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Gerstweg 2, 6534 AE Nijmegen, The Netherlands

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Author : Haris Duric & Robert Cloudt
Department : DSC-N, Development
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CDMA CELLULAR VCO WITH THE BFG425W, BFG410W AND VARACTOR BB142

Abstract:
This application note contains an example of a Voltage Controlled Oscillator for cellular CDMA applications with the fifth generation BFG425W and BFG410W Double Poly RF-transistors. The BB142 is a new varactor specially designed for RF-application with low noise performance. The VCO is designed for the receive band of the IS-95 standard.

Appendix I: Schematic of the circuit

Appendix II: Printlayout and list of used components & materials

Appendix III: Results of measurements

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Introduction:
With the new Philips silicon bipolar double poly BFG400W series, it is possible to design low phase noise VCO's for cellular and PCS frequency applications with a low current and a low supply voltage. These VCO's are well suited for the new generation low voltage high frequency wireless applications. In this note an example of such an VCO will be given. This VCO is designed for a center frequency of 881.5 MHz and a span of 25 MHz.

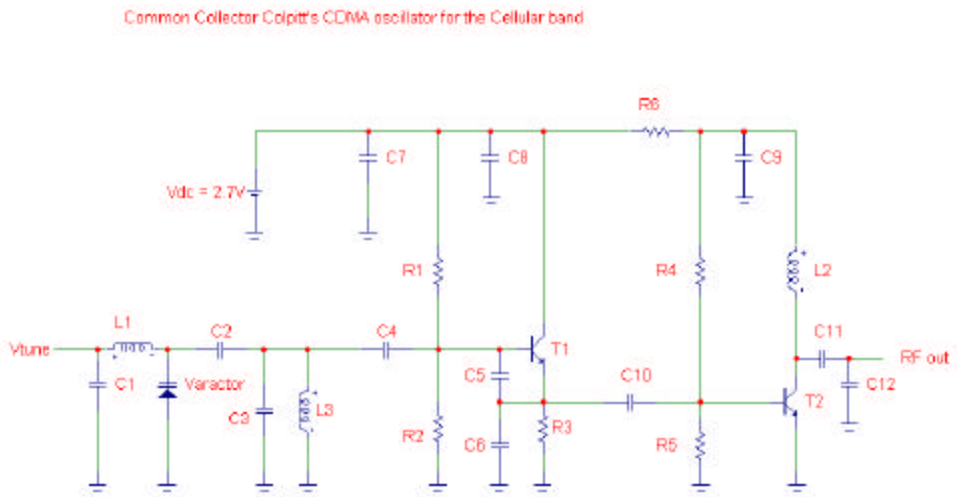
Designing the circuit:
The circuit is designed to show the following performance:

V_{SUP}=2.7 V
I_{sup}=7.3mA
Center freq=881.5 MHz
Span = 25 MHz
Pout = 3.33 dBm
Phase noise at 60 kHz <= -117 dBc/Hz
VSWRo<2:1

transistor: BFG425W, BFG410W
varactor : BB142
The output matching is realised with a LC-combination in the buffer stage. The matching circuit will also supress the harmonics somewhat. There's a trade off between the pulling and the noise performance of the VCO.

Designing the layout:
A lay-out has been designed with HP-MDS. Appendix II contains the printlayout and component placement.

Measurements:
Measurements of the total circuit (epoxy PCB) have been done. The result can be found in Appendix III.



Appendix I: Schematic of the circuit
Figure 1:VCO circuit

CDMA VCO Component list:

Component:	Value:	Comment:
C1	47n	DC-filter
C2	3.6p	Determines tuning range
C3	4.3p	Determines tuning range
C4	56p	DC-block
C5	1.2p	Negative impedance
C6	3p	Negative impedance
C7	47n	DC-filter
C8	56p	RF-bypass
C9	56p	RF-bypass
C10	47p	match between VCO and buffer
C11	1.8p	RF-feed/output match
C12	6.8p	Output match/filter
R1	8.2k	Bias
R2	22k	Bias
R3	390	Bias
R4	2k	Bias
R5	1k	Bias
R6	100	Better RF-stability (K>1)
L1	82n	RF-choke
L2	12n	Ouput match
L3	4n	Microstripline inductance for better Q
T1	BFG425W	SOT 343
T2	BFG410W	SOT 343
Varactor	BB142	SOD 523

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Appendix II: Printlayout and list of used components & materials

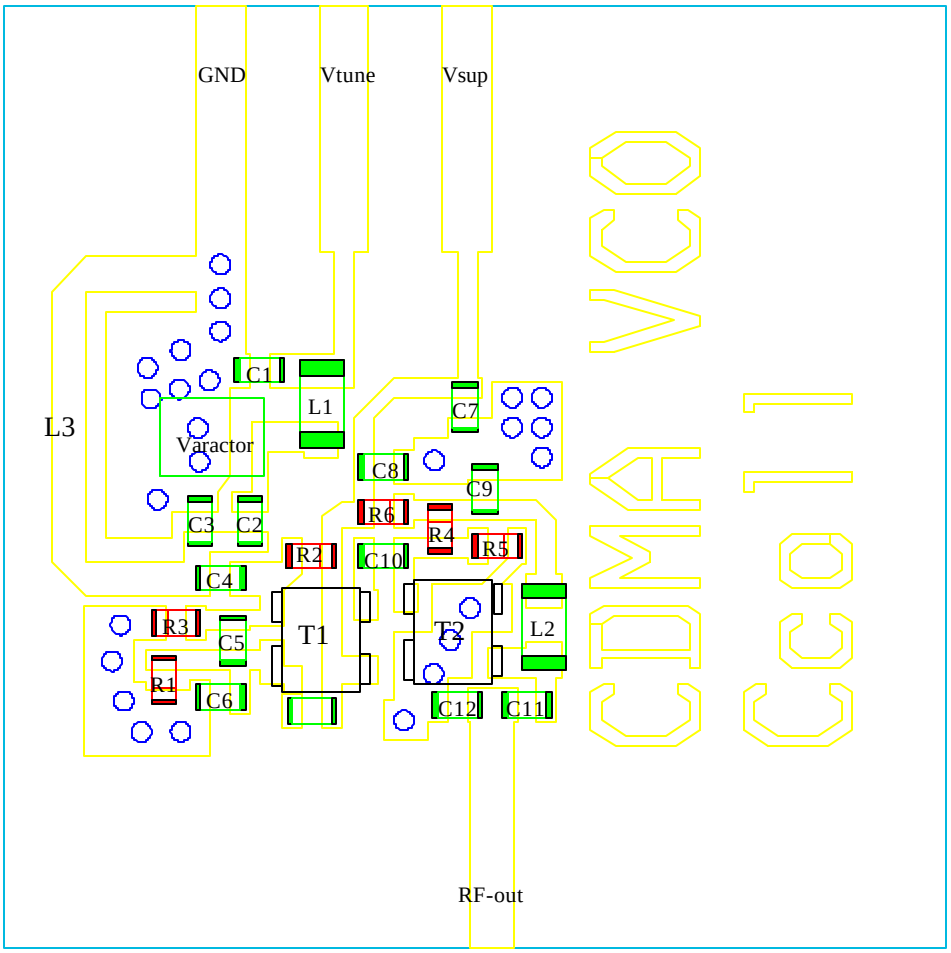

Figure 2: Printlayout

CDMA VCO Component list:

Component:	Value:	Comment:
C1	47n	0402 Philips
C2	3.6p	0402 Philips
C3	4.3p	0402 Philips
C4	56p	0402 Philips
C5	1.2p	0402 Philips
C6	3p	0402 Philips
C7	47n	0402 Philips
C8	56p	0402 Philips
C9	56p	0402 Philips
C10	47p	0402 Philips
C11	1.8p	0402 Philips
C12	6.8p	0402 Philips
R1	8.2k	0402 Philips

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R2	22k	0402 Philips
R3	390	0402 Philips
R4	2k	0402 Philips
R5	1k	0402 Philips
R6	100	0402 Philips
L1	82n	TDK MLG 1608 SERIES
L2	12n	TDK MLG 1608 SERIES
L3	4n (W=0.7mm;L=9.6mm)	Microstrip (PCB: εr=4.6,H=0.5mm)
T1	BFG425W	SOT 343
T2	BFG410W	SOT 343
Varactor	BB142	SOD523

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Appendix III: Results of measurements:

Samples CDMA VCO's		
Specification	Unit	Value
Vcc	Volt	2.7
Power Consumption	<=mA	7.3
Control Voltage range Min.	Volt	0
Control Voltage range Max.	Volt	2.5
Operating f range Min.	MHz	849
Operating f range Max.	MHz	900
Modulation sensitivity	MHz/V	17
Output Level	>=dBm	3.33
Output level deviation	(+/-dBm)	0.17
C/N	<=dBc	-75
Phase Noise(15KHz)	<=dBc/Hz	-105
Phase Noise(30KHz)	<=dBc/Hz	-111
Phase Noise(60KHz)	<=dBc/Hz	-117
Pushing figure (Vcc +/-0.3V)	(+/-KHz)	400
Pulling figure (VSWR=2.0 for all phase, ref:50Ohm)	(+/-KHz)	500
Spurious response (Harmonics)	<=dBc	-25
VSWRo		1.8
Oscillation guaranteed for VCC =	Volt	2.4<Volt<3
Width (mm)		10.25
Length (mm)		10.1