

FEATURES

- Low voltage, 3.3V power supply operation
- 100MHz to 800MHz programmable LVPECL output from a low cost crystal
- 0.5% spread-spectrum modulation control
- >7dB reduction in EMI with spread-spectrum modulation
- LVTTTL/LVCMOS compatible control inputs
- Interfaces directly to a crystal
- Precision PLL architecture ensures less than 35ps peak-to-peak, cycle-to-cycle output jitter
- 48% to 52% precision duty cycle is ideal for double data rate clocking applications
- Available in low cost 32-pin TQFP and 28-pin SOIC packages

APPLICATIONS

- High speed synchronous systems
- CPU clock
- Multi-processor workstations and servers
- Networking

DESCRIPTION

The SY89530L is a high speed, programmable PLL-based LVPECL clock synthesizer with spread spectrum modulation control. With an external crystal providing a reference frequency to the internal PLL, the differential LVPECL output frequency can be programmed between 100MHz to 800MHz in increments of 2.5MHz with less than 35ps peak-to-peak, cycle-to-cycle output jitter. The SY89530L spread spectrum mode operates with a 32.5kHz triangle modulation with 0.5% down spread (+0.0% / -0.5%). When spread spectrum is activated, the output signal is modulated which spreads the peak amplitudes, and decreases Electro-Magnetic Interference (EMI).

This document provides design and implementation information, and a detailed description of the SY89530L evaluation board. The evaluation board is intended to provide a convenient test and evaluation platform for the SY89530L programmable frequency synthesizer with spread spectrum device.

Spread Spectrum Mode

- Spread spectrum clock (SSC) output cycle-to-cycle jitter (peak-to-peak) is less than 35ps
- SSC modulation frequency is 30kHz to 33.33kHz
- SSC modulation factor is less than 0.5% (down-spread, triangle modulation)

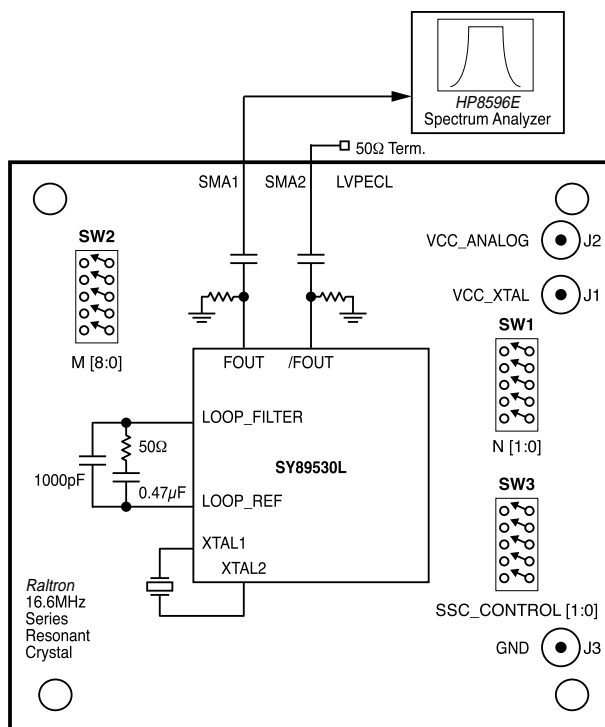


Figure 1. SY89530L Evaluation Board and Test Set-Up

FUNCTIONAL DESCRIPTION

At the core of the SY89530L programmable frequency synthesizer with spread spectrum is a precision PLL driven by a 14MHz to 20MHz series resonant fundamental crystal. The output is a single bank capable of very low peak-to-peak, cycle-to-cycle output jitter, LVPECL driver.

The evaluation board simplifies test and measurement by allowing easy setting of the M-divider, N-divider, and spread spectrum control bits. The M-divider range is 190 to 400, the N-divider range is 2 to 16, and the VCO frequency range is 800MHz to 1600MHz. In addition, the spread spectrum control bits enables and disables the -0.5% down spread mode and allows access to internal test modes. The evaluation board can be configured on the fly and does not need powering down to access spread and non-spread mode and does not need powering down to reprogram the M-divider and N-divider and spread spectrum mode.

Power Supply

The SY89530L is a 3.3V device and the evaluation board has been configured as AC-coupled outputs. Therefore, V_{CC}_ANALOG-Jumper J2, and V_{CC}_XTAL-Jumper J1, should be connected to +3.3V, and GND-Jumper J3 should be connected to +0.0V.

Board Layout

The evaluation board is constructed with FR-4 material and is co-planar designed to minimize noise, achieve high bandwidth, and minimize cross talk.

Layer Stack

L1	Signal/GND
L2	Impedance GND
L3	VCC
L4	Signal/GND

Signal Inputs/Outputs

The SY89530L evaluation board has been designed with a Ralton16MHz Series resonant fundamental crystal. In addition, the output is LVPECL and has been AC-coupled. LVPECL operation is typically 750mVpp into 50Ω. In addition, the common mode voltage is V_{CC}-1.3V.

Test Description

This section contains step-by-step instructions for evaluating the SY89530L in both down-spread mode and non-spread mode. In down-spread mode, the evaluation board allows evaluation of reduction of EMI reduction around the fundamental frequency and higher frequency harmonic components which reduces EMI radiation of a system. Further, the evaluation board allows the evaluation of cycle-to-cycle jitter.

Test Description

This section contains step-by-step instructions for evaluating the SY89530L, in terms of cycle-to-cycle jitter, and spread spectrum mode.

Non-Spread Mode (Cycle-to-Cycle) Jitter Procedure

- FIN =16MHz (Micrel recommends: Raltron AS-SIM Series resonant crystal)
- FOUT = 300MHz with less than 50ps peak-to-peak, cycle-to-cycle jitter
- FVCO =1200MHz
- M = 300
- N = 4
- KVCO =1406MHz/V (typ)
- Icp = 240μA

1. Connect the V_{CC}_ANALOG-Jumper 2, and V_{CC}_XTAL-Jumper 1 to +3.3V.
2. Connect GND-Jumper 3 to 0V.
3. Configure Dip Switch SW3 as shown in Table 1.

SSC_CNTL1	SSC_CNTL0	VCO	SSC	Operational Mode
1	1	Run	Stop	No SSC Modulation

Table 1. Dip Switch SW3 for Non-Spread Mode

4. Set the M-divider to 300 as shown in Table 2 using Dip Switch SW2.

VCO Freq (MHz)	M	256	128	64	32	16	8	4	2	1
		M8	M7	M6	M5	M4	M3	M2	M1	M0
1200	300	1	0	0	1	0	1	1	0	0

Table 2. Dip Switch SW2 (M-divider = 300)

5. Set the N-divider to 4 as shown in Table 3 using Dip Switch SW1.

Divide by	N[1]	N[0]
4	0	1

Table 3. Dip Switch SW1 (N-divider = 4)

6. Connect the output of SMA1 to CH1 (input channel) of a Wavecrest DTS-2079 instrument.
7. Terminate into 50Ω the output of SMA2.
8. Double click on the Wavecrest icon and select clock histogram.
9. Select CH1 input on menu.
10. Set the stop edges to skip to "0", see Table 4 to measure T2-T1 cycle-to-cycle jitter, T3-T1 cycle to cycle jitter, and T4-T1, cycle-to-cycle jitter.

Stop Edges Skip	Setting
T2-T1	0
T3-T1	1
T4-T1	2

Table 4. Cycle-to-Cycle Setting

- Set hits per measure to 30,000.
- Select "Accumulation Hits" mode.
- Hit the "Pulse Find" icon and make sure that voltage levels are correct.
- Hit the run icon button on the screen, and view cycle-to-cycle jitter data.

EMI Reduction (Spectral Analysis) Procedure

- Connect the output of SMA1 to the input of a HP8596E Spectral Analyzer.
- Terminate into 50Ω the output of SMA2.
- Set FOUT = 300MHz (see Table 1, 2 and 3), and configure the SY89530L in non-spread mode.
- Then view the spectrum out to the 5th harmonic by using the start and stop frequency keys on the HP8596E.
- Record peak energy levels out to the 5th harmonic.
- Configure the SY89530L from non-spread mode to -0.5% down spread mode as shown in Table 5.

SSC_CNTL1	SSC_CNTL0	VCO	SSC	Operational Mode
0	1	Run	Run	-0.5% SSC Modulation

Table 5. Dip Switch SW3 for -0.5% Down Spread Mode

- Record the peak energy levels out to the 5th harmonic and compare the energy levels of non-spread mode to spread mode, notice the reduction of energy at each harmonic.
- Further, notice that in down spread mode, the Fnominal in spread mode is Fmax in down spread mode and the Fnominal in spread mode is centered at a frequency lower than the Fnonminal in non-spread mode.

Valid VCO Frequency Range

For proper operation of the SY89530L, the crystal frequency, VCO frequency, and M-divider values must fall within a certain range of values. Table 6 below gives a range of minimum and maximum range of crystal frequencies in relation to its minimum and maximum M-divider values based on the VCO frequency at the particular setting.

- Crystal Frequency Range: $14\text{MHz} \leq \text{FXTAL} \leq 20\text{MHz}$
- VCO Frequency Range: $800\text{MHz} \leq \text{FVCO} \leq 1600\text{MHz}$
- M-Divider Range: $190 \leq M \leq 400$

Crystal Frequency (MHz)	Phase Detector Frequency (MHz)	M-Divider	VCO Frequency (MHz)	Crystal Range	M-Divider Range
14	1.75	190	665.00	Minimum	Minimum
14	1.75	400	14,000	Minimum	Maximum
20	2.5	190	950.00	Maximum	Minimum
20	2.5	320	16000.00	Maximum	Maximum

Table 6. Valid Range of Parameters of the SY89530L

FUNCTION TABLES

Inputs				Outputs		
SSC_CNTL1	SSC_CTL0	VCO	SSC	FOUT	/FOUT	Operational Modes
0	0	–	–	–	–	Reserved (Supplier Internal Test Mode)
0	1	Run	Run	100MHz to 800MHz	100MHz to 800MHz	Default SSC; Modulation Factor = 0.5%
1	0	Stop	Stop	Test I/O	Test I/O	PLL Bypass Mode, (1MHz ≤ Test Clock ≤ 200MHz), Note 1
1	1	Run	Stop	100MHz to 800MHz	100MHz to 800MHz	No SSC Modulation

Note 1. Used for characterization.

Table 7. SSC Control Input Function Table

VCO Freq (MHz)	M	256	128	64	32	16	8	4	2	1
		M8	M7	M6	M5	M4	M3	M2	M1	M0
190 ⁽¹⁾	190	0	1	0	1	1	1	1	1	0
191 ⁽¹⁾	191	0	1	0	1	1	1	1	1	1
192 ⁽¹⁾	192	0	1	1	0	0	0	0	0	0
193 ⁽¹⁾	193	0	1	1	0	0	0	0	0	1
*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*
1592	398	1	1	0	0	0	1	1	1	0
1596	399	1	1	0	0	0	1	1	1	1
1600	400	1	1	0	0	1	0	0	0	0

Note 1. The recommended VCO range is 800MHz ≤ FVO ≤ 1600MHz.

Table 8. Programmable VCO Frequency Function Table (16MHz Crystal Reference)

Divide by	N[1]	N[0]
2	0	0
4	0	1
8	1	0
16	1	1

Table 9. Output Post Divider

LAYOUT TIPS

1. Establish controlled impedance stripline, microstrip, or co-planar construction techniques for high-speed signal paths.
2. All differential paths are critical timing paths, and skew should be matched to within ± 10 ps.
3. Signal trace impedance should not vary more than $\pm 5\%$. If in doubt, perform a TDR analysis of signal traces.
4. Maintain compact filter networks as close to filter pins as possible.
5. Provide ground plane relief under filter path to reduce stray capacitance and be careful of crosstalk coupling into the filter network.
6. Isolate the output from other clock and data signals on the board.
7. Place crystal as close to the device as possible with symmetrical line lengths.

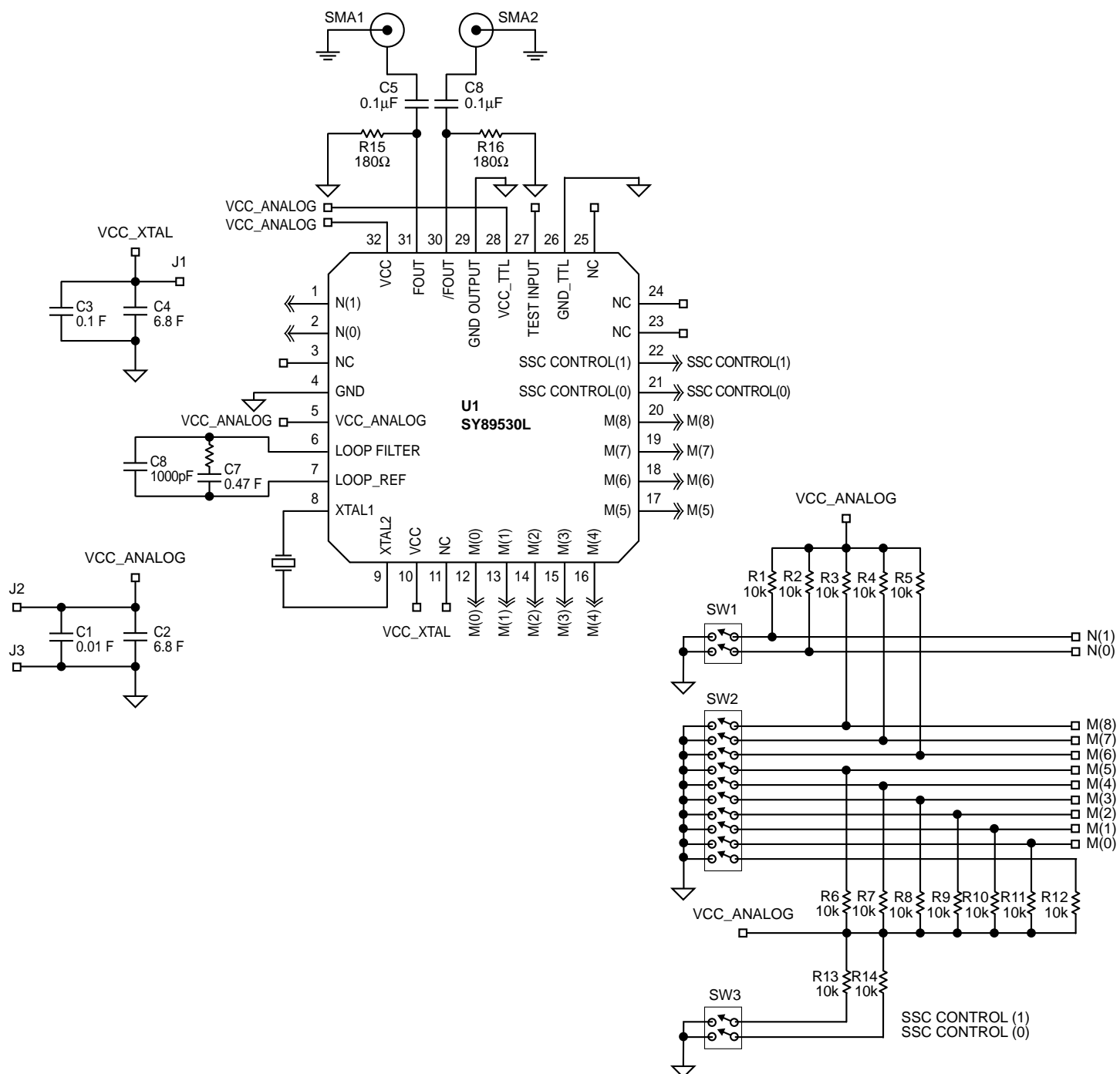
DESCRIPTION OF CONNECTORS

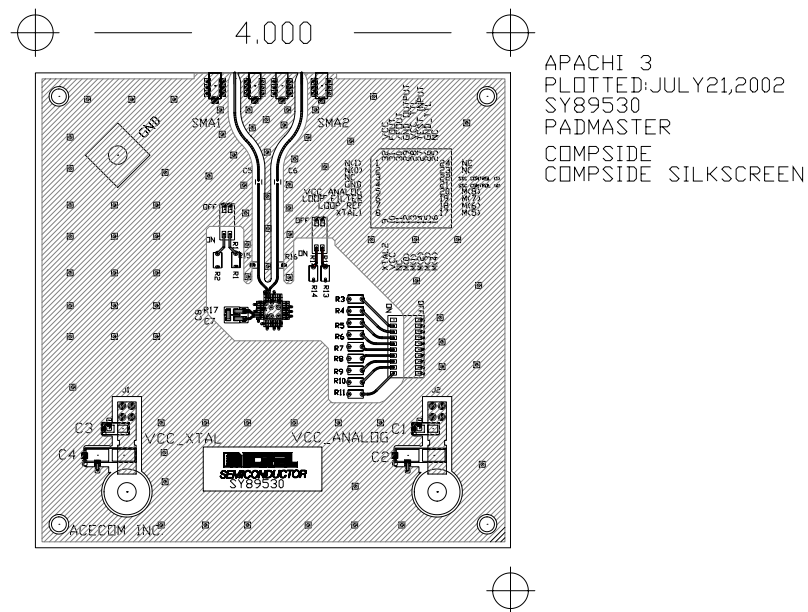
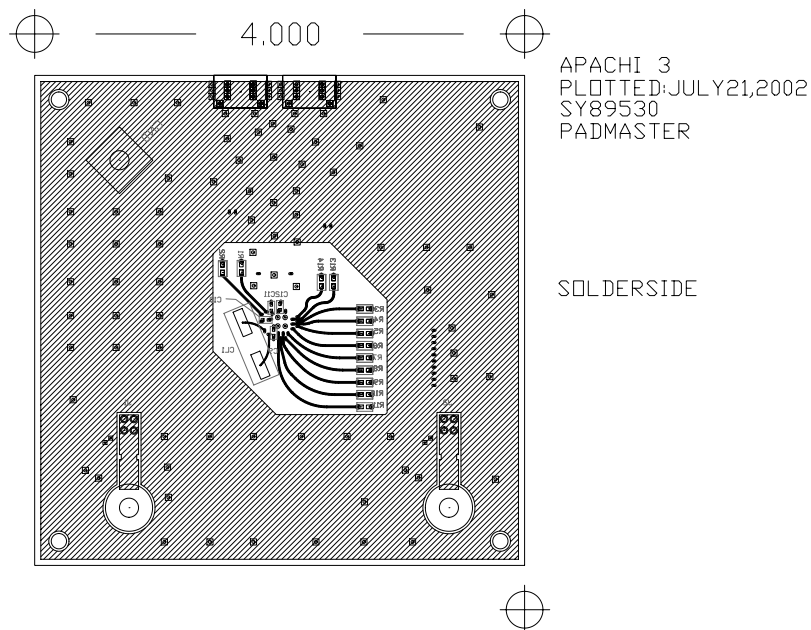
Connector	Name	Type	Connects to	Description
SMA1	FOUT	LVPECL	Pin 31	AC-coupled
SMA2	/FOUT	LVPECL	Pin 30	AC-coupled

RELATED PRODUCT AND SUPPORT DOCUMENTATION

Part Number	Function	Data Sheet Link
SY89529L	3.3V, 200MHz Precision Spread Spectrum Clock Synthesizer	www.micrel.com/product-info/products/sy89529l.shtml
SY89530L	3.3V, 100MHz to 800MHz Programmable Frequency Synthesizer w/Spread Spectrum	www.micrel.com/product-info/products/sy89530l.shtml

EVALUATION BOARD SCHEMATIC



EVALUATION BOARD LAYOUT**Figure 2. Padmaster Layout (Compside)****Figure 3. Padmaster (Solderside)**

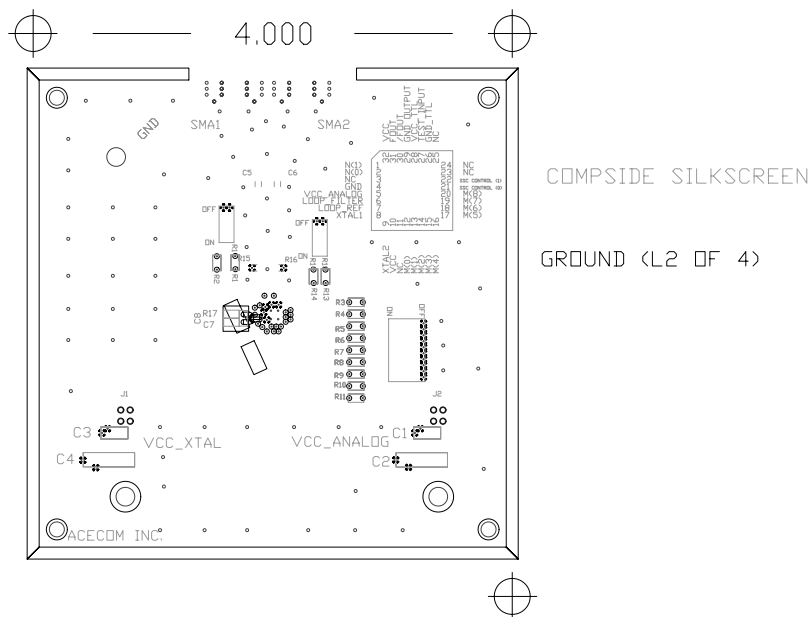


Figure 4. Compside Silkscreen (Ground)

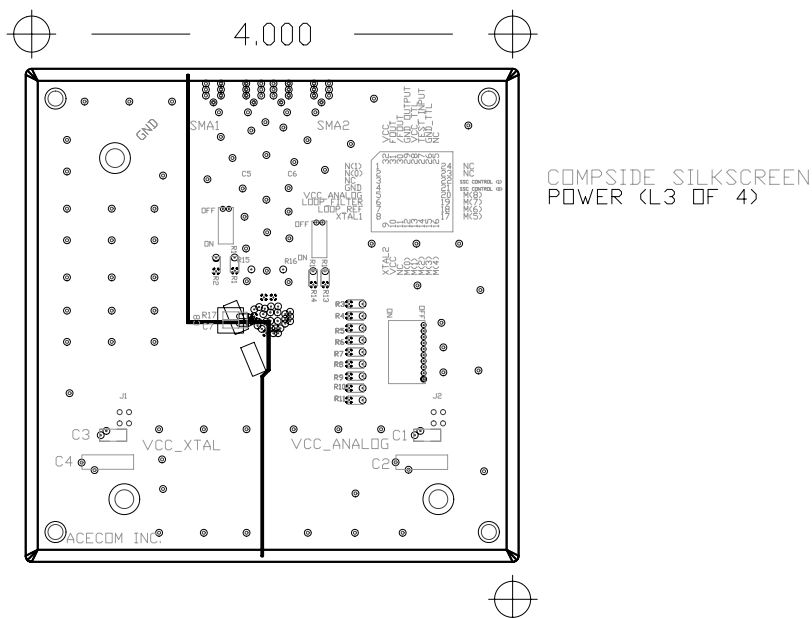


Figure 5. Compside Silkscreen (Power)

BILL OF MATERIALS

Item	Part Number	Manufacturer	Description	Qty.
C1	PC1749CT-ND	Panasonic/Digi-Key ⁽¹⁾	0.22μF, Surface Mount Capacitor	1
C2	PCC470ACVCT-ND	Panasonic/Digi-Key ⁽¹⁾	0.47pF, Surface Mount Capacitor	1
C10,C11	PCC180ACVCT-ND	Panasonic/Digi-Key ⁽¹⁾	18pF, Surface Mount Capacitor	2
C5-C27, C30,C31,C33, C36,C39	PCC1762CT-ND	Panasonic/Digi-Key ⁽¹⁾	0.01μF, Surface Mount Capacitor	
C42,C45,C46, C51,C54				5
C34,C36,C37, C39,C40	PC1801CT-ND	Panasonic/Digi-Key ⁽¹⁾	0.1μF, Surface Mount Capacitor	5
C43,C47,C52				3
C35,C38,C41, C42,C48,C49, C50,C53	PCE3000CT-ND	Panasonic/Digi-Key ⁽¹⁾	22μF, Size B SM Polarized Power Capacitor	8
R4-R29	P120JCT-ND	Panasonic/Digi-Key ⁽¹⁾	120Ω, Panasonic Surface Mount Chip Resistor	
R19	P330JCT-ND	Panasonic/Digi-Key ⁽¹⁾	330Ω, Panasonic Surface Mount Chip Resistor	1
R32-R46	P10KJCT-ND	Panasonic/Digi-Key ⁽¹⁾	10kΩ, Panasonic Surface Mount Chip Resistor	
R99	P050GT-ND	Panasonic/Digi-Key ⁽¹⁾	51Ω, Panasonic Surface Mount Chip Resistor	1
SMA1, SMA2	142-0701-851-ND	Johnson/Digi-Key ⁽²⁾	SMA	2
SW2-SW3	CT2188LPST-ND	CTS/Digi-Key ⁽³⁾	SW Dip-8	2
U1	SY89530L	Micrel Semiconductor⁽⁴⁾	3.3V Programmable Frequency Synthesizer with Spread Spectrum	1
Y1	CTX077-ND	Raltron ⁽⁵⁾	16MHz, Crystal 16MHz 50ppm @25°C	1

Note 1. Panasonic, tel.: 847-468-5624

Note 2. Johnson Components, tel.:800-247-8256

Note 3. CTS, tel.:574-293-7511

Note 4. Micrel, tel.:408-944-0800

Note 5. Raltron, tel.:305-593-6033

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