DATA SHEET

TDA8735
PLL frequency synthesizer

Product specification
File under Integrated Circuits, IC01

September 1994

Philips Semiconductors

PHILIPS

PLL frequency synthesizer TDA8735

FEATURES

- Complete 30 MHz single-chip tuning system
- Loop amplifier included
- 2-level current amplifier (charge pump) for adjusting the loop gain
- A powerful digital memory phase detector
- Programmable reference frequencies of 1 kHz, 10 kHz or 25 kHz
- I^2C-bus interface
- Programmable address select input
- Software controlled switch output.

APPLICATIONS

- Satellite sound receiver
- Radio receiver: LW, MW and SW.

GENERAL DESCRIPTION

The TDA8735 is a single-chip PLL synthesizer designed for satellite receivers. The device can be set to two different addresses which can be used in applications where independently tuned VCOs are required.

To adapt to different frequency accuracy, 3 reference frequencies are selectable via the I^2C-bus. The charge pump current can be set to 2 values with a ratio of 1 : 100 via the I^2C-bus.

A programmable switch (open collector) is integrated to enable mode or normal switching, or other types of application.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CC1}	supply voltage (pin 3)		4.5	5.0	5.5	V
V_{CC2}	supply voltage (pin 16)		V_{CC1}	8.5	12	V
I_{CC1}	supply current (pin 3)	outputs unloaded	12	20	28	mA
I_{CC2}	supply current (pin 16)	outputs unloaded	0.2	0.5	1	mA
$f_{i(max)}$	maximum input frequency		30	–	–	MHz
$f_{i(min)}$	minimum input frequency		–	–	512	kHz
$V_{i(rms)}$	input voltage (RMS value)		30	–	500	mV
P_{tot}	total power dissipation		–	0.14	–	W
T_{amb}	operating ambient temperature		–30	–	+85	°C

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA8735	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-1
TDA8735T	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

BLOCK DIAGRAM

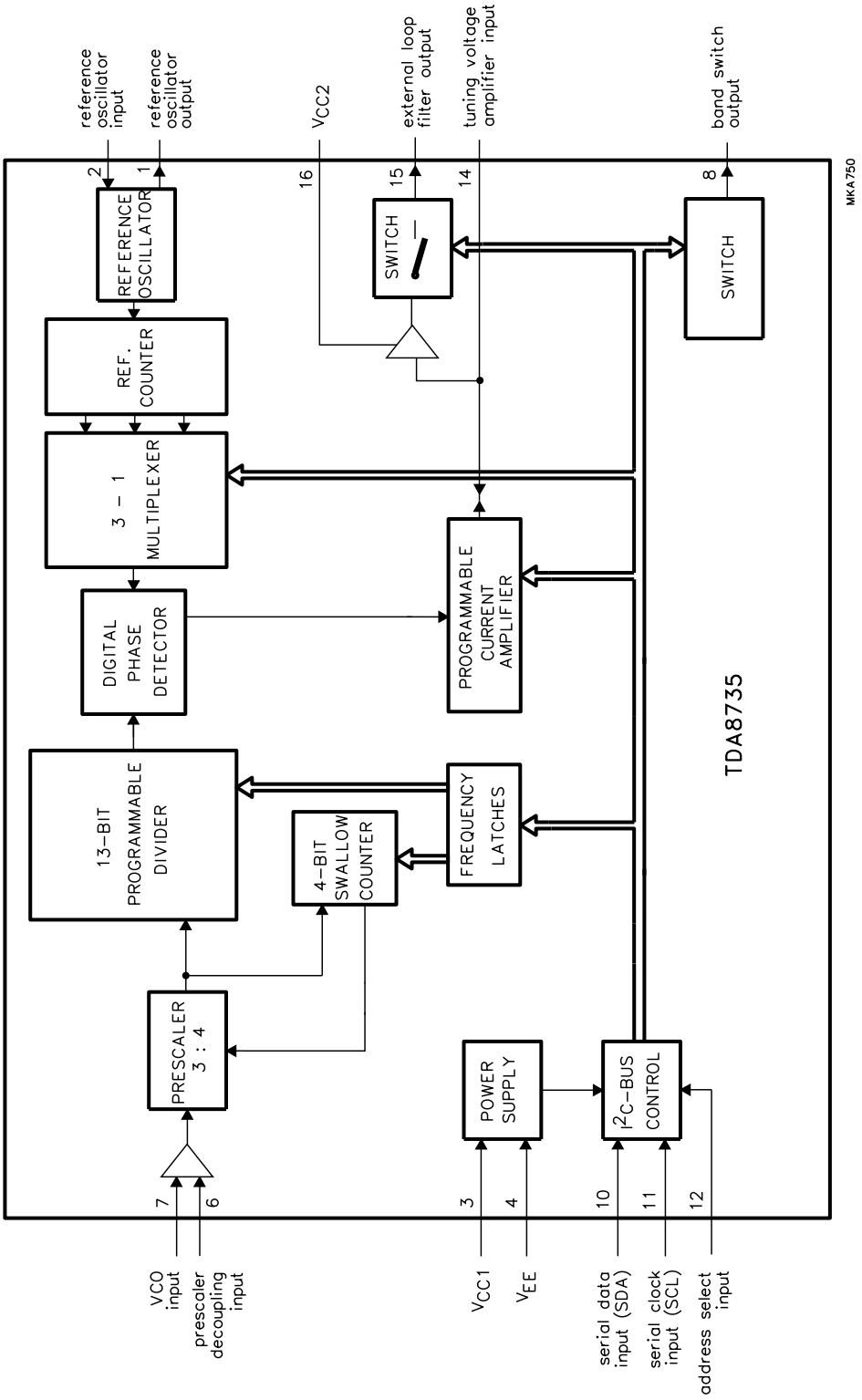


Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
XTAL1	1	reference oscillator output
XTAL2	2	reference oscillator input
V_{CC1}	3	supply voltage 1
V_{EE}	4	ground
n.c.	5	not connected
DEC	6	prescaler decoupling
VCOFI	7	VCO input frequency
BS	8	band switch output
n.c.	9	not connected
SDA	10	serial data input (I^2C-bus)
SCL	11	serial clock input (I^2C-bus)
AS	12	address select input (I^2C-bus)
n.c.	13	not connected
$LOOP_I$	14	tuning voltage amplifier input
$LOOP_O$	15	external loop filter output
V_{CC2}	16	supply voltage 2

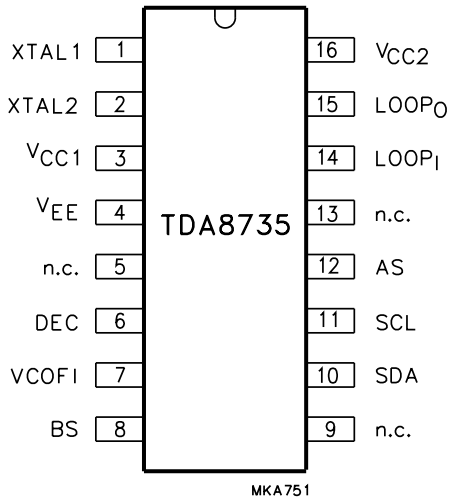


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

The TDA8735 contains the following parts and facilities:

- Input amplifier VCO-signal.
- A prescaler with the divisors 3 : 4 and a 2-bit programmable swallow counter.
- A 13-bit programmable counter.
- A digital memory phase detector.
- A reference frequency channel comprised of a 4 MHz crystal oscillator followed by a reference counter; the reference frequency can be 1 kHz, 10 kHz or 25 kHz and is applied to the digital memory phase detector.
- An I^2C-bus interface with data latches and control logic; the I^2C-bus is intended for communication between microcontrollers and different ICs or modules. Detailed information on the I^2C-bus specification is available on request.
- A software-controlled switch output.
- A programmable current amplifier (charge pump) which consists of a 5 μA and a 500 μA current source, this allows adjustment of loop gain, thus providing high-current high-speed tuning and low current-stable tuning. The output at the loop amplifier can deliver a tuning voltage of up to 10.5 V (V_{CC2} – 1.5 V).

Controls

The TDA8735 is controlled via the 2-wire I^2C-bus. As slave receiver for programming there is one module address, a logic 0 ($R/\overline{W}$ bit), a subaddress byte and four data bytes. The subaddress determines which one of the four data bytes is transmitted first. The module address contains a programmable address bit (D1) which with address select input AS (pin 12) makes it possible to operate two TDA8735 in one system.

The auto increment facility of the I^2C-bus allows programming of the TDA8735 within one transmission (address + subaddress + 4 data bytes).

The TDA8735 can also be partially programmed. Transmission must then be ended by a stop condition.

The bit organization of the 4 data bytes is illustrated in Fig.3 and is described below.

The divider number is defined by 15-bit words, bits S0 to S14. To calculate the lock frequency, the divider number has to be multiplied by the selected reference frequency.

Table 1 Divider number setting.

$\overline{ON}$	DIVIDER NUMBER SETTING	INPUT
0	$(S0 + S1) \times 2^1$ .... $+ S13 \times 2^{13} + S14 \times 2^{14}$	ON

Where the minimum divider ratio is: $2^6 = 64$ to $2^{15} - 1 = 32761$.

Table 2 Bit CP (used to control the charge pump; DB0: D0).

CP	CURRENT
0	LOW
1	HIGH

Table 3 Bits REF1 and REF2 (used to set the reference frequency applied to the phase detector; DB2: D7 and D6).

REF1	REF2	FREQUENCY (kHz)
0	0	1
0	1	10
1	0	25
1	1	0

Table 4 Bit OPAMP (used to control the switch in the tuning voltage amplifier output circuitry; DB2: D4).

OPAMP	SWITCH
1	on
0	off

Table 5 Bit BS (used to control the open-collector switch output; DB2: D2).

BS	SWITCH OUTPUT
1	sink current
0	floating

The data byte DB3 must be set to 0....0. It is also used for test purposes (see Fig.3).

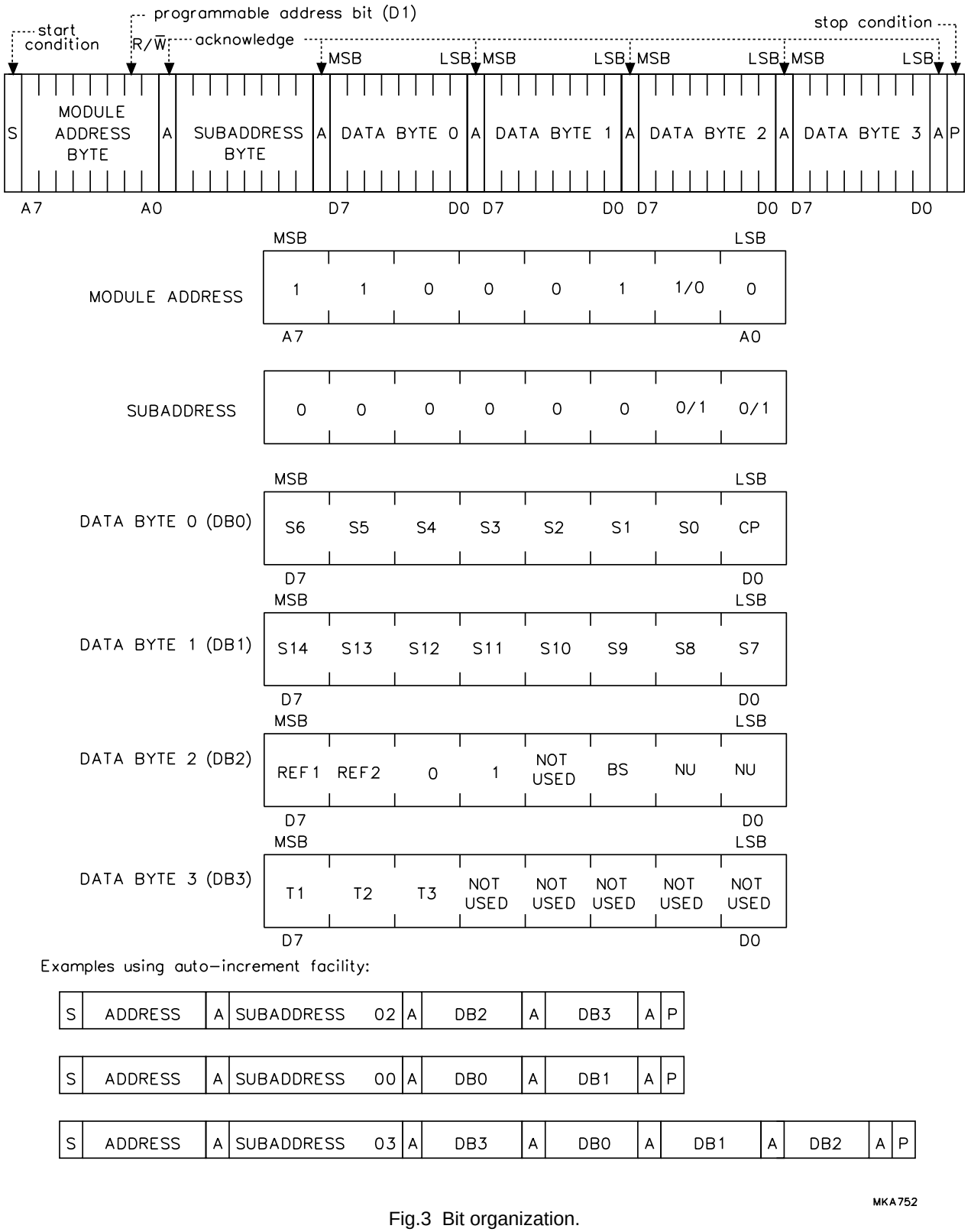


Fig.3 Bit organization.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{CC1}	supply voltage (pin 3)	–0.3	+5.5	V
V_{CC2}	supply voltage (pin 16)	V_{CC1}	12.5	V
P_{tot}	total power dissipation	–	0.85	W
T_{amb}	operating ambient temperature	–30	+85	°C
T_{stg}	storage temperature	–65	+150	°C

HANDLING

Every pin withstands the ESD test in accordance with *"MIL-STD-883C category B"* (2000 V).

CHARACTERISTICS

V_{CC1} = 5 V; V_{CC2} = 8.5 V; T_{amb} = 25 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V_{CC1}	supply voltage (pin 3)		4.5	5.0	5.5	V
V_{CC2}	supply voltage (pin 16)		V_{CC1}	8.5	12	V
I_{CC1}	supply current (pin 3)	no outputs loaded	12	20	28	mA
I_{CC2}	supply current (pin 16)	no outputs loaded	0.2	0.5	1	mA
		TDA8735T only	0.7	1	1.5	mA
I²C-bus inputs (SDA and SCL)						
V_{IH}	HIGH level input voltage		3.0	–	5.0	V
V_{IL}	LOW level input voltage		–0.3	–	+1.5	V
I_{IH}	HIGH level input current		–	–	10	µA
I_{IL}	LOW level input current		–	–	10	µA
SDA output						
V_{OL}	LOW level output voltage	open collector; I_{OL} = 3.0 mA	–	–	0.4	V
AS input						
V_{IH}	HIGH level input voltage	AS = C6	3.0	–	5.0	V
V_{IL}	LOW level input voltage	AS = C4	–0.3	–	+1.0	V
I_{IH}	HIGH level input current		–	–	10	µA
I_{IL}	LOW level input current		–	–	10	µA
RF input						
$f_{i(max)}$	maximum input frequency		30	–	–	MHz
$f_{i(min)}$	minimum input frequency		–	–	512	kHz
$V_{i(rms)}$	input voltage (RMS value)	measured in Fig.4	30	–	500	mV
R_i	input resistance		–	5.9	–	kΩ
C_i	input capacitance		–	2	–	pF

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Oscillator (XTAL1 and XTAL2)						
R_{xtal}	crystal resonance resistance (4 MHz)	see Fig.5	–	–	150	Ω
Programmable charge pump						
I_{CHP}	output current to loop filter	bit CP = logic 0	3	5	7	µA
		bit CP = logic 1	400	500	600	µA
		bit CP = logic 0; TDA8735T only	3	5	9	µA
Ripple rejection						
RR	$20 \log \frac{\Delta V_{CC1}}{\Delta V_O}$	f_{ripple} = 100 Hz	40	50	–	dB
	$20 \log \frac{\Delta V_{CC2}}{\Delta V_O}$	f_{ripple} = 100 Hz	40	50	–	dB
Band switch output (pin 8)						
V_{OH}	HIGH level output voltage		–	–	12	V
V_{OL}	LOW level output voltage	I_{OL} = 3 mA	–	–	0.8	V
$\|I_{LO}\|$	output leakage current	V_{OH} = 12 V	–	–	10	µA
Tuning voltage amplifier output (pin 15)						
$V_{O(max)}$	maximum output voltage	I_{source} = 0.5 mA	V_{CC2} – 1.5	–	–	V
$V_{O(min)}$	minimum output voltage	I_{sink} = 1 mA	–	–	0.8	V
I_{source}	maximum output source current		0.5	–	–	mA
I_{sink}	maximum output sink current		1.0	–	–	mA
$Z_{o(off)}$	impedance of switched-off output		5	–	–	MΩ
$\|I_{bias}\|$	input bias current (absolute value)		–	1	5	nA

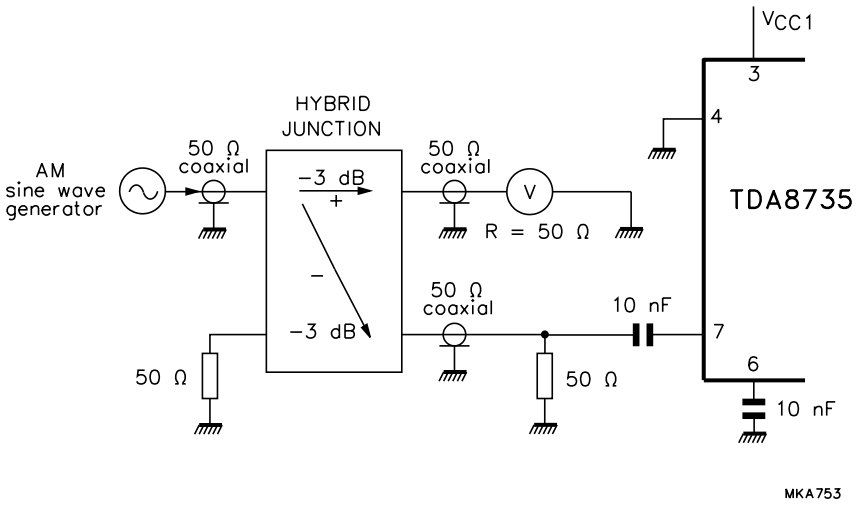


Fig.4 Prescaler input sensitivity (set-up measurement).

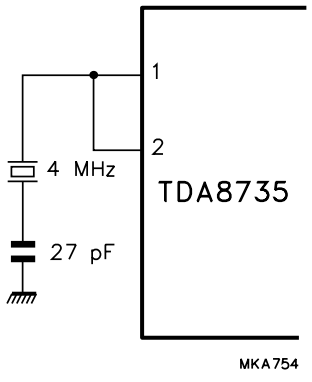
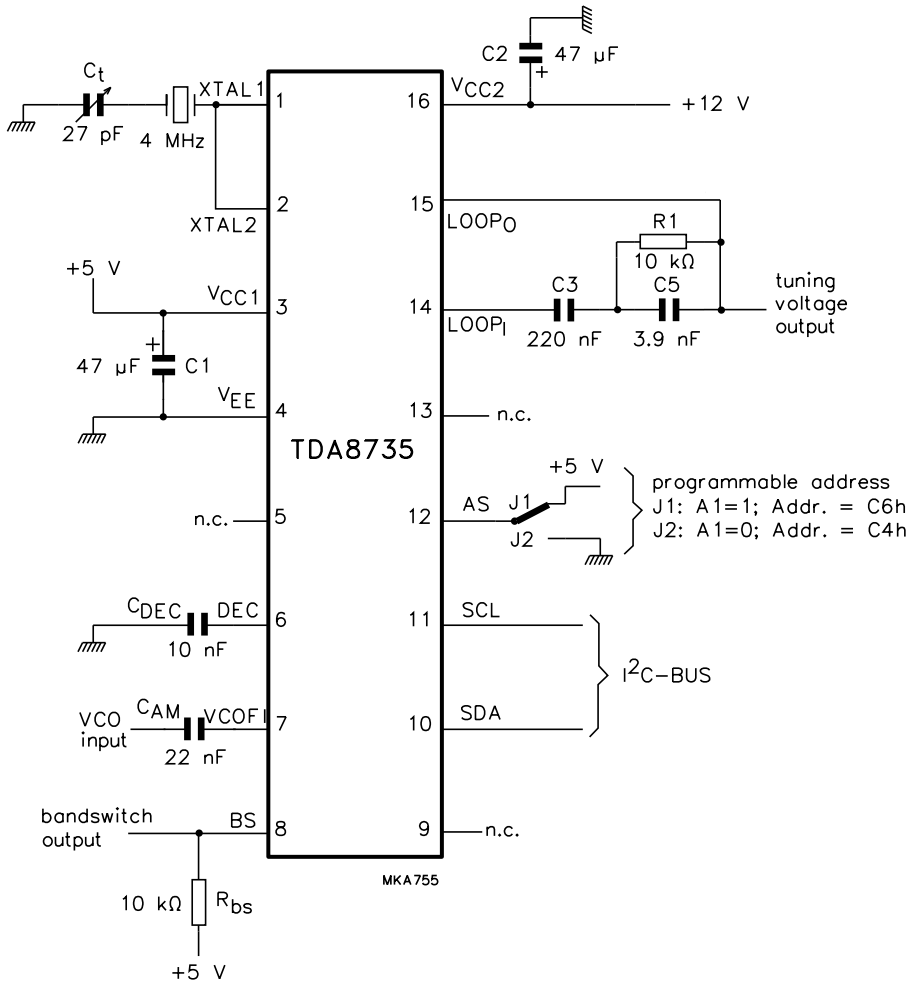


Fig.5 Crystal connection (4 MHz).

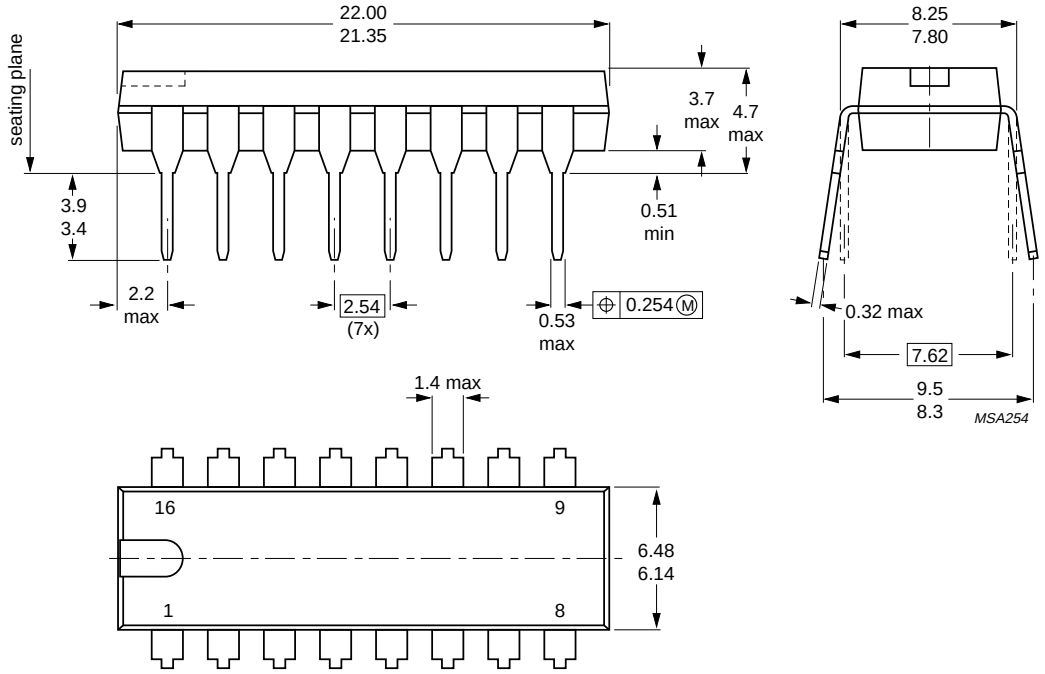
APPLICATION INFORMATION



Loop filter depends on VCO parameters.

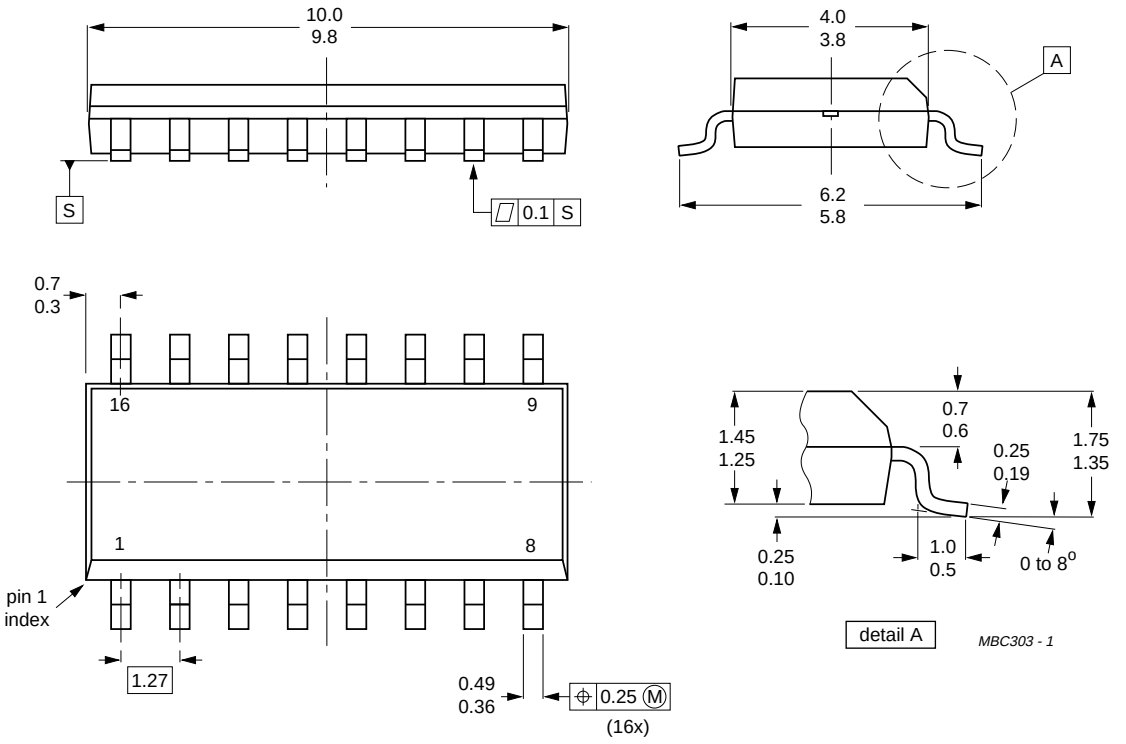
Fig.6 Application example.

PACKAGE OUTLINES



Dimensions in mm.

Fig.7 Plastic dual in-line package; 16 leads (300 mil) DIP16; SOT38-1.



Dimensions in mm.

Fig.8 plastic small outline package; 16 leads; body width 3.9 mm (SO16; SOT109-1).

SOLDERING

Plastic dual in-line packages

BY DIP OR WAVE

The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 s. The total contact time of successive solder waves must not exceed 5 s.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

REPAIRING SOLDERED JOINTS

Apply a low voltage soldering iron below the seating plane (or not more than 2 mm above it). If its temperature is below 300 °C, it must not be in contact for more than 10 s; if between 300 and 400 °C, for not more than 5 s.

Plastic small-outline packages

BY WAVE

During placement and before soldering, the component must be fixed with a droplet of adhesive. After curing the adhesive, the component can be soldered. The adhesive can be applied by screen printing, pin transfer or syringe dispensing.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder bath is 10 s, if allowed to cool to less than 150 °C within 6 s. Typical dwell time is 4 s at 250 °C.

A modified wave soldering technique is recommended using two solder waves (dual-wave), in which a turbulent wave with high upward pressure is followed by a smooth laminar wave. Using a mildly-activated flux eliminates the need for removal of corrosive residues in most applications.

BY SOLDER PASTE REFLOW

Reflow soldering requires the solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the substrate by screen printing, stencilling or pressure-syringe dispensing before device placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt, infrared, and vapour-phase reflow. Dwell times vary between 50 and 300 s according to method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 min at 45 °C.

REPAIRING SOLDERED JOINTS (BY HAND-HELD SOLDERING IRON OR PULSE-HEATED SOLDER TOOL)

Fix the component by first soldering two, diagonally opposite, end pins. Apply the heating tool to the flat part of the pin only. Contact time must be limited to 10 s at up to 300 °C. When using proper tools, all other pins can be soldered in one operation within 2 to 5 s at between 270 and 320 °C. (Pulse-heated soldering is not recommended for SO packages.)

For pulse-heated solder tool (resistance) soldering of VSO packages, solder is applied to the substrate by dipping or by an extra thick tin/lead plating before package placement.

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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