MOON

CDMA/AMPS Dual Band Transmit Circuit

Preliminary Information

Supersedes September 1997 version, DS4720- 1.6

DS4720 - 2.0 March 1998

The MOON circuit is designed for use in dual band, dual mode mobile phones (CDMA/AMPS). The circuit is designed to be compatible with digital baseband and mixed signal circuits chips from Mitel and Qualcomm (MSM2 and BBA2).

System costs have been kept to a minimum by removing the requirement for an additional SAW filter in the transmit IF path. The AGC has been split between RF and IF sections and a low pass filter has been included before the IF variable gain amplifier to reduce noise output.

FEATURES

- Dual RF ports 900MHz and 1900MHz
- AGC amplifier with 90dB of variable gain, fully compensated for temperature.
- On chip active filter removes the requirement for external SAW filter
- High power output stages driving either 900MHz or 1900MHz output

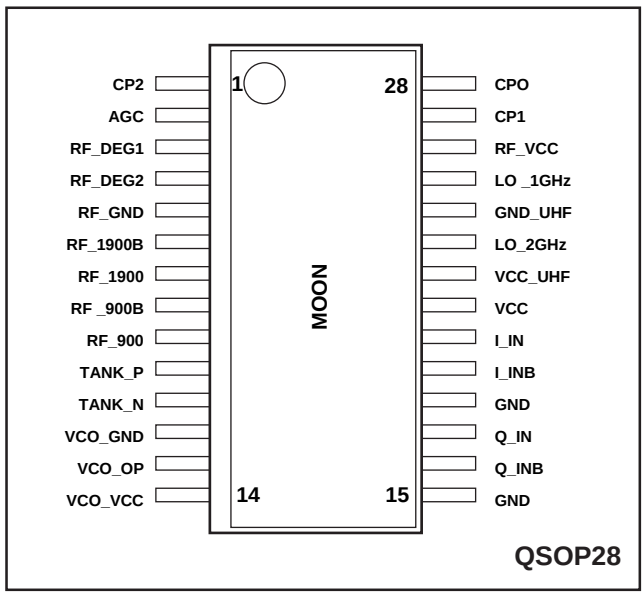

Fig.1 Pin connections - top view

ORDERING INFORMATION

MOON/KG/QP1S

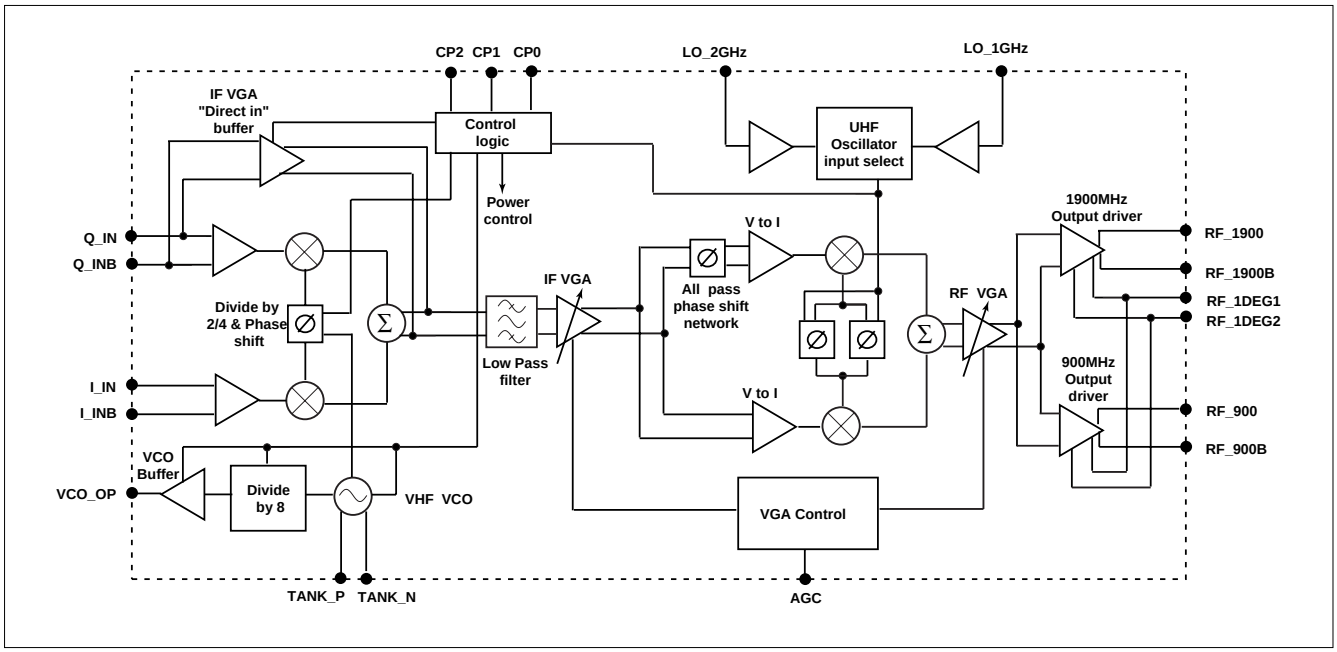

Fig.2 Block diagram

ELECTRICAL CHARACTERISTICS

These characteristics are guaranteed over the following conditions (unless otherwise stated):

T_{AMB} = -30°C to +70°C, V_{CC} = 2.7V to 3.6V

Characteristic	Value			Units	Conditions
	Min	Typ	Max		
D.C. CHARACTERISTICS					
Supply Current					
Sleep current			100	µA	All circuits off
VHF Oscillator supply current		8	10	mA	
Total supply current		118	152	mA	Max power PCS mode
Logic inputs					
Logic high voltage	2		Vcc	V	
Logic low voltage	0		0.8	V	
A.C. CHARACTERISTICS					
I & Q modulator					
I & Q input voltage level		2	2.2	V	
I & Q common mode voltage		1.2			
I & Q differential input resistance	15			kohms	
I & Q input bandwidth	2.5			MHz	
I & Q amplitude error			±0.5	dB	
I & Q phase error			3	deg	
IF vector offset			30	dB	
SSB rejection	30			dB	
VHF oscillator / divider					
Oscillator frequency	250		600	MHz	
Output phase noise			-102	dBc/Hz	30kHz offset. Tank Q = 30min
Output phase noise			-140	dBc/Hz	3MHz offset. Tank Q = 30 min
Output level from Buffer	265			mV	6pF load
Divide ratio oscillator to buffer output		8			Drive output for synthesiser
Variable gain amplifiers					
IF amplifier operating frequency range	50		130	MHz	
RF amplifier operating frequency range	750		2000	MHz	
Overall gain control range	84	90		dB	Voltage gain
Copntrol voltage for minimum gain	0.15			V	
Control voltage for maximum gain			2.6	V	
AGC control voltage slope	33		60	dB/V	
SSB mixer and UHF oscillator inputs					
SSB rejection	18			dB	
Local oscillator input level	-10	-6	-3	dBm	From external UHF oscillator
Local oscillator input frequency	954		979	MHz	1GHz local oscillator input IF = 130MHz, high side LO
Local oscillator input frequency (PCS)			1800	MHz	2GHz local oscillator input. IF = 130MHz, low side LO

ELECTRICAL CHARACTERISTICS

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T_{AMB} = -30°C to +70°C, V_{CC} = 2.7V to 3.6V

Characteristic	Value			Units	Conditions
	Min	Typ	Max		
900MHz RF output stage					Specifications assume 50 ohm load driven via a matching network
Output power CDMA	3		5	dBm	
Output power AMPS	7	11		dBm	
Output 1dB compression point CDMA	13			dBm	
Output third order intercept point	23			dBm	
1900 MHz RF output stage (PCS)					Specifications assume 50 ohm load driven via a matching network
Output power	9			dBm	
Output 1dB compression point	18			dBm	
Output third order intercept point	24			dBm	
Output fifth order intercept point	21.5			dBm	

PIN CONNECTIONS

Pin Number	Pin Name	Function
1	CP2	Control pin 2. See table 1 for function
2	AGC	Control voltage for IF and RF variable gain amplifiers
3	RF_DEG1	Connection to external inductor to control gain of power amplifiers
4	RF_DEG2	Connection to external inductor to control gain of power amplifiers
5	RF_GND	Ground connection to RF circuits
6	RF_1900B	Output from 900MHz differential output driver
7	RF_1900	Output from 900MHz differential output driver
8	RF_900B	Output from 1900MHz differential output driver
9	RF_900	Output from 1900MHz differential output driver
10	TANK_P	Connection for VHF oscillator inductor
11	TANK_N	Connection for VHF oscillator inductor
12	VCO_GND	Ground connection for VHF oscillator
13	VCO_OP	Output from VHF oscillator divided by 8
14	VCO_VCC	Positive supply to VHF oscillator
15	GND	Ground connection
16	Q_INB	Q bar data input
17	Q_IN	Q data input
18	GND	Ground connection
19	I_INB	I bar data input
20	I_IN	I data input
21	VCC	Positive supply connection
22	VCC_UHF	Positive supply to UHF oscillator input buffers
23	LO_2GHz	2GHz local oscillator input
24	GND_UHF	Ground connection to UHF oscillator input buffers
25	LO_1GHz	1GHz local oscillator input
26	RF_VCC	Positive supply connection to RF circuits
27	CP1	Control pin 1. See table 1 for function
28	CP0	Control pin 0. See table 1 for function

CIRCUIT DESCRIPTION

General

The Moon circuit is designed to provide the transmit function in dual band, dual mode CDMA/AMPS mobile phones. The circuit contains the following blocks.

1. Quadrature modulator
2. Quadrature modulator bypass amplifier
3. VHF voltage controlled oscillator and divide by 8 prescaler
4. Active IF low pass filter
5. IF variable gain amplifier
6. Single sideband mixer with external UHF oscillator inputs
7. RF variable gain amplifier
8. 900MHz and 1900MHz high power output driver stages
9. Power and mode control logic

Quadrature Modulator

I and Q data from a baseband circuit such as the Mitel Pluto circuit is applied to the I and Q inputs to the quadrature modulator where an IF in the range 130MHz to 310MHz is produced by mixing with the local oscillator frequency from the VHF VCO. The control inputs can select either a divide by 2 or divide by four function between the VHF VCO and the quadrature modulator giving a choice of possible intermediate frequencies, usually 130MHz or 290MHz.

VHF Oscillator and divider

The VHF oscillator is of differential design and requires an external tank circuit and varicap diodes to control the frequency. The oscillator drives an internal divide by eight circuit to reduce the frequency of the output signal to be sent off chip to the frequency synthesiser. This reduces the power required in the output buffer circuit and also allows a low power CMOS synthesiser to be used.

Active low pass filter

The output from the quadrature modulator is passed to the active low pass filter which attenuates wide band noise and spurious outputs to meet IS-95 specifications.

Quadrature modulator bypass

A modulator bypass mode is available for use with baseband circuits such as the BBA2 which include a quadrature modulator. When this mode is selected, the internal modulator is disabled and the modulated signal, applied to the Q inputs is fed directly to the low pass filter.

IF variable gain amplifier

The filtered IF signal is passed to the IF variable gain amplifier which in turn drives the single sideband mixer. An externally applied AGC control voltage allow the total circuit gain to be varied over a minimum 84dB range. The AGC action is split between the IF and RF portions of the circuit and an internal AGC control circuit processes the external AGC control voltage to drive both IF and RF variable gain ampllifiers and provides a near linear control characteristic over the entire AGC range.

Single sideband mixer

The modulated IF signal is fed to the single sideband mixer which up-converts the IF to the RF frequency to be transmitted by mixing with an LO signal from one of two external UHF oscillator input pins, selected by an on chip multiplexer. When 1900MHz mode is programmed, the polarity of the quadrature oscillator drive signals to the single sideband mixer are reversed, thus selecting a low side LO for 1900MHz PCS and high side for 900MHz. This technique allows a common IF and filter to be used for both 900MHz and 1900MHz bands.

RF variable gain amplifier

The SSB mixer is followed by the RF variable gain amplifier stage which provides about 23dB of the total gain variation. An additional SAW filter in the transmit path is avoided by providing the gain variation after the mixer.

The variable gain amplifier control circuit ensures that the attenuation from maximum power is initially controlled by the RF variable gain stage thus reducing the noise contribution from the RF mixer.

Output drivers

Separate output drive stages are provided for 900MHz and 1900MHz operation. A differential design is used for both amplifiers to improve power efficiency and to ease power supply decoupling problems. The 900MHz output stage provides a linear output of 3 to 5 dBm for CDMA operation, but is over driven in AMPS mode to obtain a typical output of 11dBm. In both power driver stages the DC current is backed off as the RF and IF gain is reduced, improving efficiency when less than maximum output power is required.

Control inputs

Three control inputs are provided to select different operating modes for the chip; the various modes selected by the control pins are shown in table 1.

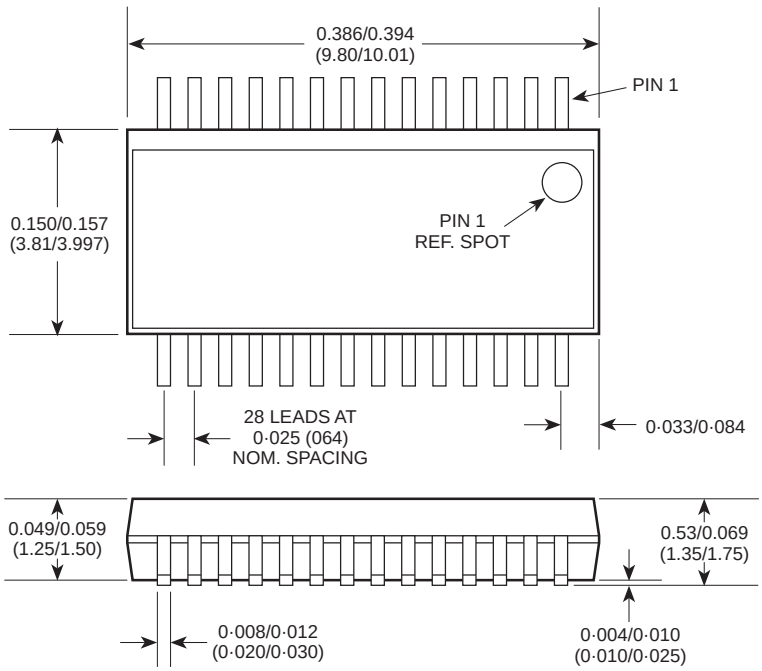
Control Pin Functions

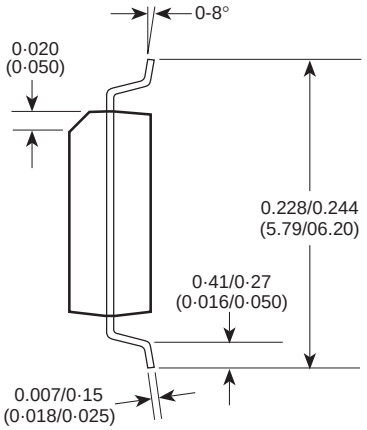
CP2	CP1	CP0	FUNCTION
0	0	0	Sleep mode. All circuits powered down
0	0	1	VHF oscillator on. All other circuits powered down
0	1	0	Quadrature modulator bypassed. 900MHz mode selected. High side UHF LO
0	1	1	Quadrature modulator bypassed. 1900MHz mode selected. Low side UHF LO
1	0	0	Quadrature modulator on. 900MHz High side UHF LO. IF = VHF VCO ÷ 2
1	0	1	Quadrature modulator on. 1900MHz High side UHF LO. IF = VHF VCO ÷ 2
1	1	0	Quadrature modulator on. 900MHz High side UHF LO. IF = VHF VCO ÷ 4
1	1	1	Quadrature modulator on. 1900MHz Low side UHF LO. IF = VHF VCO ÷ 4

Table 1

PACKAGE DETAILS

Dimensions are shown thus: mm (in). For further package information, please contact your local Customer Service Centre.





NOTES
1. Controlling dimensions are inches.
2. This package outline diagram is for guidance only. Please contact your Mitel Semiconductor Customer Service Centre for further information.

28-LEAD SUBMINIATURE PLASTIC DIL - QP28

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