IF Amplifier / Converter for DVB (Cable)

Description

The U4476B is a bipolar circuit for the processing of DVB-Cable IF signals (**D**igital **V**ideo **B**roadcasting). The amplifier/ converter is suitable for QAM modulated IF signals (1st IF) and provides the gain controlled 2nd IF. With 5 V supply voltage the IC allows application in RF/IF front ends for DVB-Cable receivers (set top boxes).

Features

- Gain controlled amplifier for the 1st IF (36 MHz)

- IF converter for the 2nd IF (7 MHz);
  VCO circuit is controlled by external PLL

- Bandwidth of the output signal: 10 MHz (–1 dB)

- Internal AGC with average detection for the QAM modulated DVB signal, reference level is adjustable

- 5 V supply voltage; low-power consumption

Package: 28-pin small outline plastic package (SO28)
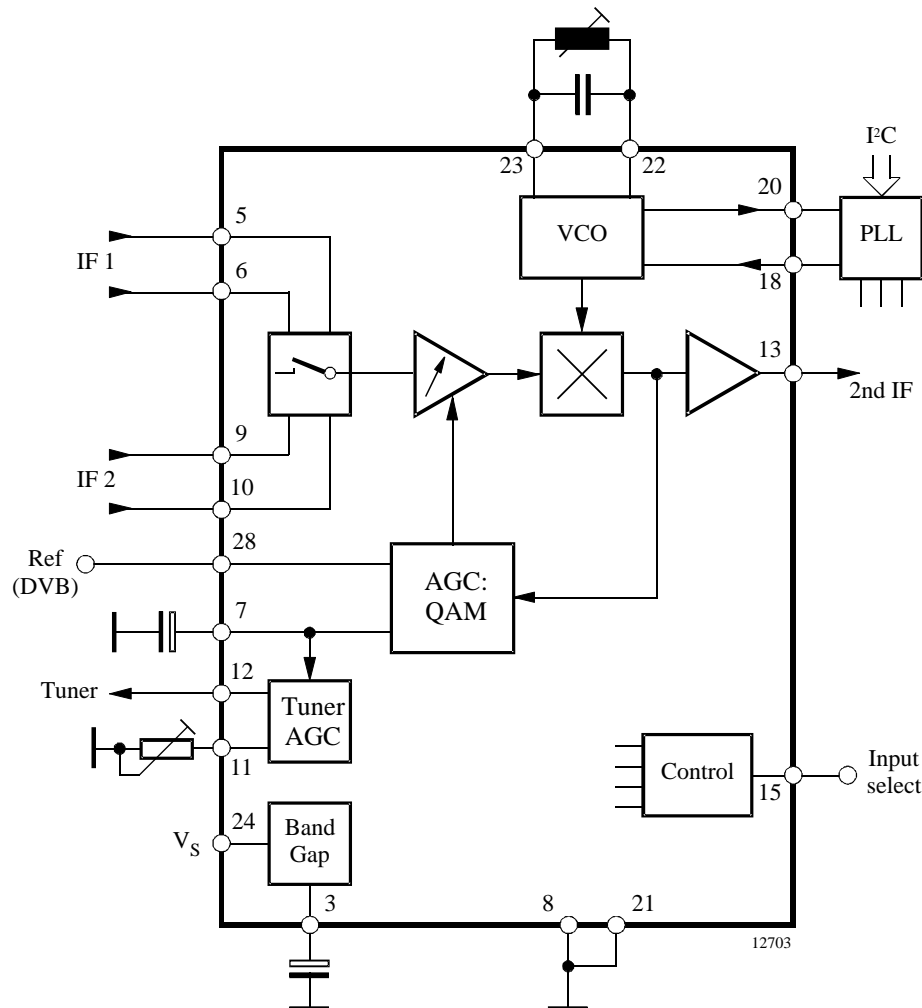
Block Diagram

Figure 1. Block diagram

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Ordering Information

Extended Type Number	Package	Remarks
U4476B-MFLG3	SO28	Taped and reeled, 2000 pcs

Pin Description

NC	1		28	AGC$_{Ref}$
NC	2		27	NC
C$_{Ref}$	3		26	NC
NC	4		25	NC
V$_{in1}$	5		24	V$_S$
V$_{in1}$	6		23	V$_{vco}$
C$_{AGC}$	7		22	V$_{vco}$
GND	8		21	GND
V$_{in2}$	9		20	LO$_{out}$
V$_{in2}$	10		19	NC
Rtop	11		18	V$_{tun}$
Itun	12		17	NC
V$_{out}$	13		16	NC
NC	14		15	V$_{sw}$

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Figure 2. Pinning

Pin	Symbol	Function
1, 2	NC	Not connected
3	C$_{Ref}$	Capacitor for internal band gap reference voltage
4	NC	Not connected
5, 6	V$_{in1}$	IF input 1 (symmetrical)
7	C$_{AGC}$	DVB AGC (time constant)
8	GND	Ground
9, 10	V$_{in2}$	IF input 2 (symmetrical)
11	Rtop	Take-over point, tuner AGC
12	Itun	Tuner AGC output current
13	V$_{out}$	Output signal (2nd IF)
14	NC	Not connected
15	V$_{sw}$	IF input selector switch
16	NC	Not connected
17	NC	Not connected
18	V$_{tun}$	Input for the external VCO tuning voltage
19	NC	Not connected
20	LO$_{out}$	Local oscillator output (reference signal)
21	GND	Ground
22, 23	V$_{vco}$	VCO circuit (symmetrical)
24	V$_S$	Supply voltage
25	NC	Not connected
26	NC	Not connected
27	NC	Not connected
28	AGC$_{Ref}$	External reference voltage (comparator DVB AGC)

Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Supply voltage	V$_S$	5.5	V
Supply current	I$_S$	100	mA
Power dissipation, V$_S$ = + 5.5 V	P$_{tot}$	550	mW
Output currents	I$_{out}$	5	mA
Junction temperature	T$_j$	125	°C
Storage temperature	T$_{stg}$	−25 to +125	°C
Electrostatic handling *)	V$_{ESD}$	tbd	V

*) Equivalent to discharging a 200-pF capacitor through a 0-Ω resistor

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Operating Range

Parameters	Symbol	Value	Unit
Supply voltage range	V_S	4.5 to 5.5	V
Ambient temperature	T_{amb}	0 to +85	°C

Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient when soldered to PCB	R_{thJA}	75	K/W

Electrical Characteristics

$V_S = 5$ V, $T_{amb} = 25$°C

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
DC supply						
Supply voltage		V_S	4.5	5.0	5.5	V
Supply current		I_S		80	100	mA
IF inputs						
Input sensitivity, rms value		v_{in}		80	120	μV_{rms}
Input impedance	See note 1	R_{in}		1.2		kΩ
Input capacitance	See note 1	C_{in}		2		pF
DVB AGC (QAM modulation)						
IF gain control range	IF2 output voltage Pin 13 = 1.8 V_{pp}	G_v	60	65		dB
VCO						
Oscillator frequency		f_{vco}		43	60	MHz
Tuning range	$f_{vco} = 43$ MHz $C_{vco} = 8.2$ pF	Δf_{tun}		±1.5		MHz
Local oscillator output signal	$f_{vco} = 43$ MHz $C_{vco} = 8.2$ pF	LOout		100		mV
Local oscillator control signal	$f_{vco} = 43$ MHz $C_{vco} = 8.2$ pF	vtun	0.5	2.7	4.5	V
2nd IF output						
Output current source Output current sink		$\pm I_{out}$	2		5 4	mA
Output resistance	See note 1	R_{out}			100	Ω
Output amplitude	Peak-to-peak value	$v_{o,vid}$	1.6	1.8	2.0	V
DC output voltage				2.2		V
Bandwidth of 2nd IF (–1 dB)	$R_L \geq 1$ kΩ, $C_L \leq 50$ pF	B	10			MHz
Frequency response over AGC range		ΔB			2.0	dB
IF input switch						
Control voltage Input 1 is active Input 2 is active	See also note 2, 'high' (IF1 active, Pin 5–6) 'low' (IF2 active, Pin 9–10)	V_{SW} V_{SW}	2.5		3.5 1.5	V V
Switching current (Pin 15 to ground)		I_{SW}		30		μA

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Electrical Characteristics

$V_s = 5$ V, $T_{amb} = +25°C$

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Tuner AGC						
Available tuner AGC current		I_{tun}	1	2	4	mA
Allowable output voltage		V_{out}	0.3		13.5	V
IF slip tuner AGC	Current I_{tun}: 10% to 90%	ΔG_{IF}		8	10	dB
IF input signal for minimum take over point		v_{in}			4	mV
IF input signal for maximum take over point		v_{in}	40			mV
Variation of the take over point by temperature (Pin 28 open)	$\Delta T_{amb} = 55°C$ IF AGC: $G_v = 46$ dB	v_{in}		2	3	dB

Notes:
1.   This parameter is given as an application information and not tested during production.
2.   Without external control voltage (pin not connected) the input 1 is automatically selected.

Basic Application Circuit
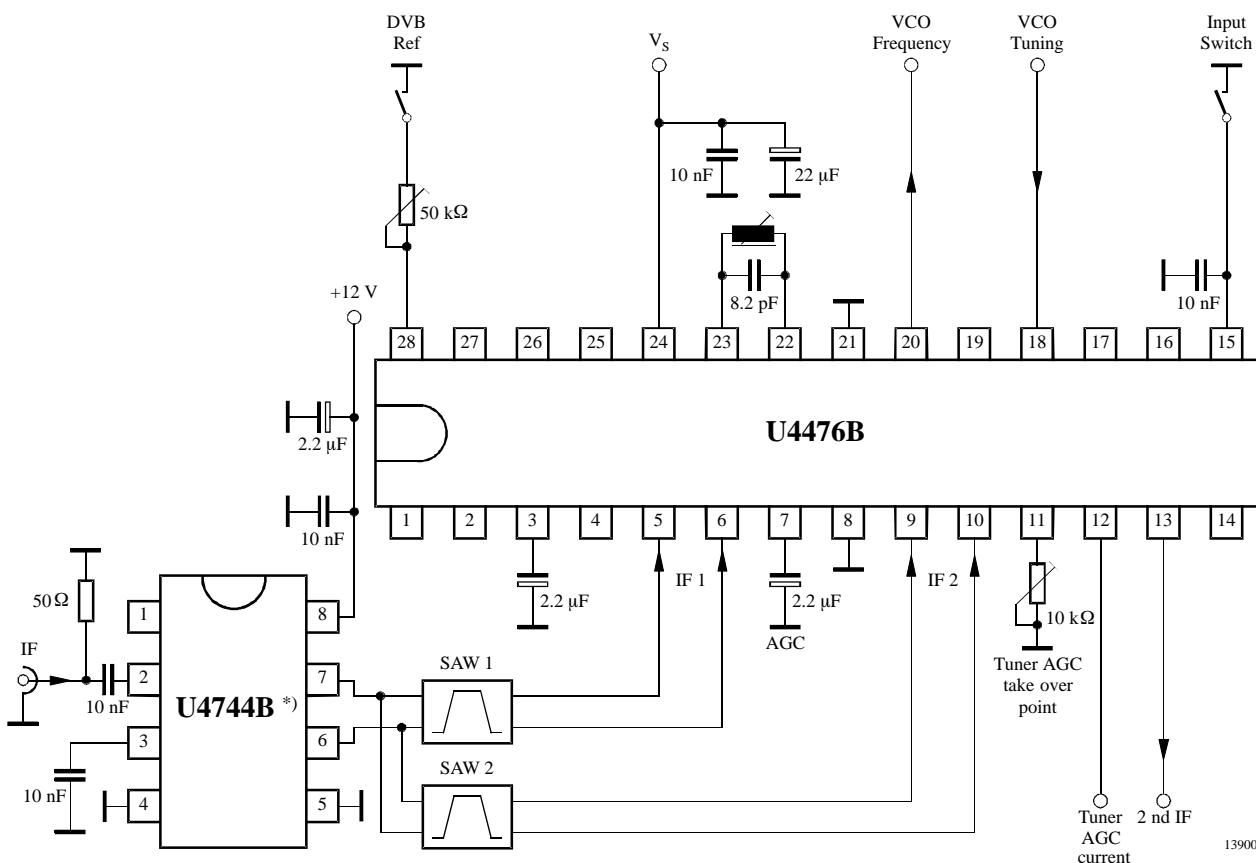
*)   U4744B: SAW driver, device phased out, not for new development

Figure 3.

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IM3 Measurements and Application Recommendations

IM3 Measurement

For correct measurement of IM3 with the 2-carrier method, it is necessary to control the internal IF amplifier via an external voltage at Pin 7. The criteria for a correct value of the external control voltage is the output amplitude of 1.8 V_{pp} (or lower). Please note that − each change of the input level requests a correction of the external gain control voltage at Pin 7 in order to achieve the 1.8-V_{pp} output level again. In this case, IM3 is nearly 43 dB, independent from the input level. With an output voltage of 1.5 V_{pp} only, the IM3 is about –50 dB. Anyway, if the output amplitude is more than 1.8 V_{pp} (specified), the IM3 will decrease rapidly. In the graphic below, IM3 is shown for two different conditions:
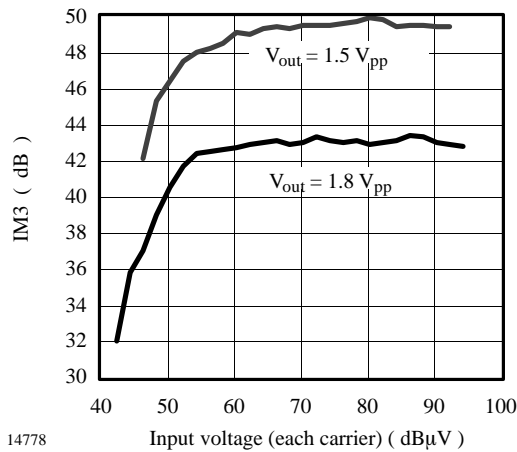
Figure 4. IM3 vs. IF input voltage and IF2out voltage
Test conditions: input: f_1 = 38 MHz,
f_2 = 39 MHz, LO = 43 MHz

Circuitry for External Gain Control

If the gain control of the IC is carried out by an external DSP, the internal charge pumps of the AGC (Pin 7) have to be overlapped by an external voltage source. The internal AGC currents are ± 20 µA. Therefore, the minimum current capacity of the external voltage source should be ± 30 µA or more.

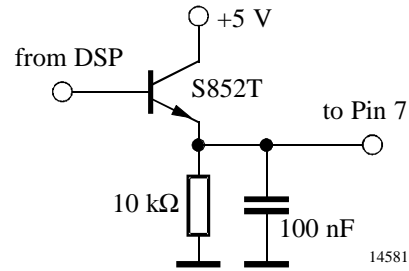The circuitry shown in figure 5 takes some more current.

Figure 5.

External LO Application

If the internal VCO is not used, the LO can be fed unbalanced or balanced to the VCO Pins 22 and 23. The application shown below is generating an unbalanced LO signal by using a 36-MHz third-overtone quartz reference. The application circuit is taken from IQD Limited Crystal Product Data Book. The LO signal is fed unbalanced with 1 nF coupling capacity to Pin 22. Pin 23 has to be blocked to ground with an 1-nF capacitor. The typical LO amplitude is 100 dBµV. The variation of the LO input amplitude should not exceed ± 5 dB (better: ±3 dB).
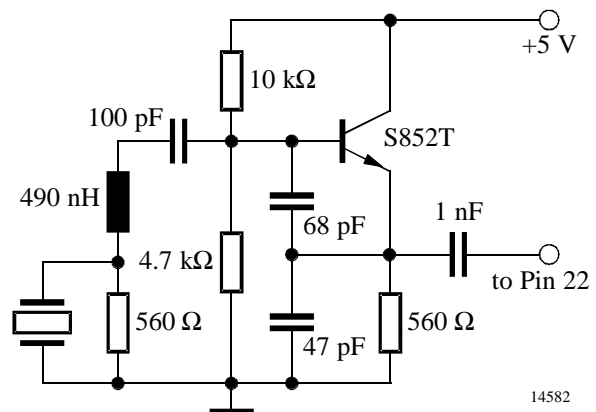

Figure 6.
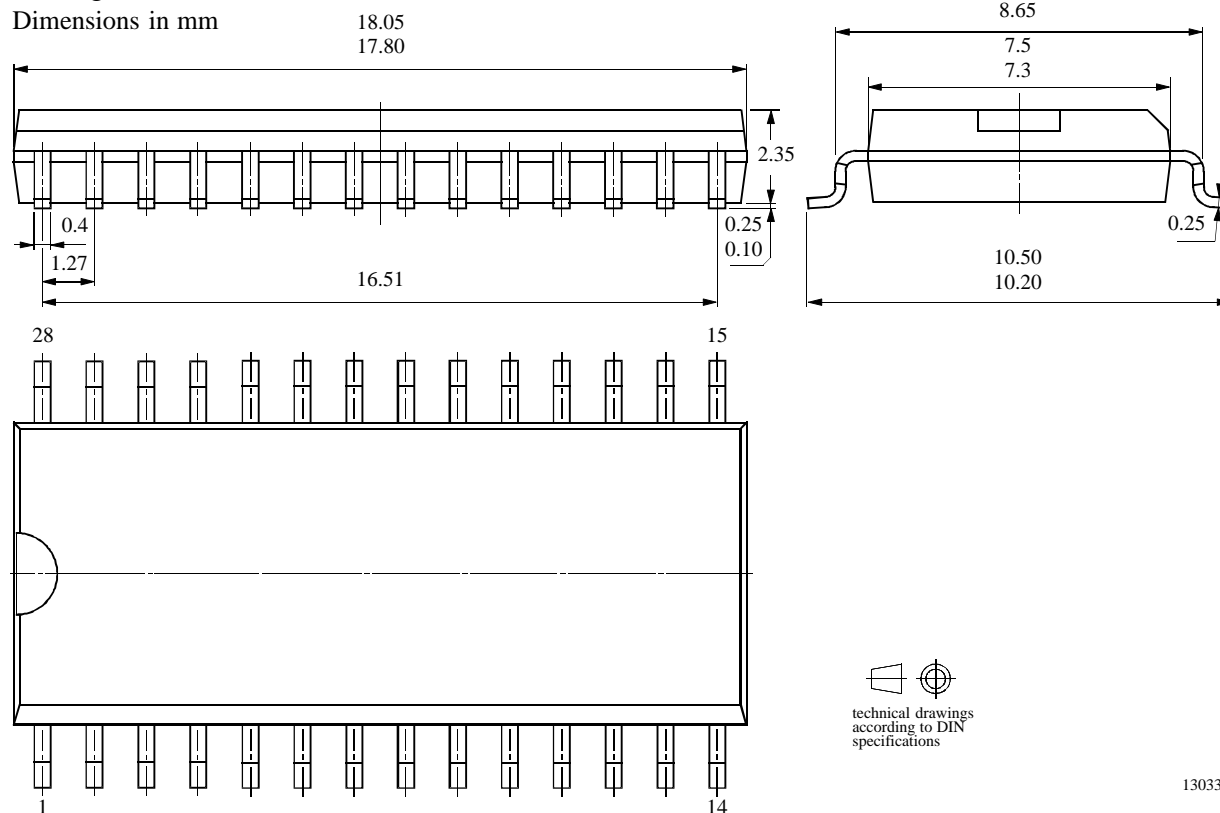
Note:
With external LO operation, Pin 18 (VCO tuning voltage) should be connected to the supply voltage, and Pin 20 (LO output) should not be connected to the PCB.

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Package Information

Package SO28
Dimensions in mm

18.05
17.80

2.35

0.4

1.27

0.25
0.10

16.51

9.15
8.65

7.5
7.3

0.25

10.50
10.20

28

15

1

14

technical drawings
according to DIN
specifications

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Ozone Depleting Substances Policy Statement

It is the policy of **Atmel Germany GmbH** to

1. Meet all present and future national and international statutory requirements.

2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

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.

Atmel Germany 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.

Atmel Germany GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

Data sheets can also be retrieved from the Internet: **http://www.atmel–wm.com**

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