
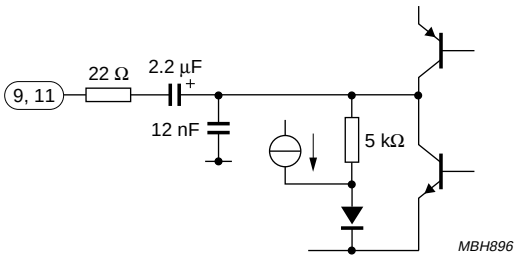
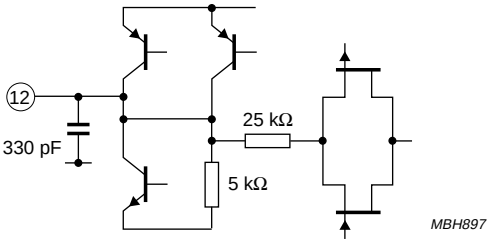


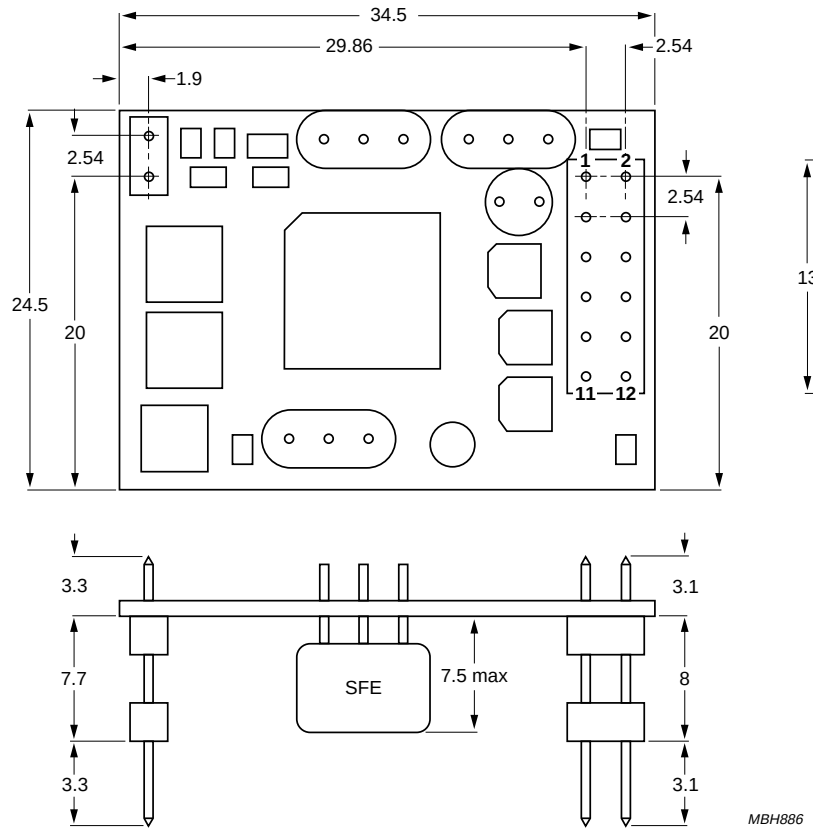
Fig.5 RF signal generator and dummy.

INTERNAL CIRCUITRY

PIN	DESCRIPTION	DC VOLTAGE (V)	EQUIVALENT CIRCUIT
1	ground	0	
2	ground	0	
3	WREN	–	
6	DATA	–	
4	CLCK	–	
5	STEREO	–	
7	+5 V	5	
8	+12 V	12	

PIN	DESCRIPTION	DC VOLTAGE (V)	EQUIVALENT CIRCUIT
9	audio right output	0	
11	audio left output	0	
10	ground	0	
12	MPX-RDS	0.7	

BOARD OUTLINE



Dimensions in mm.

Fig.6 Board outline for OM5610.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

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