環隆電氣股份有限公司
Universal Scientific Industrial Co., Ltd.

System Product Contract Mfg Business Division

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Project No. Leo

AP300 (Leo) Theory of operation

SOURCE ORGANIZATION : USI COM/PDV H/W

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1.1 Purpose of Document

The following document describes the hardware functional design, architecture, and implementation of the Leo RF Port.

1.2 Goals of System

The primary goal of the Leo RFPort is to provide a cost-effective solution for implementing dual radios which support the IEEE 802.11g (11Mbps DSSS and 54 Mbps OFDM) and IEEE 802.11a (54Mbps OFDM) Standard simultaneously. This device is to employ only one power supply option which is Power-Over-Ethernet (PoE) that is IEEE 802.3af compliant.

1.3 System Overview

The Leo RFPort is a MAC-level bridge between an Ethernet-wired LAN to a Cell Controller and Symbol's RF (802.11) network. The RFPort forwards packets from the Cell Controller over the Ethernet LAN to the appropriate wireless mobile device using Symbol's IEEE 802.11g or 802.1la compliant (2.4GHz 11Mbps DSSS and 54 Mbps OFDM or 5.2 GHz Mbps OFDM) RF network. Data traffic on the RF network may occur at 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48 and 54 Mbps for 802.11g and 6,9,12,18,24,36,48 and 54 Mbps for 802.11a. The RFPort also listens to wireless mobile device traffic and forwards their data through the Ethernet LAN via the system's Cell Controller to other Ethernet or RF based devices.

The Leo RFPort is composed of three components: the main motherboard, an 802.11g miniPCI radio and an 802.11a miniPCI radio, The motherboard includes CPU, SDRAM, Flash, watchdog timer, GPIO, and a PoE (Power-Over-Ethernet) section. The design of the miniPCI G Radio is based upon the Conexant Javelin radio reference design. The design of the miniPCI A radio is based upon the Conexant Crossbow radio reference design. Although the G radio design is based on Conexant Javelin chipset and the A radio design is based upon Conexant Crossbow chipset, the interface, access mechanisms, packet transmit, packet receive, queuing, timer services, and buffer management may not be the same as described in Conexant's radio documentation. The digital section incorporates the IBM 405EP processor, and Broadcom's AC101L Ethernet PHY. The PoE section is compatible with IEEE 802.3af. This section allows the unit to be powered using a 48V signal provided over the Ethernet cable by a UL approved and 802.3af compliant Hub, switch or similar device.

2 Features & Functionality

2.1 Functional Requirements

- Operational temperature range of –20 O C to +50 O C.
- Storage Temperature range of –40 O C to +70 O C.
  - 30 in. drop (11.a & 11.g with internal Antenna) to concrete without malfunction (2 drops per face – 2x6).
  - 36 in. drop (11.a & 11.g with external Antenna) to concrete without malfunction (2 drops per face – 2x4).
- FCC Part 15, class B EMI
- ESD Protection: +/-15kV Air discharge and +/-8kV Contact discharge
  - 802.11b/g Direct Sequencing Spread Spectrum (DSSS) physical layer.
  - 802.11g Orthogonal Frequency Division Multiplexing (OFDM) physical layer.
  - 802.11a Orthogonal Frequency Division Multiplexing (OFDM) physical layer.
  - 802.11g data rate capability – 1, 2, 5.5, 6, 9, 12, 18, 24, 36, 48 and 54Mbps.
  - 802.11a data rate capability –6, 9, 12, 18, 24, 36, 48, 54 Mbps
- Robust roaming and dynamic rate switching
- 10/100Base-T Ethernet interface up to 100Mbps
- Power-Over-Ethernet (PoE)
- Integrated Antenna requirements and specifications
- A Radio
  - Bandwidth: 4900 – 5850 mHz
  - VSWR: x.x : 1
  - Impedance: 50 Ohms input
  - Gain:x.x dBi peak
  - Beamwidth: (x dB) E-plane xxx° / xx°, H- plane xx° / xx°
  - Connector: 90 degree Reverse SMA
  - Diversity: Transmit and Receive
- G Radio
  - Bandwidth: 2400-2500 mHz
  - VSWR: x.x : 1

- Impedance: 50 Ohms input
- Gain: x dBi peak
- Beamwidth: (x dB) E-plane xxx° / xx°, H- plane xx° / xx°
- Connector: reverse BNC
- Diversity: Transmit and Receive

2.2 External Hardware Interface(s)

- 10/100Base-T Ethernet interface

2.3 Operating Parameters

2.3.1 Electrical

- Power source: 48V Power-Over-Ethernet @ 12.95W
- IEEE 802.3af class 0 Power Classification
- Input voltage: 48Vnominal; 37Vmin and 57Vmax
- Ripple and Noise: 500mVpp maximum for low frequencies (less than 500Hz) and
- 200mVpp maximum for higher frequencies (20kHz up to 100MHz).
- Maximum Inrush Current: Iinrush of 500mA
- Frequency Range: 2.4 to 2.5GHz
- Ethernet Compatibility: 10/100Base-T (RJ-45) connector
- RF Transmit Output Power: Approximately 100mW maximum
  100mW (20dBm) maximum; 70.8mW (18.5dBm) average

2.3.2 Environmental

- Operational temperature range of –20 O C to +50 O C. (Metal)
- Operational temperature range of +0 O C to +35 O C. (Plastic)
- Storage Temperature range of –40 O C to +70 O C.
- FCC Part 15, class B EMI
- Environmental Qualification
- High Temp (+50 O C) /Low Temp (–20 O C) operation

- High Temp (+70 O C) /Low Temp (–40 O C) storage
- Heat Cycle
- High Temp/High Humidity
- Condensation
  - 30 in. drop (11.a & 11.g with internal Antenna) to concrete without malfunction (2 drops per face – 2x6).
  - 36 in. drop (11.a & 11.g with external Antenna) to concrete without malfunction (2 drops per face – 2x4).
  - Vibration – Packed
  - Loose cargo – Unpacked
- ESD Protection: +/-15kV Air discharge and +/-8kV Contact discharge

2.3.3 Mechanical

- Storage Temperature range of –40 O C to +70 O C.
- 30 in. drop (11.a & 11.b with internal Antenna) to concrete without malfunction (2 drops per face – 2x6).
- 36 in. drop (11.a & 11.b with external Antenna) to concrete without malfunction (2 drops per face – 2x4).

2.4 Configurations

There are two product configurations for Leo. The basic configuration consists of the Leo motherboard with both a 2.4 GHz and a 5.2 GHz A radio. There are two versions of this unit, a plastic version and a metal version. The plastic unit is rated for 0 to +40 degrees C, and has internally mounted antennas. The metal housing is rated for operation or –20 to +50 degrees C. The metal unit is plenum rated and provides for two externally mounted 2.4 GHz and 5.2 GHz antennas. The metal unit requires the purchase of two 2.4 GHz antennas and 2 5.s GHz antennas.

The Leo Rfport can only be powered by 802.3af power source, there are no other power supply options.

2.5 Failure Modes

Leo deals with failures in several ways. A main board/cpu error will cause a software reset of the board, resulting in a loss of any A and/or G clients. The hardware will respond in a similar manner to a power up under this reset condition. If the cpu detects a 5.2 or 2.4 GHz radio error, the unit will attempt to reset the radio and re-initialize that radio with out impact to the operation of the other radio. If the error can not be cleared, the cpu will take the radio off line and begin blinking the LED, (green for 2.4 and Amber for 5.2) at a 1 second blink rate to indicate the error. If a user initiated power reset does not clear the error condition, the user may have to have the unit serviced.

3 Design

3.1 Design Objectives

3.1.1 Performance Objectives

- IEEE 802.11b compliant DSSS communication at 1, 2, 5.5, and 11Mbps.
- IEEE 802.11g compliant DSSS communication at 1, 2, 5.5, 6, 9, 12, 18, 24, 36, 48 and 54 Mbps.
- IEEE 802.11a compliant OFDM communication at 6, 9, 12, 18, 24, 36, 48, 54 Mbps.

3.1.2 RF Performance Objectives

3.1.2.1 Leo 11a radio

Item	Description	MIN	MAX	Unit	Comment
1	Radio Architecture : Conexant Crossbow Radio in mini-PCI format				
2	Operating Environment Relative Humidity		90	%	
3	Operating temperature	-20	50	˚C	
4	Supply voltage	3.2	3.4	Vdc	
5	Standby current			mA	

6	Transmit current		500	A	
7	Receive current		400	mA	
8	Frequency tolerance -20°C to +70°C, 3.2 to 3.4Vdc	-20	+20	PPM	
Receive requirements					
9	Sensitivity				
	6 Mbps	-88		dBm	10% packet error rate for 1000 bytes
	9 Mbps	-87			
	12 Mbps	-85			
	18 Mbps	-81			
	24 Mbps	-79			
	36 Mbps	-75			
	48 Mbps	-70			
	54 Mbps	-68			
10	Adjacent channel rejection				
	6 Mbps	16		dB	At 10% packet error rate with a PSDU length of 1000 bytes.
	9 Mbps	15			
	12 Mbps	13			
	18 Mbps	11			
	24 Mbps	8			
	36 Mbps	4			
	48 Mbps	0			
	54 Mbps	-1			
11	Alternate adjacent channel rejection				
	6 Mbps	32		dB	At 10% packet error rate with a PSDU length of 1000 bytes.
	9 Mbps	31			
	12 Mbps	29			
	18 Mbps	27			
	24 Mbps	24			
	36 Mbps	20			
	48 Mbps	16			
	54 Mbps	15			
12	Out of band selectivity	50		dB	

13	Receive emissions, 30MHz to 1GHz		-57	dBm	Conductive
14	Receive emissions, 1GHz to 12 GHz		-47	dbm	Conductive
Transmit requirements					
15	Transmitter Output Power				
	6 Mbps	18		dbm	Power output measured at relative constellation error specifications.
	9 Mbps	18			
	12 Mbps	16			
	18 Mbps	16			
	24 Mbps	14			
	36 Mbps	14			
	48 Mbps	12			
	54 Mbps	12			
16	Constellation error (EVM)				
	6 Mbps		-5	%	At rated power output for each modulation rate per IEEE 802.11a
	9 Mbps		-8		
	12 Mbps		-10		
	18 Mbps		-13		
	24 Mbps		-16		
	36 Mbps		-19		
	48 Mbps		-22		
	54 Mbps		-25		
17	Transmit signal Spectrum mask				
	BW < 18 MHz		0	dBr	
	@ ± 11 MHz		-20		
	@ ± 20 MHz		-28		
	> ± 30 MHz		-40		
18	Band-edge spurious signal		-44	dBm	Conductive

3.1.2.2 Leo 11g radio (CCK Mode)

Item	Description	MIN	MAX	Unit	Comment
1	RADIO ARCHITECTURE: Conexant Javelin in mini-PCI format				
2	Supply voltage	3.2	3.4	Vdc	
3	Power supply ripple		25	mVrms	Sinewave 50 Hz to

					5 Mhz
4	Standby current	N/A	N/A	mA	
5	Reset current	N/A	N/A	mA	
6	Transmit current	TBD	450	mA	
7	Receive current	TBD	300	mA	
8	Inrush current		N/A	mA	
9	Frequency tolerance -20°C to +70°C, 3.0 to 3.6Vdc	-25	+25	PPM	
Receive requirements					
9	Sensitivity -20°C to +70° C, 3.0 to 3.6Vdc				
	11 Mbps	-84	+10	dBm	8% Packet error rate for 1,024 Octets
	5.5 Mbps	-88	+10		
	2 Mbps	-90	+10		
	1 Mbps	-94	+10	dBm	
10	Adjacent channel rejection	35		dB	Measured per IEEE802.11b 18.4.8.3
11	Out of band selectivity	50		dB	
12	Third-order intermod intercept point	-5		dBm	
13	RSSI value @ -60 dBm signal level			int	Record in ATE data base
14	RSSI dynamic range @ 2,442 Mhz				Montone, increasing from –90 dBm to –10 dBm
15	Receive emissions, 30MHz to 1GHz		-57	dBm	Conductive
16	Receive emissions, 1GHz to 12 GHz		-47	dbm	Conductive
Transmit requirements					
17	Power level -20°C to +70°C, 3.2 to 3.4 Vdc				
	Hi Level	17	20		
	Incremental Levels	1	1		
	Low Level	4	4	dbm	
18			-33		

	Transmit signal Spectrum		-55		
19	Band-edge spurious signals		-44	dBm	
20	Carrier suppression		-15	DBc	
21	RF output rise time	0.2	2	µS	10% to 90%
22	RF output fall time	0.2	2	µS	90% to 10%
23	Phase noise		-100	dBc/Hz	At 100kHz offset
24	Key click/spectral regrowth		10	DBr	
25	Modulation accuracy (EVM)		20	%	Measured per IEEE802.11b 18.4.7.8
26	Load stability				Infinite VSWR, all phase
27	Channel switching time		224	µS	Measured per IEEE802.11b 18.4.6.12
28	Transmit to receive switch time		10	µS	Measured per IEEE802.11b 18.4.6.9

The above tables represent design goals. At this time, some of the operational parameters of both the 5.2 and 2.4 GHz radios are still being tested and characterized.

3.1.2.3 Leo 11g radio (OFDM Mode)

Item	Description	MIN	MAX	Unit	Comment
1	Radio Architecture : Conexant Javelin RF in mini-PCI format				
2	Operating Environment Relative Humidity		90	%	
3	Operating temperature	-20	50	°C	
4	Supply voltage	3.2	3.4	Vdc	
5	Standby current			mA	
6	Transmit current		500	A	
7	Receive current		400	mA	
8	Frequency tolerance -20°C to +70°C, 3.2 to 3.4Vdc	-20	+20	PPM	

Receive requirements					
9	Sensitivity				
	6 Mbps	-88		dBm	10% packet error rate for 1000 bytes
	9 Mbps	-87			
	12 Mbps	-85			
	18 Mbps	-81			
	24 Mbps	-79			
	36 Mbps	-75			
	48 Mbps	-70			
	54 Mbps	-68			
10	Adjacent channel rejection				
	6 Mbps	16		dB	At 10% packet error rate with a PSDU length of 1000 bytes.
	9 Mbps	15			
	12 Mbps	13			
	18 Mbps	11			
	24 Mbps	8			
	36 Mbps	4			
	48 Mbps	0			
	54 Mbps	-1			
11	Alternate adjacent channel rejection				
	6 Mbps	32		dB	At 10% packet error rate with a PSDU length of 1000 bytes.
	9 Mbps	31			
	12 Mbps	29			
	18 Mbps	27			
	24 Mbps	24			
	36 Mbps	20			
	48 Mbps	16			
	54 Mbps	15			
12	Out of band selectivity	50		dB	
13	Receive emissions, 30MHz to 1GHz		-57	dBm	Conductive
14	Receive emissions, 1GHz to 12 GHz		-47	dbm	Conductive
Transmit requirements					
15	Transmitter Output Power				

	6 Mbps	17.5		dbm	Power output measured at relative constellation error specifications.
	9 Mbps	17.5			
	12 Mbps	16			
	18 Mbps	16			
	24 Mbps	14			
	36 Mbps	14			
	48 Mbps	12			
	54 Mbps	12			
16	Constellation error (EVM)				
	6 Mbps		-5	%	At rated power output for each modulation rate per IEEE 802.11a
	9 Mbps		-8		
	12 Mbps		-10		
	18 Mbps		-13		
	24 Mbps		-16		
	36 Mbps		-19		
	48 Mbps		-22		
	54 Mbps		-25		
17	Transmit signal Spectrum mask				
	BW < 18 MHz		0	dBr	
	@ ± 11 MHz		-20		
	@ ± 20 MHz		-28		
	> ± 30 MHz		-40		
18	Band-edge spurious signal		-44	dBm	Conductive

The above tables represent design goals. At this time, some of the operational parameters of both the 5.2 and 2.4 GHz radios are still being tested and characterized.

3.1.3 Compatibility Objectives

- Compatible with any IEEE 802.11b compliant wireless LAN.
- Compatible with any IEEE 802.11g compliant wireless LAN.
- Compatible with any IEEE 802.11a compliant wireless LAN.
- Compatible with IEEE 802.3af compliant PoE networks.

3.1.4 Industry Standards Objectives

- IEEE 802.11b 11Mbps Direct Sequencing Spread Spectrum

- IEEE 802.11g 54Mbps Orthogonal Frequency Division Multiplexing
- IEEE 802.11a 54Mbps Orthogonal Frequency Division Multiplexing
- FCC part 15, class B US Unintentional Emissions
- FCC part 15.247, 15.205, 15.209 US Spread Spectrum
- ETSI 300-328 European Spread Spectrum
- EN60601-1-2 European EMC – includes ETS 300 683 EMC, EN 50082-2 (10V/m)
- DOC RSS-210 Canadian Spread Spectrum
- RCD STD-33R Japanese Cpread Spectrum
- WECA WiFi 2001

3.1.5 Manufacturing Objectives

- Follow USI PCB Guidelines.
- Follow USI Final Assembly Guidelines.
- Follow USI Environmental Guidelines and Qualification Test Standards.

3.1.6 Customer Support Objectives

- At this time, the goals of customer support are still being determined. Presently, USI will service directly any field failures until such a time that other actions are more cost effective.

3.1.7 Reliability Objectives

- MTBF of approximately 5 years (43,800 hours) of operation before RFPort failure at100% Duty Cycle at the maximum normal operating temperature (50 O C). MTBF numbers are still being determined.

3.2 Design Decomposition (Block Diagram)

The Leo is composed of three major sub-sections: the 802.11g & 802.11a radio, the digital sub-section, and the PoE sub-section.

3.2.1 Leo Block Diagram

The digital sub-section is composed of:

(1) CPU: IBM 405EP

(2) Ethernet PHY: Broadcom AC101L

(3) Mini PCI : two MiniPCI connectors

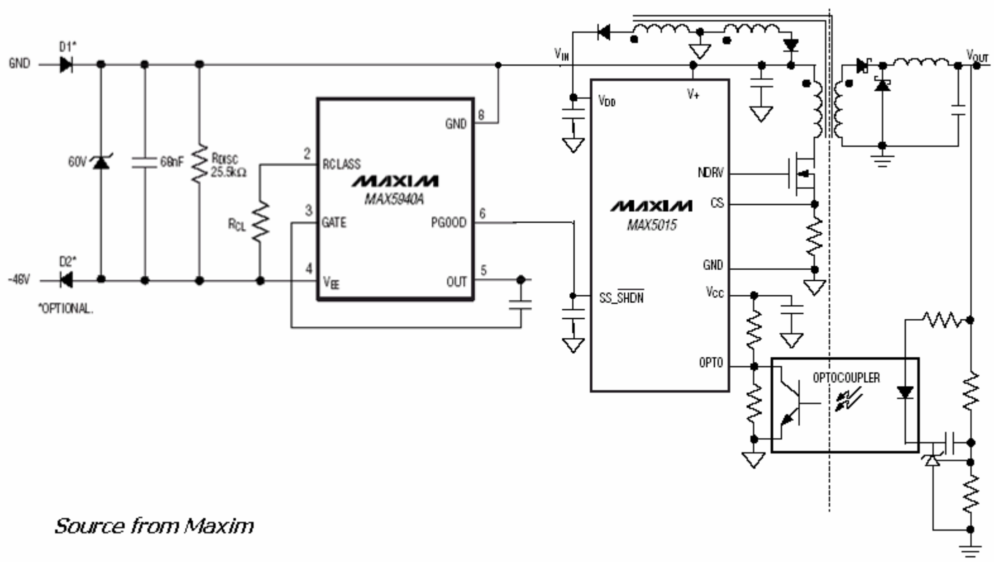
(4) Flash : AM29LV040B-90EI

(5) SDRAM: 4Mbyte, IC42S16101-7TI x2

(6) Display : 4x2 LEDs (Green & Yellow) .

(7) PCI CLK: 32MHz

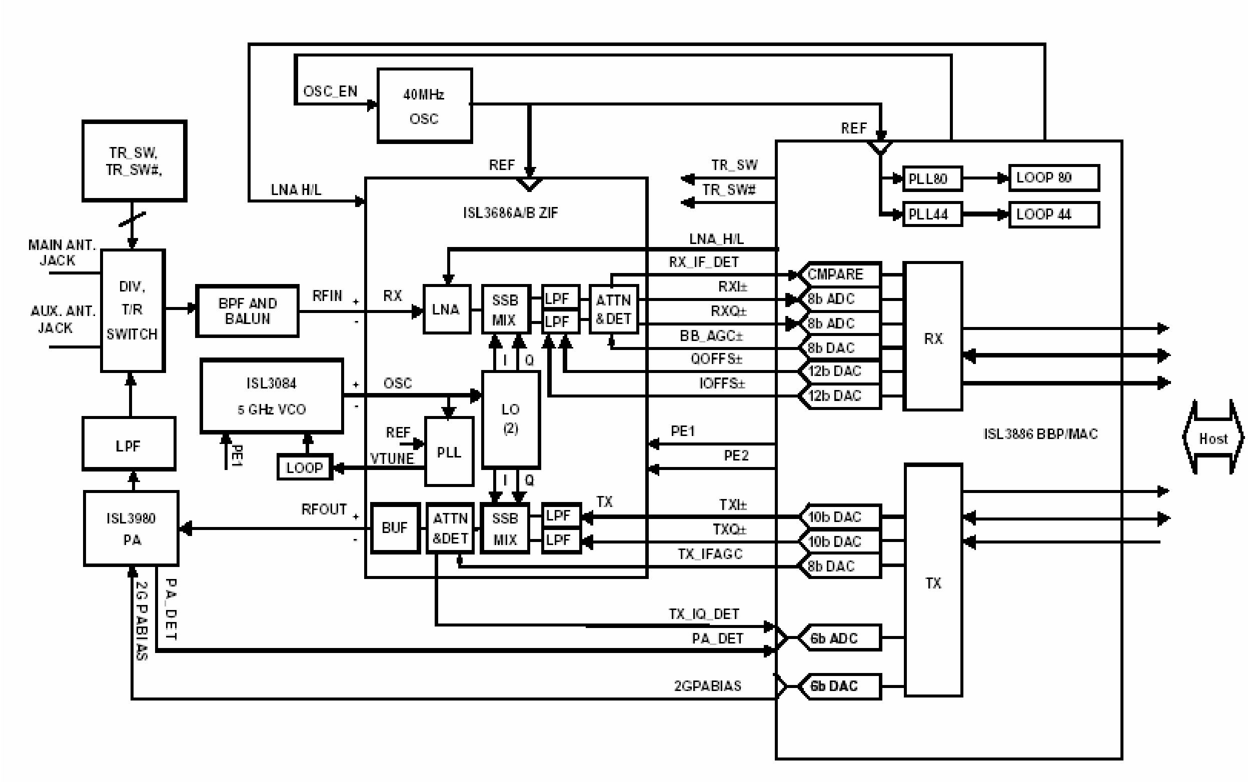
The Power-Over-Ethernet (PoE) sub-section provides the Leo system power 3.3V



3.2.2 Leo 802.11g RFPort Block Diagram

The Leo 802.11g radio is based upon the Conexant Javelin chipset to implement the spreading, modulation, demodulation and de-spreading. The RF up and down conversion approach is the common Zero IF manufactured by Conexant and PA from Conexant ISL3980.

Block Diagram

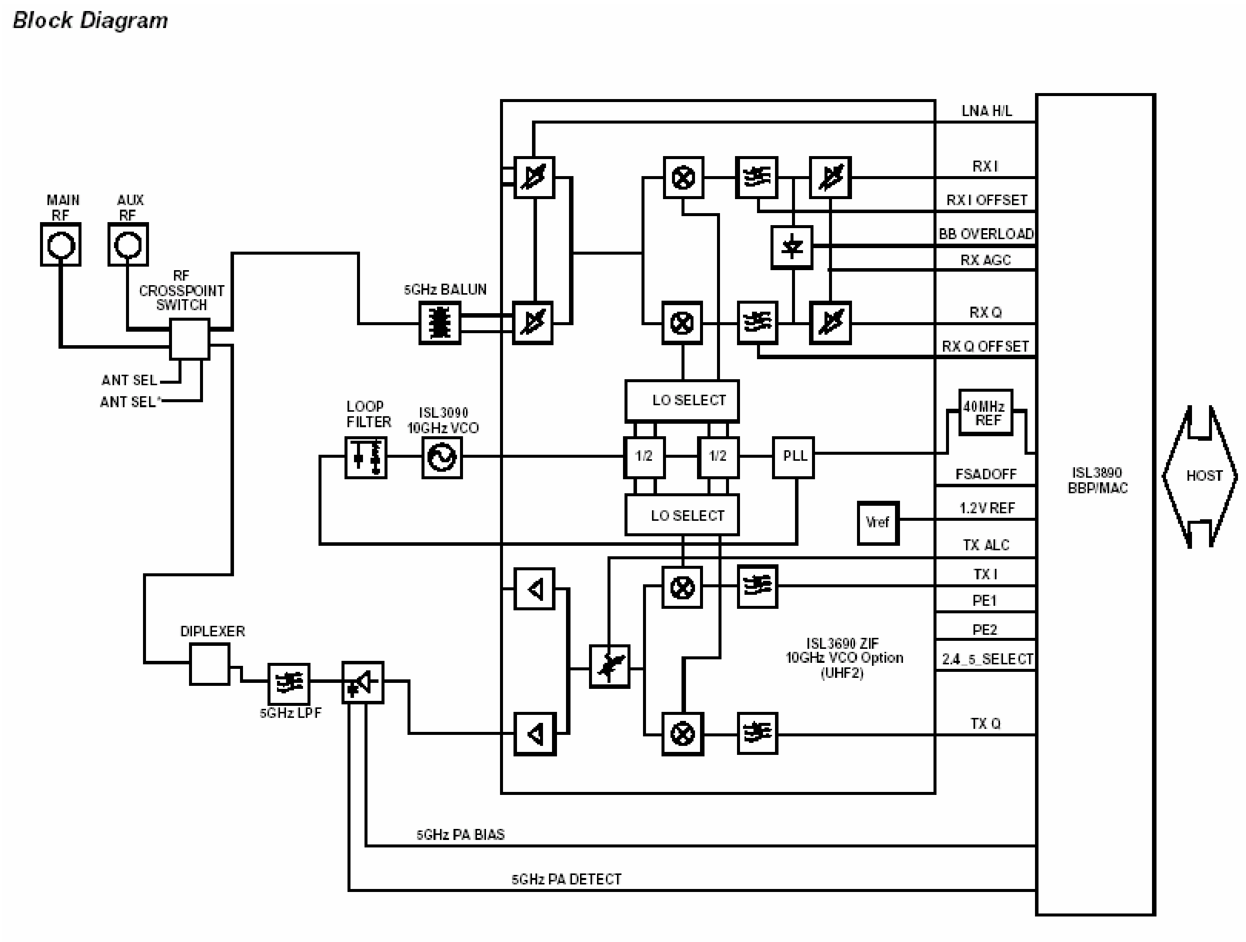


The 802.11g radio design is composed of four major components: the ISL3886 MAC/Baseband Processor, the ISL3686B 2.4GHz RF IC, the ISL3980 Transmit Power Amplifier, and a pair of antennas for diversity. The radio section also includes supplementary Direct Sequence transmit and receive circuitry, RF synthesizers, reference oscillators, and power switching circuits. The 2.4 GHz radio is IEEE 802.11b/g 11/54Mbps DSSS/OFDM compliant.

The ISL3886 is the highly integrated MAC/BB processor. It is the digital interface for the RF section to MiniPCI . The ISL3686B is 802.11b/g RF solution. It controls the radio's frequency synthesizers, modulation/demodulation, as well as, the transmit and receive data paths. The ISL3980 is the transmit power amplifier that provides the RF transmit power output of approximately 100mW.

3.2.3 Leo 802.11a RFPort Block Diagram

The Leo 802.11a radio is based upon the Conexant Crossbow chipset design. ISL3886 is an MAC/Baseband processor with MiniPCI interface. The ISL3692IR is a single-chip Zero IF radio transceiver. The ISL3992IR is the PA.



3.3 Hardware Approach (Theory of Operations)

3.3.1 802.11g Radio

One of the radio option's for the Leo RFPort is an IEEE 802.11g compliant 2.4GHz Direct Sequence/ OFDM radio based on the Conexant Javelin MiniPCI radio design.

3.3.1.1 Operating Channels

The FCC (US), IC (Canada), and ETSI (Europe) specify operation for 2.4 GHz Spread Spectrum radios from 2400MHz to 2483.5MHz for thirteen useable channels (1 to 13). There is also an additional channel 14 that is specified in the IEEE 802.11b specification for operation in Japan.

Channel	Frequency
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442

Channel	Frequency
8	2447
9	2452
10	2457
11	2462
12	2467
13	2472
14	2484

3.3.1.2 Modulation and Channel Data Rates

There are three different modulation modes utilized in 802.11g radios: Legacy 1 and 2Mbps, Complementary Code Keying (CCK) and Orthogonal Frequency Division Multiplexing (OFDM). These are more fully described in the subsequent paragraphs. The radios support the following 12 data rates:

- 1Mbps (BPSK modulation)
- 2Mbps (QPSK modulation)
- 5.5Mbps (CCK modulation)
- 6Mbps (OFDM with BPSK carrier modulation)
- 9Mbps (OFDM with BPSK carrier modulation)
- 11Mbps (CCK modulation)
- 12Mbps (OFDM with QPSK carrier modulation)
- 18Mbps (OFDM with QPSK carrier modulation)
- 24Mbps (OFDM with 16QAM carrier modulation)
- 36Mbps (OFDM with 16QAM carrier modulation)

• 48Mbps (OFDM with 64QAM carrier modulation)
• 54Mbps (OFDM with 64QAM carrier modulation)
Note that each OFDM constellation type supports two different data rates. This is due to the change in the degree of rate coding between the two formats. For example the 6Mbps BPSK mode uses rate 1/2 coding whereas the 9Mbps mode uses rate 2/3 coding.

3.3.1.3 Transmit Path

The Intersil ISL3886 MAC/baseband processor creates the transmit waveform and outputs the signal on the TX I/Q lines. The Intersil ISL3686B up-converts the transmit baseband signal to mixed up to the channel frequency use ZIF. The signal is then amplified (2.4 to 2.5 GHz passband) and filtered to create the required output power while keeping spurious and harmonic emissions in spec. The switche provide for antenna diversity and receive/transmit switching.

3.3.1.4 Receive Path

The input signal to the radio is received through either one of the antenna connectors. The selection of the antenna is performed through the operations of the ISL3886 BBP/MAC and the RF Crosspoint Switch. The use of the diversity switch helps to overcome the effects of multipath fading and antenna pattern nulls. The received signal from the selected antenna is then fed to a bandpass filter/balun, which effectively prevents out-of-band interfering signals from degrading the performance of the receiver.

ISL3686B Zero Intermediate
Frequency (ZIF) chip. The ZIF chip serves as a direct down conversion transceiver. It contains a Low-Noise Amplifier (LNA), a Quad Up/Down Converter, Synthesizer, Low-Pass Filter (LPF) and a Baseband AGC Receiver.

3.3.1.5 Frequency Generation

The LO is generated by a external VCO use ISL3084IR and generates the 2 times channel frequency. A 40MHz crystal is the reference for the synthesizer.

3.3.2 802.11a Radio

Standard with the Leo RFPort is an IEEE 802.11a compliant 5.2 GHz Orthogonal Frequency Division Multiplexing radio based on the Conexant Crossbow MiniPCI radio design.

3.3.2.1 Operation Frequency

.The radio frequency is used for the 5.15–5.25, 5.25–5.35 and 5.725–5.825 GHz unlicensed national information structure (U-NII) bands, as regulated in the United States by the Code of Federal Regulations, Title 47, Section 15.407.

3.3.2.2 Modulation and Channel Data Rates

In 802.11a mode, the radio supports all of the specified Orthogonal Frequency Division Multiplexing (OFDM) modulation modes. The following 8 data rates are supported in the 802.11a 5.2GHz band:

- 6Mbps (OFDM with BPSK carrier modulation)
- 9Mbps (OFDM with BPSK carrier modulation)
- 12Mbps (OFDM with QPSK carrier modulation)
- 18Mbps (OFDM with QPSK carrier modulation)
- 24Mbps (OFDM with 16QAM carrier modulation)
- 36Mbps (OFDM with 16QAM carrier modulation)
- 48Mbps (OFDM with 64QAM carrier modulation)
- 54Mbps (OFDM with 64QAM carrier modulation)

These modulation formats are essentially the same as the corresponding OFDM waveforms in 802.11g mode. As in the low-band, each OFDM constellation type supports two different data rates by also providing coding at rate 1/2 and rate 2/3.

3.3.2.3 Receive Path

The received signal from the selected antenna is then fed to a diplexer, which separates the path into a low-band(2.4GHz) path and a high-band path (5.2GHz). The end of low-band path is a load with 50 ohm resistor. The high-band path, the signal passes through a Balun.

The input impedance of the filter and filter/balun is 50Ω unbalanced whereas the output is 100Ω. balanced in order to correctly drive the differential receive input of the ISL3692 Dual-band Zero Intermediate Frequency (ZIF) chip. The ZIF chip serves as a direct down conversion transceiver for both low- and high-band. For each band, it contains a Low-Noise Amplifier (LNA), a Quad Up/Down Converter, Synthesizer, Low-Pass Filter (LPF) and a Baseband AGC Receiver

Amplifier (RX Amp), as well as a Transmitter Amplifier (TX Amp) for the Transmitter Signal Path (to be discussed later).

3.3.2.4 Transceiver Path

Data from the host computer is sent to the MAC through the miniPCI interface. Prior to any communication, however, the MAC sends a Request To Send (RTS) packet to the other end of the link and it receives a Clear to Send (CTS) packet in return. The MAC then formats the payload data packet (MPDU) by appending it to a preamble and header and sends it to the BBP.

As previously noted, the radio supports 12 different modulation modes in low-band and 8 in high-band:

- The two legacy data rates: 1 and 2Mbps (2.4GHz band only)
- The two CCK data rates: 5.5 and 11Mbps (2.4GHz only)
- The eight OFDM data rates: 6, 9, 12, 18, 24, 36, 48 and

3.3.2.5 Frequency Generation

The LO is generated by a external VCO use ISL3090IR and generates the 2 times channel frequency. A 40MHz crystal is the reference for the synthesizer.

3.3.3 Leo Main Board

3.3.3.1 PowerPC 405EP Diagram

Designed specifically to address embedded applications, the PowerPC 405EP (PPC405EP) provides a high-performance, low-power solution that interfaces to a wide range of peripherals by incorporating on-chip power management features and lower power dissipation requirements. This chip contains a high-performance RISC processor core, SDRAM controller, PCI bus interface, Ethernet interface, control for external ROM and peripherals, DMA with scatter-gather support, serial ports, IIC interface, and general purpose I/O. Technology: IBM CMOS SA-27E, 0.18 μm (0.11 μm Leff) Package: 31mm, 385-ball, enhanced plastic ball grid array (E-PBGA) Power (typical): 1.2W at 200MHz

Major features of the PowerPC 405EP are as follows:

- IBM PowerPC 405 32-bit RISC processor core operating up to 333MHz with 16KB D- and Icaches
- PC-133 synchronous DRAM (SDRAM) interface

- 32-bit interface for non-ECC applications

- 4KB on-chip memory (OCM)
- External peripheral bus

- Flash ROM/Boot ROM interface
- Direct support for 8- or 16-bit SRAM and external peripherals
- Up to five devices

- DMA support for memory and UARTs.

- Scatter-gather chaining supported
- Four channels

- PCI Revision 2.2 compliant interface (32-bit, up to 66MHz)

- Asynchronous PCI Bus interface
- Internal or external PCI Bus Arbiter

- Two Ethernet 10/100Mbps (full-duplex) ports with media independent interface (MII)
- Programmable interrupt controller supports seven external and 19 internal edge-triggered or level-sensitive interrupts
- Programmable timers
- Software accessible event counters
- Two serial ports (16750 compatible UART)
- One IIC interface
- General purpose I/O (GPIO) available
- Supports JTAG for board level testing
- Internal processor local Bus (PLB) runs at SDRAM interface frequency
- Supports PowerPC processor boot from PCI memory

JTAG

- IEEE 1149.1 test access port
- IBM RISCWatch debugger support
- JTAG Boundary Scan Description Language (BSDL)

3.3.3.2 Power Diagram (Power over Ethernet)

The 802.113af PoE is OR Wire with the 48V Power Adapter input to determine the system power supply source. The Leo motherboard uses a 48 volt input PWM switching controlled Power supply to provide a 3.3 V 3.5A output which is 82.45% efficient.

a. Power sequence : 48V→ 3.3V → 1.8 ; 2.5V.

b. Power reset:

The Leo motherboard has a ***Maxim/Dalla*** MAX6387XS29D3-T 3.3-Volt Micro Monitor Chip as a Power reset supervisor. If it detects out-of-tolerance power supply conditions, it will hold the CPU in reset until proper power supply conditions are met.

- Reset Threshold Voltages Ranging from +1.58V to +4.63V in Approximately 100mV Increments
- ±2.5% Reset Threshold Accuracy Over Temperature (-40°C to +125°C)
- Reset Timeout Delay : 140ms
- 2 input for monitoring voltage
- Low Power Consumption of 6µA at +3.6V and 3µA at +1.8V

1. PoE concept :

The Power over LAN Hub is connected to the PD load with 100m cable. The assumption is that the hosting LAN infrastructure complies with IEEE 802.3 and utilizes standard TIA/EIA-568 Category 5 cabling. According to the IEEE 802.3 standard, the maximum permitted DC resistance of a single twisted pair link is 40 Ω between terminal and source. This includes all interconnections, outlets, etc. Since the Power over LAN Hub delivers its power via two twisted pairs connected in parallel, we assume 20 Ω Link Resistance as worst case. (The newer Cat 5E cable has a resistance of 25 Ω per 100m, therefore 12.5 Ω max would be seen over parallel cables. Typically, the resistance in common installations is even lower.)

— **RLINE = 20 Ω , Vsmin=39.9V, Vsmax=57.05V, ILIM=11.87A, ICUT =0.34A**

The minimum load operating voltage 39.89**Vdc.**
ICUT = max. continuous operating current
ILIM = max. peak/Inrush current for limited time.

2. Circuit descriptions &.Layout considerations :

Using Forward and Sync. Rectification power topology, a 48 VDC switching power supply exists which provides the required input to output isolation and supports a wide input range, in a compact format. This 48 volt switching power supply is specially designed to work as the power conversion unit in Power over LAN applications. A major advantage of this circuit is its ability to work with input voltages ranging from 39V ~ 60V.

Use ground plane construction or single point grounding techniques.
__ Make the connection between R215 , R214 and the Primary coil as short as possible.
__ Minimize the loop area that is formed by input and output “In-going & Returning” path currents. A good design practice is locating the positive high current trace as close as possible to its negative return path for minimizing parasitic inductance.
__ Place the voltage feedback loop components far from the transformer to prevent inducing noise into the feedback loop.
__ Place the Vcc to GND bypass capacitor as close to the Vcc pin as possible.

3.Output Capacitors
__ low ESR to enable low ripple at the output. and handle high RMS currents.
__ use a capacitor rated for 75% of the DC load current.
__1.5 times greater than the maximum working voltage rating
__ Notice that the total input capacitance must not exceed 180uF to enable circuit startup with a Power-Hub.

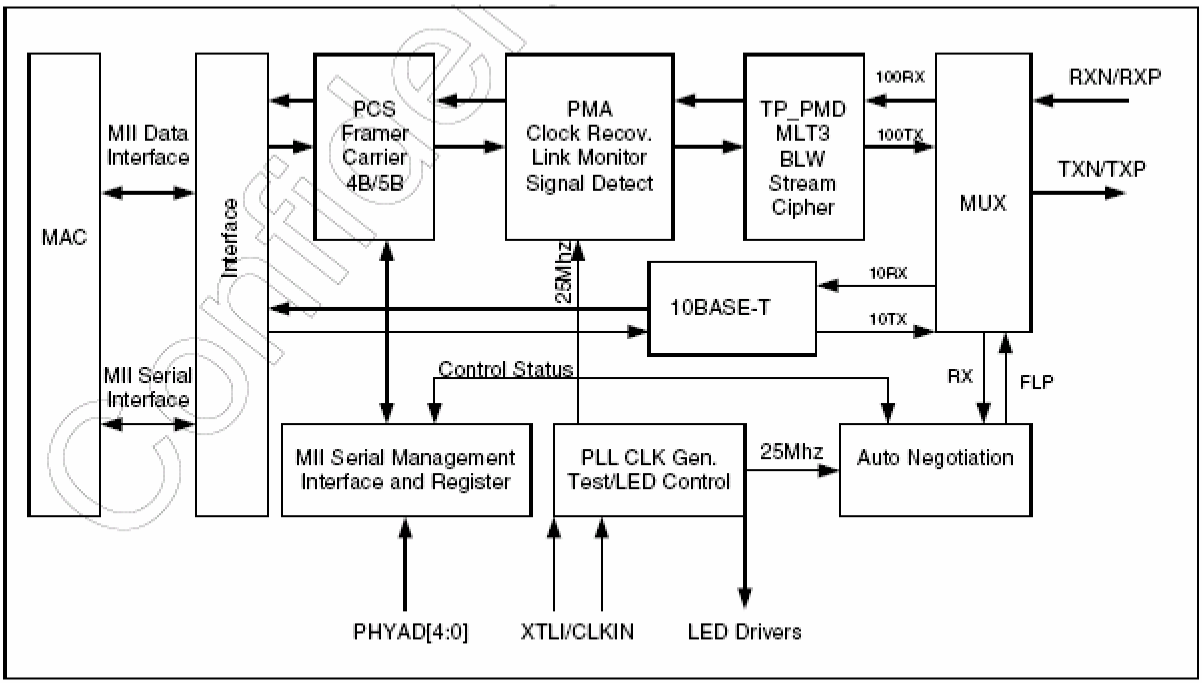
3.3.3.3 AC101L Diagram

The AC101L is a single channel, low power, 10/100BASE-TX/FX transceiver. The AC101L transceiver has an integrated voltage regulator to allow operation from a single 3.3 V or 2.5 V supply source. The device contains a full-duplex 10BASE-T/ 100BASE-TX/ 100BASE-FX Fast Ethernet transceiver, which performs all of the physical layer interface functions.

The AC101L is a highly integrated solution combining an encoder/decoder, link monitor, auto-negotiation selection, parallel detection, adaptive equalization, clock/data recovery, baseline wander correction, multi-mode transmitter, scrambler/descrambler, far-end fault (FEF), and auto-MDI/MDIX circuitry. It is fully compliant with the IEEE802.3 and 802.3u standards.

Major features of the AC101L are as follows:

- 3.3 V tolerant and 2.5 V capable
- Integrated voltage regulator to allow operation from a single 3.3 V or 2.5 V supply source
- 10/100 TX/FX
- Full-duplex or half-duplex
- FEFI on 100FX
- 48-pin TQFP
- Industrial temperature (–40° C to +85° C)
- 0.25 μm CMOS
- Fully compliant with IEEE 802.3/802.3u
- MII interface
- Baseline wander correction
- Multifunction LED outputs
- Cable length indicator
- HP auto-MDI/MDIX
- Eight programmable interrupts
- Diagnostic registers


MAC
MII Data Interface
MII Serial Interface
Interface
PCS Framer Carrier 4B/5B
PMA Clock Recov. Link Monitor Signal Detect
TP_PMD MLT3 BLW Stream Cipher
100RX
100TX
MUX
RXN/RXP
TXN/TXP
25Mhz
10BASE-T
10RX
10TX
Control Status
RX
FLP
MII Serial Management Interface and Register
PLL CLK Gen. Test/LED Control
25Mhz
Auto Negotiation
PHYAD[4:0]
XTLI/CLKIN
LED Drivers