RADIO TRANSCEIVER MANUAL

FOR INTERNAL USE ONLY

POLAR REMOTE CONTROLS
DIVISION OF ATLAS POLAR COMPANY LTD.
60 NORTHLINE RD.
TORONTO ONTARIO M4B 3E5

PART NUMBER   600-682-01
REV. #0
APRIL 2012

TABLE OF CONTENTS

SECTION ONE

INTRODUCTION

Please note:

This manual will only discuss the conditions governing regulations,
not the overall system. To understand the complete unit package, installation, operation
and maintenance, ALL equipment manuals should be read thoroughly.

POLAR RADIO REMOTE SYSTEM

This device complies with Part 15 of FCC & RSS-Gen of IC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Le present appareil est conforme aux CNR d'Industrie Canada applicable aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

CAUTION : Changes or modifications not expressly approved by Atlas polar Company Ltd., could void the users authority to operate this equipment.

NOTE: This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
-Reorient or relocate the receiving antenna.
-Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or manufacturer for further assistance.

RSS-Gen Notices for Transmitter Antenna

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its

gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter (IC: 6272A-60068201) has been approved by Industry Canada to operate with the antenna types listed in this document with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this document, having a gain greater than the maximum gain indicted for that type, are strictly prohibited for use with this device.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'une type et d'un gain maximal (ou inferieur) approuvé pour l'émetteur par Industire Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance istrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio (IC: 6272A-6006820) a été approuvé par Industrie Canada pur fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

SECTION TWO

TECHNICAL DATA

ATLAS POLAR COMPANY LIMITED

POLAR 9900R **TECHNICAL DATA**

SYSTEM

Frequency: 902-924 MHz Frequency Hopping Spread Spectrum

Operating Temperature   -25®C to +50®C

Transmission Range   122 m or 400 feet

Data Transmission   11 bytes including Identity and CRC error values

Addressing   Programmable. 65,500 unique addresses

Approved by   Pending

Operating Licensing   Not required

SECTION THREE

OPERATION THEORY

OPERATION THEORY

The Polar Radio Remote Control System consists of a wireless transceiver that is connected to the Polar actuator (purchased separately). All communicated information between the transceiver is in a digital format and works on the 900 MHz frequency.

FREQUENCY HOPPING DESCRIPTION

The transceiver use 50 equally spaced frequencies (902 TO 928 MHz). The transceiver has a stored unique random stepping sequence throughout the 50 channels. The random stepping sequence will utilize all 50 channels, and continue to repeat the same sequence during its communication.   The transmitter and receiver portion of the transceiver have identical bandwidth for the channel. The hopping system doesn't use any intelligence or coordinate with any other FHSS system operating in vicinity in any way and its algorithm doesn't change its hopping sequence to avoid any collision, hence the system complies with the non-coordination requirement stated by FCC & IC.

The transceiver communicates on a frequency hopping, spread spectrum algorithm. The hopping sequence is unique for each transceiver and therefore the communication link is immune to interference from other radios. There is a setup procedure that is required to establish the hopping sequence between the transceiver. This allows the ability of swapping transmitters, receivers, or programming multiple transmitters for use with one receiver.   Once the communication link between one transceiver is established, another tuned transmitter cannot interfere unless the first link (other transmitter) is disconnected.

The receiver has a safety algorithm to protect against undesirable interference. The safety algorithm not only brings all functions to a neutral state but also closes the safety dump valve, ensuring no unwanted movement of the crane.

The receiver must be powered up before the transmitter. When the transmitter is powered, there will be a 1 second delay before communication. This is to allow transceiver to synchronization.

When the communication task is completed, the transmitter should be turned off with the
E-stop engaged to preserve battery power. If the communication has been stopped due to pressing of an E-Stop, powering down, or loss of range, the communication may be resumed by cycling the E-stop.

FCC ID: WB4-60068201
IC: 6272A-60068201
MODEL: 60068201
ATLAS POLAR COMPANY

Rev 5

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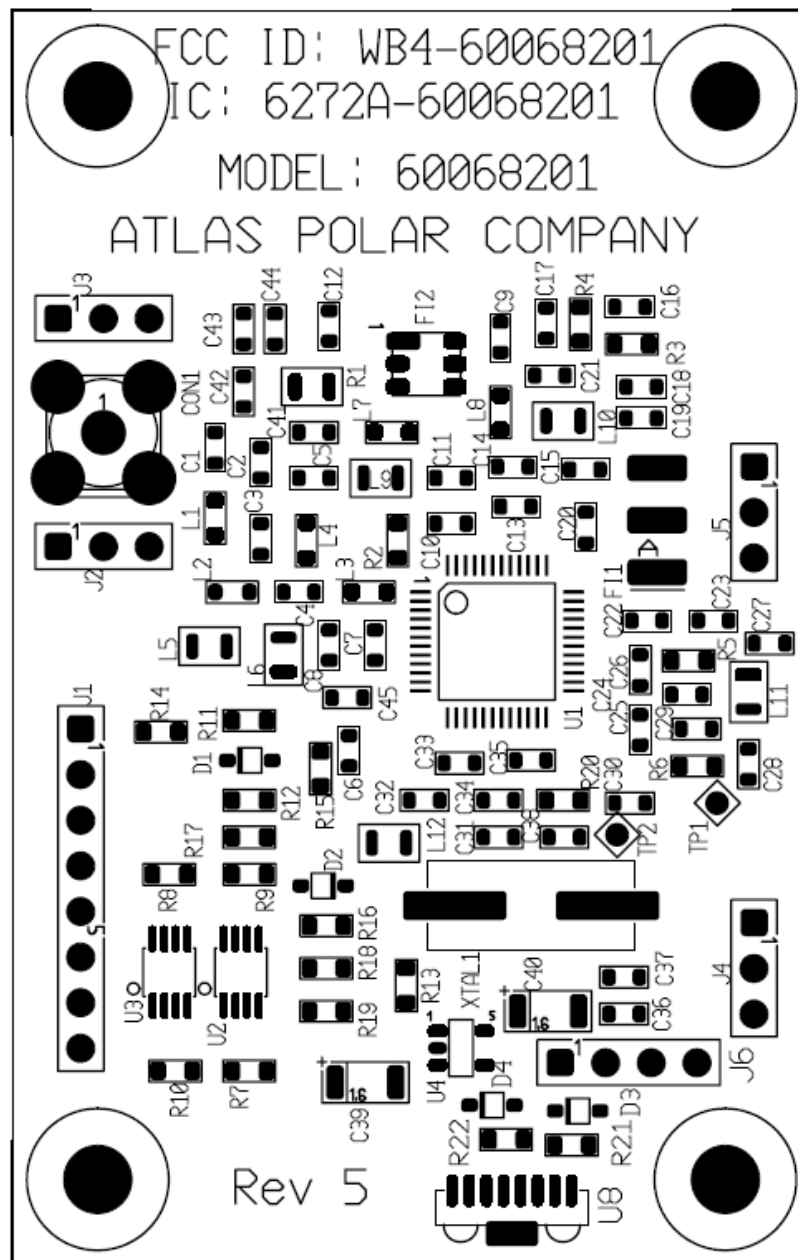
SECTION FOUR

ELECTRICAL INTERFACE

ELECTRICAL INTERFACE

1.   Connectors:

Connector J1	Pin description
Pin 1	Serial Instruction Enable
Pin 2	Serial Instruction Clock
Pin 3	Data Rx
Pin 4	Data Tx
Pin 5	Read/Write Data Message
Pin 6	Read/Write Serial Instruction
Pin 7	Serial Instruction Data
Pin 8	Supply Voltage

Connector J2	Pin description
Pin 1	Ground
Pin 2	Ground
Pin 3	Ground

Connector J3	Pin description
Pin 1	Ground
Pin 2	Ground
Pin 3	Ground

Connector J4	Pin description
Pin 1	Ground
Pin 2	Ground
Pin 3	Ground

Connector J5	Pin description
Pin 1	Ground
Pin 2	Ground
Pin 3	Ground

Connector J6	Pin description
Pin 1	IR Transmit
Pin 2	IR Receive
Pin 3	Not used
Pin 3	IR Shut down

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2. DC Characteristics:

Parameter	Min	Typ	Max	Unit	Comment
Supply Voltage	3.5	5	6.5	Volts	
Voltage to any Serial Instruction line	3.5	5	6.5	Volts	Should not exceed supply voltage
Data Tx voltage	3.5	5	6.5	Volts	Should not exceed supply voltage
Data Rx voltage					Vcc
Tx/Rx data rate	9.6k	19.2k	20k	Bits/second	

3. Carrier Frequency, Frequency deviation and hopping sequence Selection:

The register values for the carrier frequency, of the receiver, high and low deviation carrier frequency for transmitter registers and hopping patterns are found in the arrays contained in the files "RF_Tables.C". These tables must be included in the mother board operating code to load the values into the RF module. Below is a list of the function calls and a brief description of the function and variables that are required.

Function call	Description
void Next_channel(void)	Loads a hopping channel index from the random table
void Take_Reg_TX(int NbChannel)	Loads the transmitter register frequency values (carrier plus deviation and carrier minus deviation) with the hopping channel value
void Take_Reg_RX(int NbChannel)	Loads the receiver register frequency values with the receiver hopping channel value.

The communication of the register values to the RF module must comply with the timing as indicated in the AT86RF211S data sheet.
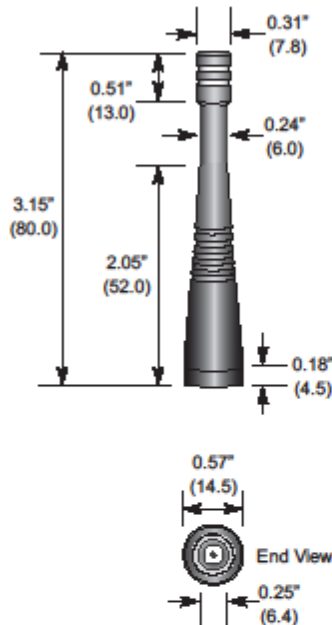
Once these registers are loaded with the parameter values, the Data Tx and/or Data Rx can be read or written directly as a data stream to the Data Tx, Data Rx pins. The mother board must supply the data buffering.

The serial number entered into the ROM memory of the mother board provides an index to the random table so there will be a hopping pattern uniqueness to the transmitter/receiver pair if they contain the same serial number. The serial number also must become part of the packet for data identification. The data packet must also include a CRC value for data verification.

4. Antenna:

The only antennas that are permitted for use with the 600-682-01 RF module are the Antenna Factor ANT-916-CW-QW, Antenna Factor ANT-916-CW-RCL, and a 3.0" solid wire.

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ANT-916-CW-QW DATA SHEET

Product Dimensions

0.31" (7.8)

0.51" (13.0)

0.24" (6.0)

3.15" (80.0)

2.05" (52.0)

0.18" (4.5)

0.57" (14.5)

End View

0.25" (6.4)

Description

CW Series 1/4-wave antennas deliver outstanding performance in a rugged and cosmetically attractive package. These antennas are available with standard SMA or FCC Part 15 compliant RP-SMA connectors. RP-SMA connectors allow for easy field replacement while complying with FCC requirements. A wide variety of matching connectors permit numerous mounting options.

Features

- Low cost
- Excellent performance
- Omni-directional pattern
- Wide bandwidth
- Very low VSWR
- Fully weatherized
- Flexible main shaft
- Rugged & damage-resistant
- SMA or Part 15 compliant RP-SMA connector
- Use with plastic* or metal enclosures
  * Requires proximity ground plane
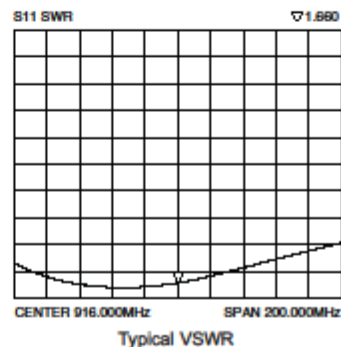
Electrical Specifications

- Center Freq.   916MHz
- Recommended Freq. Range   865-965MHz
- Wavelength   1/4-wave
- VSWR   <1.9 typ. at center
- Impedance   50 ohms
- Connector   SMA or RP-SMA

Electrical specifications and plots measured on 4.00" x 4.00" reference ground plane

Ordering Information

- ANT-916-CW-QW   (with RP-SMA connector)
- ANT-916-CW-QW-SMA (with SMA connector)

VSWR Graph

S11 SWR   ▽1.660

CENTER 916.000MHz   SPAN 200.000MHz

Typical VSWR

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Summary	Multiple Frequency	Multiple Cut	3D-View	Reserved

No.	Freq.	PwrSum Eff.[%]	Avg.[dBi]	Peak[dBi]	θ[deg]	φ[deg]	H(θ=90) Avg.[dBi]	Peak[dBi]	φ[deg]	BW[deg]	E1(φ=0) Avg.[dBi]	Peak[dBi]	θ[deg]	BW[deg]	E2(φ=90) Avg.[dBi]	Peak[dBi]	θ[deg]	BW[deg]
1	866.000	73.66	-1.33	1.59	90.00	185.00	-1.58	1.59	185.00	90.12	0.52	1.51	-90.00	999.00	-2.86	0.55	-130.00	999.00
2	886.000	73.18	-1.36	1.78	30.00	20.00	-1.48	1.38	195.00	90.65	0.55	1.43	-135.00	999.00	-3.08	0.10	-130.00	999.00
3	906.000	73.17	-1.36	1.98	30.00	10.00	-1.58	1.23	190.00	91.88	0.59	1.95	30.00	999.00	-3.22	0.02	-130.00	999.00
4	916.000	72.45	-1.40	1.84	30.00	0.00	-1.68	1.24	190.00	91.66	0.54	1.84	30.00	999.00	-3.26	0.13	130.00	999.00
5	936.000	85.58	-0.68	2.35	30.00	355.00	-1.01	2.05	190.00	91.51	1.22	2.34	30.00	999.00	-2.45	1.21	130.00	999.00
6	956.000	84.58	-0.73	2.25	135.00	195.00	-1.07	2.09	190.00	89.85	1.12	2.07	45.00	999.00	-2.43	1.27	130.00	999.00
7	966.000	94.56	-0.24	2.72	135.00	200.00	-0.57	2.61	195.00	89.60	1.60	2.46	-90.00	999.00	-2.00	1.73	130.00	999.00

H-Cut (θ=90)

E1-Cut (φ=0)

E2-Cut (φ=90)
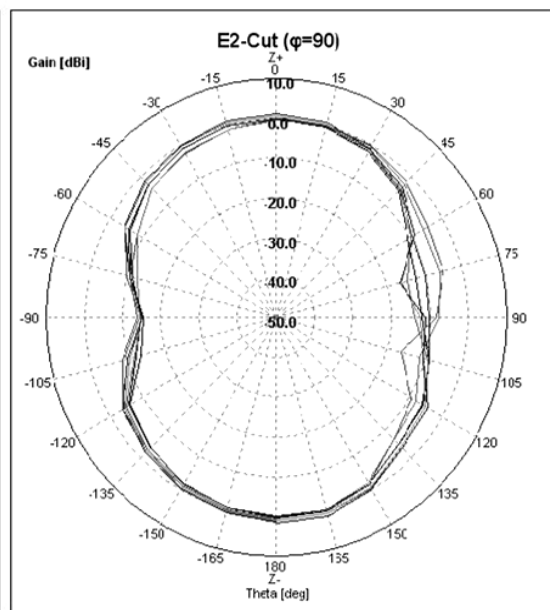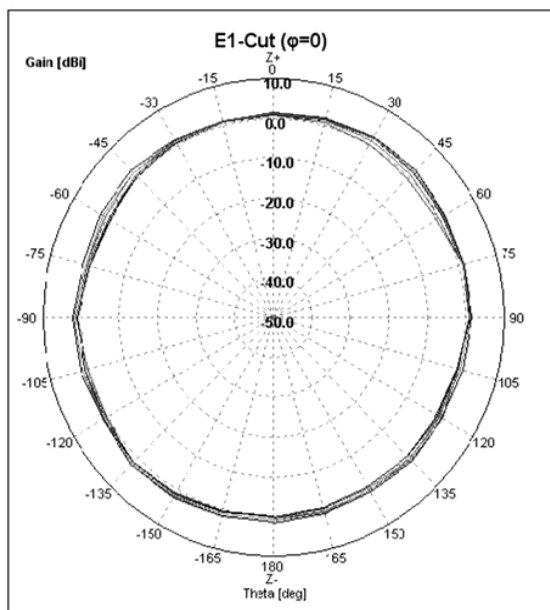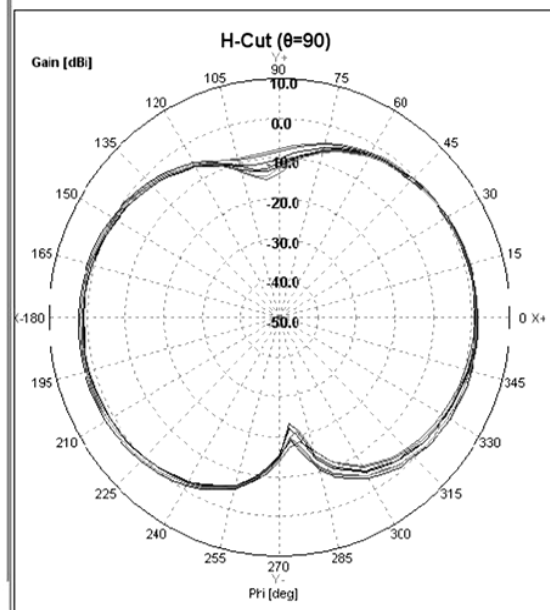
5. Chamber

WIRELESS COMMUNICATIONS TEST SET

VECTOR NETWORK ANALYZER

SYSTEM CONTROLLER & LCD MONITOR

GPIB Inter-Connection
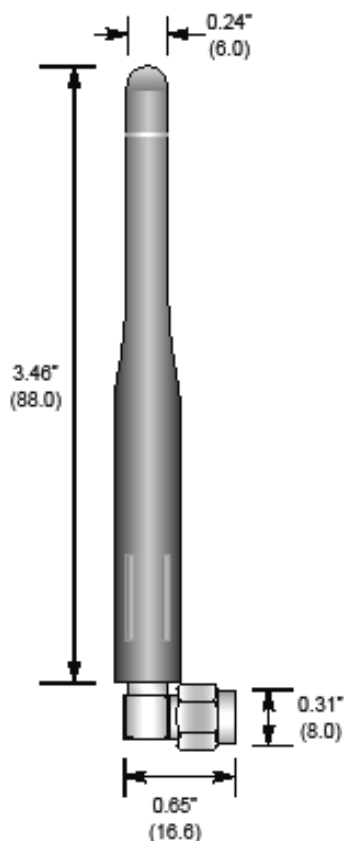
RF(TX)
RF(RX)

Polarization control with RF Switch

Fiber Optic Convert & Cable
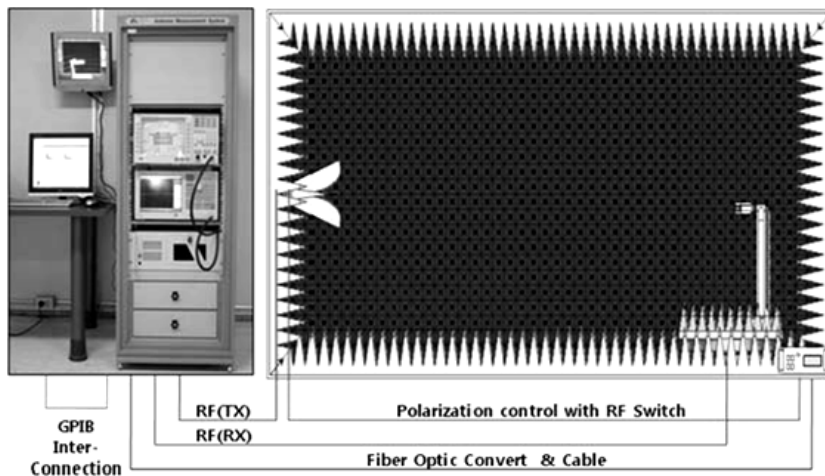
Chamber - MTG 6x3x3(m), 300MHz~6GHz
Active - Agilent E5515C (8960 Series 10)
Passive - Agilent E5071B 300KHz~8.5GHz

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RADIO TRANSCEIVER MANUAL
SECTION 4

Product Dimensions

0.24"
(6.0)

3.46"
(88.0)

0.31"
(8.0)

0.65"
(16.6)
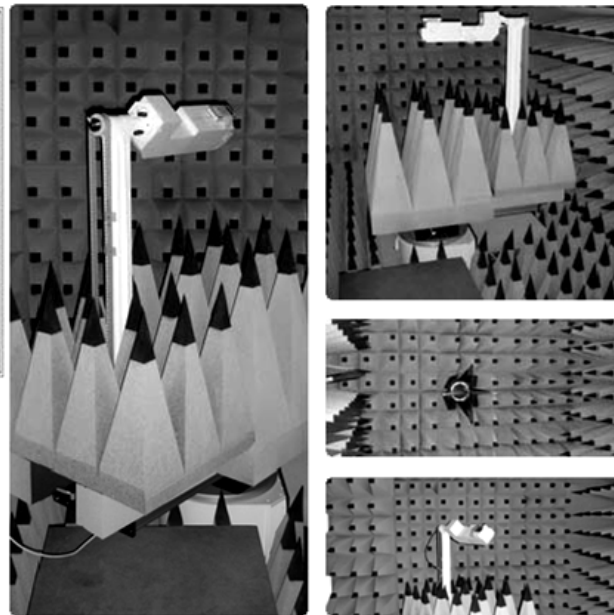
Description

The RCL Series is useful in products where additional height above the product's case is needed or a slightly wider operational bandwidth is desired. The 916MHz version has a 1/4-wave element. The antennas attach via a Part 15 compliant RP-SMA connector.

Features

- Right-angle mount
- Reduced-height whip
- Excellent performance
- Omni-directional pattern
- Fully weatherized
- Rugged & damage-resistant
- Part 15 compliant RP-SMA connector

Electrical Specifications
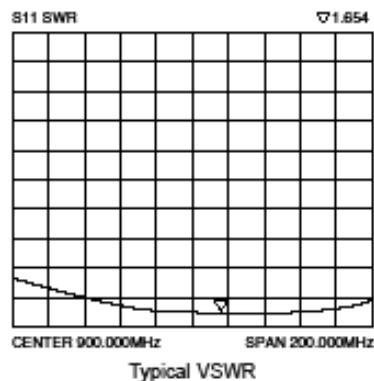
- Center Freq.   916MHz
- Bandwidth   150MHz
- Wavelength   1/4-wave
- VSWR   <1.7 typ. at center
- Impedance   50 ohms
- Connector   RP-SMA

Electrical specifications and plots measured on 4.00" x 4.00" reference ground plane

Ordering Information

- ANT-916-CW-RCL

VSWR Graph

S11 SWR   ▽1.654

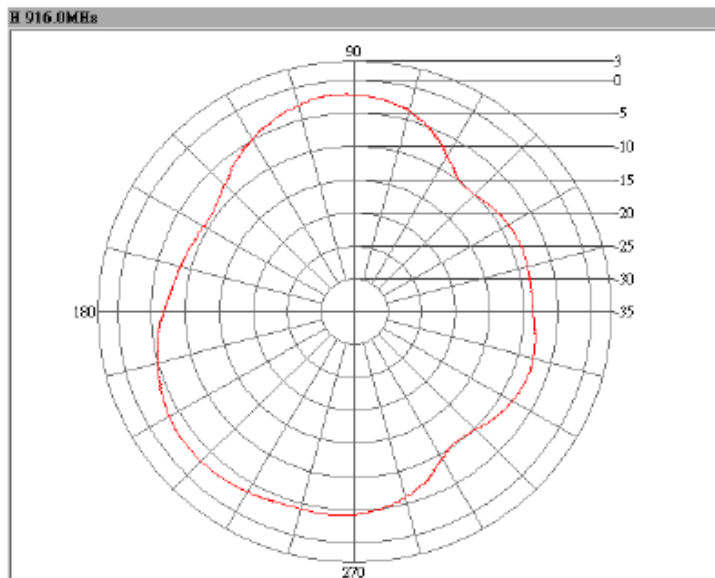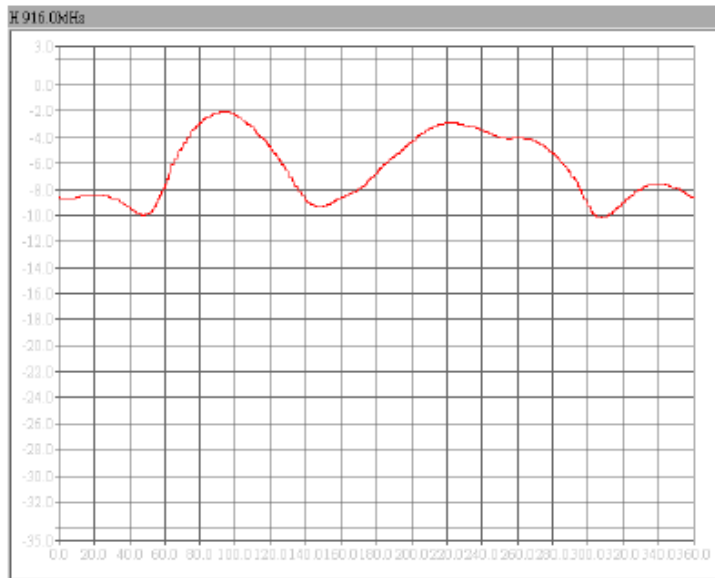CENTER 900.000MHz   SPAN 200.000MHz

Typical VSWR

ANT-916-CW-RCL 2D Pattern @916.0MHz

Note: 2.5-3 dBi cable loss uncompensated for in plot

Date / Time : ☐2011221 / 14:26☐
Software Version : ☐V1.2☐
Measurement Distance : ☐9M*4M*4M(3.6M)☐
Project Number : ☐☐
Operator Name : ☐jackie☐
Model Name : ☐ANT-916-CW-RCL☐
Serial Number : ☐☐
Temperature : ☐20☐
Humidity : ☐55☐
NETWORK☐Agilent 50MHz-20GHz 8720ET☐
Stand Data:☐SCHWARZBECK 9108A1☐

|	H
Max Gain (dBi)	-2.03
Max Gain@Angle (degree)	93
Min Gain (dBi)	-10.18
Min Gain@Angle (degree)	309
Average Gain (dBi)	-5.62
-3dB Angle L (degree)	121
-3db Angle R (degree)	68.43
HPB (degree)	52.57
FBR (dB)	2.05

H 916.0MHz

H 916.0MHz

ANT-916-CW-RCL 2D Pattern @916.0MHz

Note: 2.5-3 dBi cable loss uncompensated for in plot

Date / Time : 〔2011221 / 13:59〕
Software Version : 〔V1.2〕
Measurement Distance : 〔9M*4M*4M(3.6M)〕
Project Number : 〔〕
Operator Name : 〔jackie〕
Model Name : 〔ANT-916-CW-RCL〕
Serial Number : 〔〕
Temperature : 〔20〕
Humidity : 〔55〕
NETWORK〔Agilent 50MHz-20GHz 8720ET〕
Stand Data:〔SCHWARZBECK 9108A1〕

	E1
Max Gain (dBi)	-3.9
Max Gain@Angle (degree)	150
Min Gain (dBi)	-29.23
Min Gain@Angle (degree)	269
Average Gain (dBi)	-8.65
-3dB Angle L (degree)	176.8
-3db Angle R (degree)	129.23
HPB (degree)	47.57
FBR (dB)	2.18

E1 916.0MHz

E1 916.0MHz
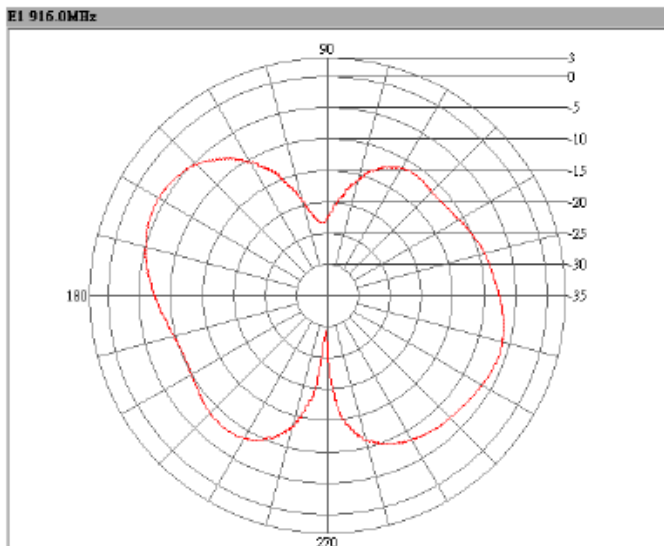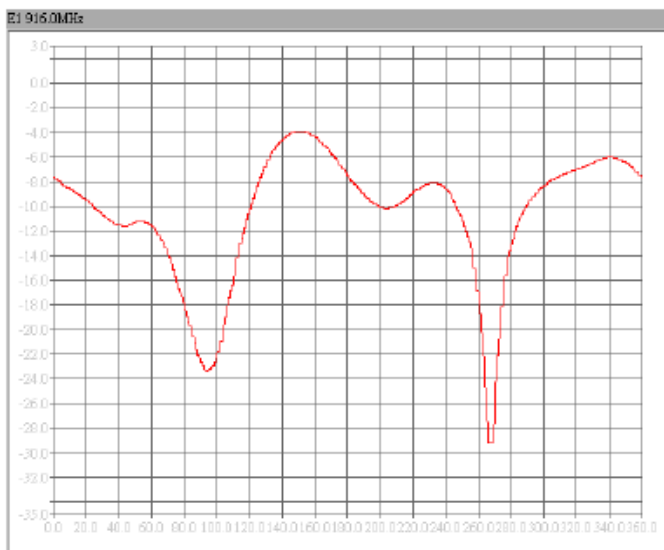
5. Required Host System Labeling

FCC ID and Industry Canada ID on Host System
The integrator must affix the module's FCC ID and Industry Canada ID on the product, if the part number 600-682-01 is installed inside the host system and its FCC ID and Industry Canada ID may not be visible, then the FCC ID and Industry Canada ID label must appear on the outside of the host system visible to the user.

Example text to appear somewhere on the outside of the host system visible to the end user:

Contains "FCC ID: WB4-60068201" & :IC: "6272A-60068201"

OR

Contains Transmitter Module, FCC ID: WB4-60068201 IC: 6272A-60068201

6. To access the RF module remove all screws on the enclosure and separate/open   enclosure.

7. Module currently used in the following Atlas Polar Products :

MODEL PB926-T
MODEL PB926-R
 MODEL HV900-60H
 MODEL HV900-60S