NJIAL200
EXHIBIT 9
“Operational Description”

This exhibit is submitted to comply in part with
FCC 47CFR section 2.1033 part b item 4:
“ A brief description of the circuit functions of the device along with a statement describing how the device operates. This statement should contain a description of the ground system and antenna, if any, used with the device.”

This exhibit is submitted to comply in part with
FCC 47CFR section 2.1033 part b item 8:
“If the equipment for which certification is being sought must be tested with peripheral or accessory devices connected or installed, a brief description of those peripherals or accessories. The peripheral or accessory devices shall be unmodified, commercially available equipment.”

This exhibit is submitted to comply with
FCC 47CFR section 2.1033 part c item 5:
“Frequency Range.”

This exhibit is submitted to comply with
FCC 47CFR section 2.1033 part c item 6:
“Range of operating power values or specific operating power levels, and description of any means provided for variation of operating power.”

This exhibit is submitted to comply with FCC 47CFR section 2.1033 part c item 7:

"Maximum power rating as defined in the applicable part(s) of the rules."

This exhibit is submitted to comply with FCC 47CFR section 2.1033 part c item 8:

"The dc voltages applied to and dc currents into the final radio frequency amplifying device for normal operation over the power range."

This exhibit is submitted to in part comply with FCC 47CFR section 2.1033 part c item 10:

"A schematic diagram and a description of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power."

This exhibit is submitted to comply with FCC 47CFR section 2.1033 part c item 13:

"For equipment employing digital modulation techniques, a detailed description of the modulation system to be used. Including the response characteristics (frequency, phase, amplitude) of any filters provided, and a description of the modulating wavetrain, shall be submitted for the maximum rated conditions under which the equipment will be operated."

This exhibit is submitted to comply with FCC 47CFR section 22.921:

E911 call processing legislation.

Submission examination in detail on FCC 47CFR section 2.1033 part b item 4:

Whereas the description of the circuit functions is shown below, along with a statement of how the device operates this requirement is evidenced.
Whereas the description of the ground system and reference to the antenna requirements in Exhibit 7 "Users Manual" is shown below this requirement is evidenced.

Submission examination in detail on FCC 47CFR section 2.1033 part b item 8:

Whereas the description of the peripheral or accessory devices is shown below, this requirement is evidenced.
Wheras Exhibit 5 "Test Report" includes a listing of these devices, and photographs of the peripheral or accessory devices connected, this requirement is verified.
Wheras Exhibit 6 "Test setup photos" shows photographs of the peripheral or accessory devices connected, this requirement is verified.

Submission examination on FCC 47CFR section 2.1033 part c item 5:

Whereas the frequency range of the device is shown, the requirement is evidenced.

Submission examination on FCC 47CFR section 2.1033 part c item 6:

Whereas the range of operating power values and specific operating levels along with a description of the means provided of variation of operating power is shown below, this requirement is evidenced.

Submission examination on FCC 47CFR section 2.1033 part c item 7:

Whereas the maximum power rating is shown below, and the applicable parts of the rules are quoted, this requirement is evidenced.

Submission examination on FCC 47CFR section 2.1033 part c item 8:

Whereas the dc voltage applied to and the dc currents for normal operation are described below this requirement is evidenced.

Submission examination on FCC 47CFR section 2.1033 part c item 10:

Whereas the schematics are shown in Exhibit 4 “Schematic Diagram” this requirement is evidenced.
Whereas the device descriptions are shown in Exhibit 11 “Parts List/Tune Up Info” this requirement is evidenced.
Whereas the circuitry description is shown below for suppression of spurious radiation, for limiting modulation and for limiting power, this requirement is evidenced.
Whereas the adjustment of the device to meet the requirements is shown in Exhibit 11 “Parts List/Tune Up Info” this requirement is evidenced.

Submission examination on FCC 47CFR section 2.1033 part c item 13:

Whereas the description the digital modulation techniques is shown below, this requirement is evidenced.

Submission examination on FCC 47CFR section 22.921:

Whereas the device is shown to not allow user initiated calls as shown below, this requirement is evidenced.

NJIAL200 FCC 47CFR section 2.1033 part b item 4:

A brief description of the circuit functions of the NJIAL200 along with a statement describing how the NJIAL200 operates. This contains a description of the ground system and antenna used with the device.

NJIAL200
AssetLink 200
Brief description of circuit functions of the device along with a statement describing how the device operates.

Document: **NJIAL200 Assetink Brief Description of Circuit Functions.**
Date: **January 02, 2002**
Issue: **Rev 1**
Authors: **R. Braathen**
Company: CSI-Wireless

TABLE OF CONTENTS

Acronyms and Abbreviations

bps	Bits per Second
AMPS	American Mobile Phone System
CVDM	Cellular Voice Data Modem
DAC	Digital to Analog Converter
DUT	Device Under Test
EEPROM	Electronic Erasable Programmable Read Only Memory
EMC	Electro-Magnetic Compatibility
ESN	Electronic Serial Number
FCC	Federal Communications Commission (USA)
FLASH	Type of computer memory
FCP	Function Control Processor
FOCC	Forward Control Channel
GPS	Global Positioning System
ID	Identification (Numeric or alpha value)
I/O	Inputs and/or outputs
mA	Milliamp (1000th of an Ampere)
mSec	Millisecond (1000th of a second)
mW	Milliwatt (1000th of a Watt)
MIN	Mobile Identification Number
PCB	Printed Circuit Board
PPM	Parts per Million
RAM	Random Access Memory
RECC	Return Control Channel
RF	Radio Frequency
RSSI	Received Signal Strength Indicator
RTC	Real Time Clock
RX	Receiver or Receive
SID	System Identification Number
SMC	Sub-Minature Connector
TNC	Type of RF Connector
Tx	Transmit
VSWR	Voltage Standing Wave Ratio

Introduction

The AssetLink Product consists of the following major components:

- Function Control Processor (FCP)
- Global Positioning Receiver
- Power Supply and Power Management
- Cellular Radio Section

Operating Modes

The AssetLink™ device incorporates three distinct operating modes:

- Power Off Mode
- Armed Mode
- Active Mode

Operational Description

Function Control Processor

The Function Control Processor (FCP) performs the following functions:

1) Monitors the vehicle battery voltage.
2) Controls the Operating Modes.
3) Monitors and controls external I/O port signals (both digital and analog).
4) Controls the cellular module state.
5) Controls the GPS receiver.
6) Manages the non-volatile configuration memory in serial EEPROM.
7) Schedules event processing.
8) Performs input signal and geo-fence handling.
9) Maintains the Real Time Clock (RTC).
10) Supports program code updates.

Twelve Channel GPS Receiver

A highly sensitive receiver that allows the simultaneous tracking of up to 12 satellites that transmit timing information. Using this information and the known location of the satellites the GPS receiver will determine it's position. This receiver may use a pre-amplified antenna input.

The GPS receiver is part of the GPS2E chip set, using the GRF2i as a mixer and sampling converter for DSP functions that generate a demodulation of the GPS signals. The RF input for GPS has a 5 volt supply superimposed for the external LNA. The RF input is amplified and filtered before input to the GRF2i.

Power Management Section

The Power Manager Section provides for:

- The conditioning of an external +8 to +36 volt power source.
- Internal supply voltage regulation.
- Power management of the Cellular Transceiver and the GPS receiver.

Cellular Radio Section

A 0.6 watt cellular radio operating on receive from 869 to 894 MHz, and transmit from 825 to 849 MHz allows operation using the Analog specifications of IS-136.

The receiver is a dual conversion superheterodyne cicuit as described below. The transmitter consists of a direct modulation of a low frequency VCO, and the mixing of that signal with a higher frequency VCO to produce the signal on the desired frequency. A controlled output power amplifier amplifies the signal from the mixer output to a duplexer input. A detailed description of the transmitter is given below. The calibration and tune-up of the transceiver is described.

All call processing and control functions are performed by the software running on the ACE9050 CPU within the cellular section as described below.

The GPS receiver, modem, power management system, digital I/O and A/D converter are all controlled by a dedicated function control processor (FCP) that operates autonomously from the ACE9050.

The AssetLink has software operated by the FCP that controls the power management to allow operation of the circuitry for both vehicle operation and battery operated scenarios. A back-up battery is not part of the AssetLink, and an external power source is necessary to operate the AssetLink product.

Receiver

The receiver chain includes a duplexer, low noise amplifier, SAW filter, buffer amplifier, first mixer to the first I.F. A VCO at 45 MHz above the receive frequency is used for the other input to the first mixer. The first I.F. is filtered by a 4-pole band pass crystal, the output of which is amplified and mixed by a second mixer to the second I.F. within the SA606DK IC. A fixed frequency second signal at 450 KHz above the first I.F. coming from the ACE9030 is used as the other input to the second mixer. The second I.F. is further filtered and amplified by logarithmic amplifiers before being sent to a demodulation section. The signal strength of the incoming signal is detected by the logarithmic amplifier section.

The base band signal, which can be data or voice is demodulated by the ACE9030. The digital output is communicated by the ACE9030 to the ACE9050. The voice or audio output is filtered by the ACE9040 before being used by the modem or the optional headset output.

The operation of the ACE9020, ACE9030, ACE9040 and ACE9050 are given in their respective data sheets.

Transmitter

The transmit signal is processed in baseband by the ACE9040. The output of the ACE9040 modulates the 90 MHz VCO that is controlled by the ACE9020. The output of the 90 MHz VCO with the frequency modulation is mixed within the ACE9020 to be 90 MHz below the VCO. The VCO is described below. The mixer output is filtered, amplified, and variable gain amplified before the duplexer input.

The output of the duplexer is sampled by a level controlling I.C. AD8314, and the output of that I.C. controls the variable gain power amplifier MAX2235. The AD8314 input that controls the power output a filtered DAC output from the ACE9030.

The transmitter is controlled by the ACE9050, which monitors the presence of the RF and has the required hardware for detection of inadvertent transmissions. The power supply for the cellular section is further monitored by the FCP, and correct operation of the cellular transmitter is ensured through the monitoring by this independent hardware.

Cellular Processor

The AMPS (Advanced Mobile Phone System) as defined by the voice portion and the control channel specifications of IS-136 are controlled by the ACE9050, and are covered in detail in that IC's specification. This IC operates a dual tasking operating system that performs all the call processing functions and the test and configuration functions.

The ACE9050 operates from a 14.85 MHz crystal that is used for an initial frequency reference. The ACE9040 generates a 8 MHz clock from a VCO internal to that IC based on the 14.85 MHz signal. The 14.85 MHz signal is used by the ACE9020 to phase lock the 915 to 939 MHz VCO. The 14.85 MHz signal is also used to phase lock the 90 MHz VCO in the ACE9020, as well as produce the 44.55 MHz second Local Oscillator output from the ACE9030. The demodulation of the signals in the ACE9030 is done by a time delay comparison using the 14.85 MHz signal as a basis. The ACE9050 has software that allows the phase locking of the 14.85 MHz signal to a received cellular signal for minimal frequency offset.

Function Control Processor and Cellular

The Function Control Processor (FCP) is the GPS2e, which controls the power on/off for the cellular section, serial communications from the ACE9050, and monitors the status of the power supplies in the cellular section. This processor maintains a Real Time Clock (RTC) that controls the analog and digital I/O as well as external serial communications. The FCP is capable of removing all power to the cellular section, and will operate the GPS receiver without the cellular section being powered.

Grounding

The case of the AssetLink is to be connected to the chassis or metallic ground of the asset. The negative input from the power supply should be at chassis or ground potential. The antenna cable has a chassis grounded sheath, and the antenna if grounded must be maintained at the same potential as the AssetLink case.

Antenna

The antenna as specified for both GPS and Cellular in the Operation and Installation Instructions must be used. A professional installer must use equipment that is within the specifications, and mount the antenna per the Installation and Operating Instructions.

NJIAL200 FCC 47CFR section 2.1033 part b item 8:

The peripherial and accessory devices connected or installed on the NJIAL200 for testing.

These devices are unmodified, commercially available equipment.

NJIAL200 Accessories Used in Testing for FCC 47 CFR Compliance

Dec 28-01
R. Braathen

Refer to the test photographs in the test report in section 2.1033 part b (6) for actual placement of Accessories while in test.

Item 1: External 13 way connector:

Refer to the Installation and Operation Manual for information on the function of each pin on the 13 way connector.
All used pins on the 13 way connector are connected to unterminated, insulated, unshielded #22 gauge wires in testing.
Of these, 3 lines used for Serial Communications cable.

These are insulated, unshielded #22 gauge stranded copper wires approximately 0.3 meters long, used in testing for serial communications at 9600 baud. The connector is a DB-9 connector with the following pins connected:

- DB-9 Pin 2: Transmit Data connected to 13 way connector pin 9
- DB-9 Pin 3: Receive Data connected to 13 way connector pin 10
- DB-9 Pin 5: Signal Ground connected to 13 way connector pin 8

The other connections are made to insulated, unshielded, #22 gauge stranded copper wires approximately 1 meter long, connected on the 13 way connector to pins 1, 2, 3, 4, 5, 6, 7 and 13. These lines are spread on the test surface to allow testing for RF Spurious Radiation in a typical installation.
Pin 11 and 12 of the 13 way connector are not connected. Pin 11 is for factory use only. Pin 12 is used as a 5 volt reference, and is not normally connected.

Item 2: 2 Wire Power Supply:

Refer to the Installation and Operation Manual for information on the function of the power supply connections.
A typical installation will normally use a 2 way in-line plastic shroud connector. The testing used a direct connection to the CCA with the wires in the same location as the 2 way connector. These wires are insulated, unshielded, #22 gauge stranded copper wires approximately 0.3 meters long, connected on the CCA to pin 1 and pin 2 of the 2 way connector. The red wire connects to pin 1, and the black wire connects to pin 2.
These wires are connected to a power supply lead pair, supplied by unshielded red and black are insulated, unshielded, #22 gauge stranded copper wires that enter the chamber and come from a regulated power supply approximately 3 meters away.

Item 3: Monaural headset with microphone:

The connection of a commercially available, standard headset for audio communication is shown. This is connected within the AL200 by the “headset connection” (optional) as shown in the schematic. The headset connection is via a 2.5 mm headset jack that has:

- Tip: connection to a electret microphone with 3.3 Kohm to a 3 volt bias.
- Ring: connection to a 600 ohm headset with a D.C. blocking capacitor
- Ground: connection to chassis ground

The Headset used in testing was a Radio Shack (Tandy Corporation) stock number 43-1951 with the title “Hands-Free Headset”. It is advertised as “For cordless, cellular, PCS – any phone with a 2.5 mm headset jack”.

The connecting cables are not radio frequency shielded, and the connector to the headset is a standard 2.5 mm connector with no specific radio frequency characteristics or shielding capability. The headset cable is noted as being 4 foot long (1.2 meters). The connection into the EUT was via a 3.5 mm female test connector to allow input of electrical signals to test for modulation characteristics. An unshielded cable 6 inches long with a male 3.5 mm connector on one end, and a female 2.5 mm connector on the other end was used to allow connection of an industry standard headset. The “headset connection” will use a 2.5 mm female connector physically mounted onto the chassis, or a 3 wire connection exiting the chassis as on the EUT to a 2.5 mm female connector.

The cable was set on the test surface and spread out to allow testing for RF Spurious Radiation in a typical installation.

Item 4: Cellular and GPS Antenna.

Refer to the Installation and Operation Manual for information on specification of acceptable antennas to be connected to the AL200.

While the Cellular and GPS antennas may be dual-purpose such as the antenna used in testing, the use of single antennas for each purpose is acceptable. The testing using a dual-purpose antenna is the closest to the normal installation.

The GAP-2 antenna (refer to the advertising brochure attached separately) is a typical antenna used for this application. The JEMA antenna as noted in the NJILOCA01 FCC application is nearly identical in performance, and is an acceptable antenna also.

- The connection of the cellular antenna is by the TNC type connector.
- The connection of the GPS antenna is by the SMA type connector.

The cable used in testing was 3 meters long, and is within the length specified as being less than 15 feet (4.5 meters) in length by the Installation and Operation manual. This length is the most common length used in the typical installation of the AL200. The cable was set on the test surface and spread out to allow testing for RF Spurious Radiation in a typical installation.

The EUT AL200 was placed on an insulating surface, and the accessories were spread within a 1 meter radius from the EUT in a 180 degree direction from the connector side. The dual purpose antenna was placed away from the accessory cables, and supported to be away from any absorbing material for best radio frequency radiation measurement.

Preliminary

GAP-2

- Combination dual mode cellular and GPS antenna
- Affordable design well-suited for Systems Integrators
- Various packaging options available depending on customer requirements
- Wide input voltage range of 3.3 to 12 VDC (nominal 9 mA current consumption)
- Low profile design and compact footprint allows you to install the GAP-2 in a variety of ways, including covert installations

Cellular, PCS, and GPS Antenna

The CSI Wireless GAP-2 antenna provides tri-mode cellular, PCS, and GPS reception for OEM use. Primary applications for the GAP-2 include digital AVL systems and covert installations within vehicles. This is an internally mounted antenna.

The GAP-2 has a low profile, compact footprint, allowing it to be installed in various locations within an asset tracking system. Various packaging types are available, depending on customer requirements.

A broad input voltage range of 3.3 to 12 VDC provides versatility for systems integrators, with a low nominal current consumption of 9 mA.

Cellular / PCS

The GAP-2 provides reception of both the 824 to 900 MHz AMPS and 1850 to 1900 MHz PCS services. Antenna gain is 0 dBi, peak. Return loss is rated at less than -12 dB.

The cellular cable interface is 3 m in length, using RG-58 coaxial cable, terminated with a male TNC connector.

GPS

L1 GPS reception is provided with the use of an active ceramic micro-strip antenna incorporating a minimum 20 dB LNA gain.

To reduce the effect of out-of-band signal interference received via the GPS antenna, the GAP-2 provides greater than 40 dB attenuation at cellular frequencies is incorporated into its filtering.

The GPS cable interface is 3 m in length, using RG-174 coaxial cable, terminated with a male SMA connector.

Warranty

CSI Wireless is committed to our customers and our products, and offers a one-year warranty on parts and labor.

Contact CSI Wireless today to learn how the GAP-2 will provide you with an accurate, dependable positioning solution.

www.csi-wireless.com

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GAP-2

Preliminary

GPS Antenna Specifications

Frequency: GPS L1
Polarization: Right circular
Element Gain: >-5 dBic above 15° elevation, 5 dBic at zenith
LNA Gain: > 20 dB
Noise Figure: <2 dB
Cellular Rejection: > 40 dB (800 to 900 MHz)

Cellular / PCS Antenna Specifications

Frequency Bands: 824 to 890 MHz and 1700 to 1900 MHz
Peak Gain: 0 dBi (without cable loss)
Polarization: Linear
Return Loss: < -12 dB
VSWR: < 2:1 in band
Maximum Power: 3 W

Environmental

Storage Temperature: -50°C TO +90°C
Operating Temperature: -40°C to +85°C
Humidity: < 95% R.H. non-condensing, waterproof packaging available

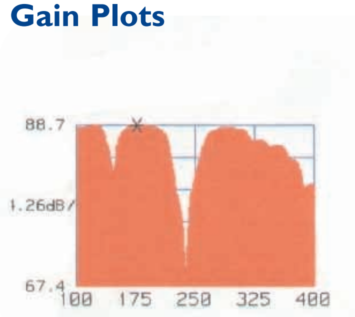
GPS Antenna Power

Input Voltage: 3.3 to 12 VDC
Current Consumption: 9 mA

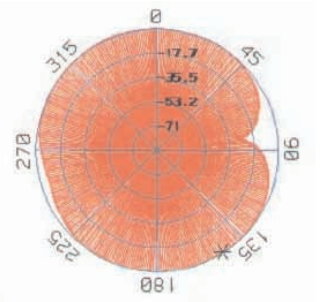
Mechanical

Enclosure: Various available
Dimensions: <110 mm L x <70 mm W x <28 mm H (<4.35" L x <2.75" W x <1.11" H)
Weight: <125 g (<4.4 oz)
Cables: 3 m standard, custom lengths available

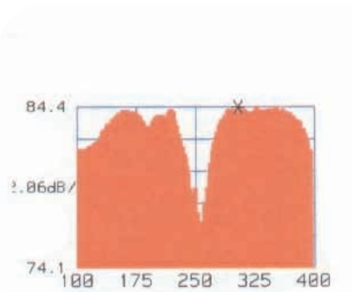
Gain Plots



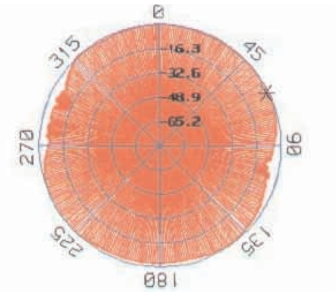
800 MHz Elevation



800 MHz Azimuth



1700 MHz Elevation



1700 MHz Azimuth

csi wireless™

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NJIAL200 FCC 47CFR section 2.1033 part c item 5:

Frequency range of NJIAL200.

NJIAL200
CSI Wireless Inc.

The cellular transmitter center frequency range of NJIAL200 is 869.040 MHz to 893.970 MHz.

The cellular receiver center frequency range of NJIAL200 is 824.040 MHz to 848.970 MHz.

The global positioning system (GPS) receiver center frequency range of NJIAL200 is for the “L1” band at 1575.4 MHz +/- 10 MHz.

NJIAL200 FCC 47CFR section 2.1033 part c item 6:

Range of operating power values or specific operating power levels, and description of any means provided for variation of operating power.

NJIAL200
R. Braathen
Dec 13, 2001

Range of operating power values.

The digital to analog output (DAC) output (DAC3) of the ACE9030 is input by a low pass filter to the control input on the AD8314. This variable voltage from 0 volts to 1.1 volts is used in the AD8314 to compare to the detected RF voltage coming from the Ant port of the duplexer.

The comparison of the control input and the detected RF voltage within the AD8314 causes the control output to go upward if the RF power is too low, and downward if the RF power is too high. The control output of the AD8314 goes from 0 to 1.2 volts, and is low pass filtered before input to the MAX2235 control input pin.

The control input to the MAX2235 final amplifier changes the gain of that amplifier over a 37 dB range. The use of the feedback loop with the AD8314 controls the output power to vary less than 0.5 dB over the temperature and frequency range.

The digital number for the DAC3 output of the ACE9030 is obtained by serial communication with the ACE9050 microprocessor. The ACE9050 uses values stored in EEPROM to select a power output level desired. These values are stored in the EEPROM during the Tune Up Procedure (see section 2.1033 part c (9) for details).

The level of the radio frequency power output is controlled to be either 28 dBm, 24 dBm, 20 dBm, 16 dBm, 12 dBm or 8 dBm nominal levels as selected by digital communication from a cellular base station.

NJIAL200 FCC 47CFR section 2.1033 part c item 7:

Maximum power rating as defined in the applicable part of the rules.

The applicable part of the FCC 47 CFR rules are in section 2.1046 part a.

The Installation and Operation instructions ensure that the equipment falls within the 22.913 part a limit of less than 7 watts ERP.

The Installation and Operation instructions ensure that the equipment falls within the 2.1091 part c limit of less than 1.5 watts ERP, for less than 1.5 GHz.

NJIAL200

R. Braathen
Dec 13, 2001

Maximum Power Rating.

The NJIAL200 is designed as a 0.6 watt cellular transceiver. The maximum output power is specified as 28.75 dBm over 869 MHz to 894 MHz. This is measured in accordance with 2.1046 part a.

The maximum output power, when combined with the maximum specified antenna gain of less than 3 dBd will produce an effective radiated power (ERP) of 31.75 dBm. Calculation is: 28.75 dBm + <3 dB = <31.75 dBm.

The NJIAL200 ERP with a maximum specified gain antenna is not more than the 1.5 watt (31.76 dBm ERP) requirement of section 2.1091 part c for devices operating under 1.5 GHz. This ensures the NJIAL200 is not subject to routine environmental evaluation as specified in section 2.1091.

NJIAL200 FCC 47CFR section 2.1033 part c item 8:

The dc voltages applied to and dc currents into the several elements of the final radio frequency amplifying device for normal operation over the power range.

NJIAL200 Description:
DC Voltages and Currents into the Final Amplifier

Dec 28-01
R. Braathen

Refer to the Schematic Diagram included for 47 CFR 2.1033 part b (5) for circuit details.

C(8) – DC voltages applied to and currents into the several elements of the final radio frequency amplifying device for normal operation over the power range.

The several elements of the final radio frequency amplifying device are the MAX2235, the DFY0836H0881F, the AD8314 and associated circuitry.

MAX2235 Final Amplifier

The MAX2235 is a variable gain radio frequency amplifier with a shut-down control input. The MAX2235 output power control range is over a 38 dB range. The shutdown mode causes the current to drop to less than 1 microampere from the 5 volt supply.

With the output power of the MAX2235 set to 28.75 dBm, the input current is near 600 ma from the 5 volt regulated supply. The shutdown input pin must be under 0.5 volts for the amplifier to operate.

With the shutdown input pin at over 2 volts, the input current is less than 1 microampere from the 5 volt regulated supply.

When there is no radio frequency input to the MAX2235, it is rated to draw less than 20 milliamps from the 5 volt regulated supply.

The voltage on the gain control input pin is from 0.6 volts for minimum gain, to 2.5 volts for maximum gain. The maximum gain is 26 dB, and the minimum gain is –12 dB.

DFY0836J0881F Duplexer

The DFY0836J0881F Duplexer is rated for a maximum loss from transmit (Tx) port to antenna (Ant) port of 3.0 dB from 824 to 849 MHz with a specified maximum input to the Tx port of 3 watts (34.7 dBm).

There is no power supply necessary for the duplexer, it is a passive coupled resonant cavity device.

AD8314 RF Detector/Controller

The AD8314 is a complete subsystem for the measurement and control of RF signals that include the cellular mobile transmit frequencies.

The AD8314 operates from a 4 volt supply, and draws nominally 4 milliamperes from the 4.0 volt regulated supply.

The radio frequency input to the AD8314 is a sampled RF voltage using a 1.5 Kohm resistor in series with 51 ohms from the Ant port of the duplexer.

The attenuation of the AD8314 RF input from the Ant port of the duplexer to the AD8314 input is 30 dB. The RF input maximum for the AD8314 is 0 dBm, and with a 28.75 dBm output at the Ant port the level at the RF input is –1.25 dBm.

The control input to the AD8314 from an analog to digital converter is low pass filtered to less than 3 KHz. The input impedance of the control input is 10 Kohms, with a maximum control input voltage of 1.1 volts.

The output of the detected RF is from 0 to 1.2 volts from a current limited output for less than 2 milliamperes.

The control output voltage for the input control to the MAX2235 is from 0.1 to 2.5 volts for less than 6 millamperes load current.

External supply input to the 5 volt supply

The regulated 5 volt power supply is a switch-mode type, with a nearly constant efficiency of 90% over the input voltage range of 8 volts to 32 volts. Above 32 volts input the efficiency drops to 80% at 36 volts. Below 8 volts input the efficiency drops to 80% at 6 volts. Below 6 volts the power supply has an automatic shutdown mode. Within the range 6 to 36 volts the power supply ripple is low enough to maintain carrier sidebands of less than –50 dBc. Full output power continuous operation is possible over 8 to 36 volts. Operation over 36 volts and up to 50 volts at maximum output power is possible without damage, but is not specified. Over 50 volts the input protection circuitry may remove power from the AL200.

The power supply current from the 5 volt supply to the MAX2235 varies from 600 ma at 28.75 dBm output to 100 ma at 8 dBm output.

NJIAL200 FCC 47CFR section 2.1033 part c item 10:

A schematic diagram and description of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power.

NJIAL200 Description of Circuitry in Cellular Transmitter

Dec 28-01
R. Braathen

Refer to the Schematic Diagram included for 47 CFR 2.1033 part b (5) for circuit details.

C(10) part a -- stabilizing frequency:
The AL200 uses a temperature compensated reference crystal oscillator for initial cellular frequency determination. The crystal oscillator operates at 14.85 MHz over the full temperature range of the AL200.

The microprocessor ACE9050 communicates with the I/O section ACE9030 via a serial interface. The ACE9030 has an analog input that indicates the ambient temperature. This ambient temperature is obtained by an NTC-10K thermistor in series with a reference supply. The reference supply is DOUT8, which is supplied with power from the 4V_SYN supply, a 4.0 volt linear regulated power supply. The ACE9030 communicates the ambient temperature digitization to the ACE9050 by the serial communications.

The ACE9050 uses a look-up table to determine the corrective voltage to be applied to a crystal oscillator over the temperature range. The ACE9050 also uses an EEPROM stored value selected in calibration to adjust the center frequency of the crystal.

The serial communication from the ACE9050 to the ACE9030 sets the value of two Digital to Analog (DAC) converters within the ACE9030. DAC1 is the output from the ACE9030 that gives the center frequency calibration value, which is determined in unit calibration. DAC2 is the output from the ACE9030 that gives a correction value that is determined by the ambient temperature digitization.

DAC1 and DAC2 adjust the voltage on two varactors (variable capacitance diodes, with reverse voltage determining the capacitance). These varactors operate to maintain the center frequency of the AT cut crystal within 2 parts per million over the temperature range.

The center frequency is further adjusted by reception of a base station signal inthe ACE9030. The base station frequency is used to adjust the crystal oscillator center frequency. Before the cellular transmitter is allowed to transmit, the offset frequency of the received cellular base stationl transmission is adjusted to a minimum by adjustment of the crystal oscillator’s center frequency. This automatic frequency control (AFC) then provides the AL200 with a reference that is as accurate as the cellular base station frequency standard.

C(10) part b -- suppression of spurious radiation:

The AL200 has a metal outside case, and all connections going in and out of the AL200 are filtered to remove interference above the limit for a class 15 device.

The transmitter section of the AL200 uses a 846 to 894 MHz surface acoustic wave (SAW) filter before the transmitting amplifier section to remove any spurious signals before input to the amplifiers. The output of the amplifier section is matched through a matching network to 50 ohms impedance.

The 50 ohms impedance of the amplifier output is connected through a duplexing filter that has a bandpass of 846 to 894 MHz for that port to the output 50 ohm TNC Connector. The TNC connector is connected via a 50 ohm transmission line to the output of the duplexing filter.

The TNC connector outside shell is connected to the CCA ground with a soldered connection, and further connected to the chassis by two mounting screws.

The GPS input via a 50 ohm SMA connector is connected via a low noise amplifier to a SAW filter for 1570 +/- 50 MHz. The SAW filter output is input to a digital section that receives the Global Positioning Satellites (GPS) signals for location determination.

The SMA connector outside shell is connected to the CCA ground with a soldered connection.

The power supply, 13 pin connector and headset connections are filtered to remove interference above the limit for a class 15 device.

The CCA is grounded to the metal chassis top by 3 metal screws. The mounting of the CCA into the case will cause interference connections of the CCA to the metal case top and bottom.

The metal case bottom of the AL200 has integral shields that separate the cellular section from the other sections of the unit on that side of the CCA.

The metal case of the AL200 has an interference fit for the edge of the top section to the edge of the bottom section. Tightening the central screw will both seal the central screw hole and cause the metal to metal contact of the top to bottom case.

C(10) part c -- limiting modulation:

The ACE9040 processes all of the signals that are used to modulate the frequency modulated (FM) carrier for the cellular section.

The levels within the ACE9040 are adjusted by a serial communications to the ACE9050. The ACE9050 uses values stored in EEPROM during calibration for communication to the ACE9040. The Tune Up Procedure for the AL200, under the submission for 2.1033 part c (9) has the details for the determination of the correct values stored the EEPROM.

The Digital Data is Manchester Encoded (see the submission for 2.1033 part c (13) for a complete description), and is transmitted at +/- 8.0 KHz +/- 0.8 KHz as a frequency modulation on the RF carrier.

The signaling tone (ST-- see the submission for 2.1033 part c (13) for a complete description), and is transmitted at +/- 8.0 KHz +/- 0.8 KHz as a frequency modulation on the RF carrier.

The supervisory audio tone (SAT-- see the submission for 2.1033 part c (13) for a complete description), and is transmitted at +/- 2.0 KHz +/- 0.2 KHz as a frequency modulation on the RF carrier.

The audio modulation can be sourced from either a microphone input or an internal voice grade modem. The audio is transmitted from the microphone input with amplification, band-pass filtering, compression, pre-emphasis, limiting, post limiting filtering at a maximum of less than +/- 12 KHz deviation +/- 1.2 KHz. . The modem tones are transmitted from the modem input with amplification, compression, pre-emphasis, limiting, post limiting filtering at a maximum of less than +/- 12 KHz deviation +/- 1.2 KHz. The limiting action is such that a minimum of 8.0 KHz deviation with less than 5% distortion can be obtained.

For a complete description of the internal operation of the ACE9040, see submission 2.1033 part b (5) which contains the manufacturer's description of the operation of that device.

C(10) part d -- limiting power:

The radio frequency (RF) output level is determined by a feedback control loop that measures the voltage of the output signal level at the antenna port, and reduces the output level according to the input level from a digital to analog converter (DAC).

The voltage applied from the DAC (which is DAC3 on the ACE9030) is compared to a voltage proportional to the RF detected by an application specific integrated circuit AD8314. For a complete description of the internal operation of the AD8314, see submission 2.1033 part b (5) which contains the manufacturer's description of the operation of that device.

The voltage control output of the AD8314 is applied to the gain control input of the variable gain amplifier MAX2235. The MAX 2235 gain varies with the voltage applied to it's gain control pin. For a complete description of the internal operation of the MAX2235, see submission 2.1033 part b (5) which contains the manufacturer's description of the operation of that device.

The power supply for the amplifier MAX2235 is described in submission 2.1033 part b (8), this is a current limited and voltage regulated power supply.

The operation of the circuitry in the output power feedback control loop will cause the output power available at the antenna terminal to be limited to the value set during calibration.

The output power of the cellular radio is specified by the celluar industry as being 0.6 watts (28 dBm +2 dB, -4 dB) output, with 4 dB steps downward to 8 dBm output. The level of the cellular radio's output is selected by the cellular base station, and communicated by cellular signals digitally to the AL200.

Calibration of the AL200 will set the maximum power output to be 28.75 dBm (0.75 watts).

NJIAL200 FCC 47CFR section 2.1033 part c item 13:

For equipment employing digital modulation techniques, a detailed description of the modulation system to be used, including the response characteristics (frequency, phase, amplitude) of any filters provided, and a description of the modulating wavetrain, for the maximum rated conditions under which the equipment will be operated.

NJIAL200 Description of Digital Modulation Used on Cellular Systems for IS-19 to IS-136

Dec 30, 2001
R. Braathen

The following is a description based on TIA/EIA/IS-136 and specifically the legacy modulation for cellular signaling and control from the original Bell Advanced Mobile Phone Specification (AMPS) system that was introduced to the public domain in the TIA/EIA/IS-19. This signaling and control is used for both the “Digital Cellular” and the “Analog Cellular” portion of the TIA-EIA/IS-136 system.

This modulation is known as Manchester-encoded non-return to zero (NRZ) Modulation, and is described in textbooks on digital communication. This is accomplished by transforming each NRZ binary one to a zero to one transition and each NRZ binary zero to a one to zero transition.

The Manchester modulation is defined as “wideband data” in IS-137. It is used to modulate the transmitter carrier using direct binary frequency shift keying (FSK). A one (i.e. high state) into the modulator shall correspond to a peak frequency deviation of 8 KHz above the carrier frequency, and zero (i.e. low state) into the modulator shall correspond to a peak frequency deviation of 8 KHz below the carrier frequency.

The requirement in IS-136 is for +/- 8 KHz peak deviation +/- 10% tolerance. The center frequency of the carrier is measured with no modulation, and averaged as necessary.

Wideband data is used on the paging and access channels and is used on the voice channels for vertical services and for handoff and other mobile station control functions. All other modulation sources to the transmitter are inhibited when wideband data is being transmitted at the 10 kilobit/second rate.

While the IS-136 is silent on the requirements for the filtering for the digital signals, the adjacent and alternate channel power due to modulation is defined:

- Using a bandwidth of 300 Hz the power on any frequency removed from the carrier by greater than 20 KHz and up to 45 KHz shall be 26 dB below the level of the unmodulated carrier.
- Using a bandwidth of 300 Hz the power on any frequency removed from the carrier by greater than 45 KHz and up to 60 KHz shall be 45dB below the level of the unmodulated carrier.
- Using a bandwidth of 300 Hz the power on any frequency removed from the carrier by greater than 60 KHz and up to 90 KHz shall be 65dB below the level of the unmodulated carrier.

- Using a bandwidth of 300 Hz the power on any frequency removed from the carrier by greater than 90 KHz and up to the first multiple of the carrier frequency shall be 63 + 10[$\log_{10}$(mean power in Watts)]dB below the level of the unmodulated carrier.
- As well, in a 30 KHz band centered anywhere between 869 and 894 MHz the mean power of emissions from the transmitter with modulated carrier shall not exceed –80 dBm.

The original AMPS specification noted that these requirements could be achieved with a Bessel type filter on a digital wavetrain. The filtering of the wideband signal is not specified in IS-136 as there are multiple ways of achieving the spectrum occupancy and the zero crossing accuracy requirements for obtaining the required bit error rates.

The base station's requirement of BER on reception is used as a basis for the zero crossing requirements of the mobile transmitter. Use of a Bessel filter as defined by the AMPS specification will give a "jitter" of less than 10% on the mid-bit and bit transitions.

The accuracy of the digital clock signal for the 10 Kbits/second is +/- 1 Hz.

The signaling tone (ST) is a special case of the broadband data, and is characterized by having no transitions at the transition time. This allows the clock recovery to synchronize with the bit transitions and not the mid-bit transitions that carry the information in the Manchester encoding scheme. The ST is a 10 KHz wavetrain and is generated by the bit stream 101010…. .

For a more detailed explanation of the Manchester encoding scheme along with the filtering requirements and BER versus noise refer to the AMPS specification.

NJIAL200 with reference to
22.921 "911 Call Processing"

R. Braathen
January 25, 2002

The NJIAL200 does not have a handset, or any device that is capable of communicating such that a phone call can be initiated, or any programming overridden by the user in a normal installation. The headset that is used on the NJIAL200 is a microphone and an earpiece, it is not a handset. There is no provision for dialing a cellular number by the user within the NJIAL200. While the NJIAL200 is a mobile phone and operates in the analog mode, there is no operator input to initiate a call in normal usage. Refer to the Exhibit 9 User's Manual for verification.