

Response to Questions from the International Bureau

On April 16, 2013, Iridium Satellite LLC and Iridium Carrier Services LLC (collectively, “Iridium”) filed applications to modify their Mobile Earth Station authorizations in the 1618.725 to 1626.500 MHz Mobile Satellite Service band to add transmit and receive Aeronautical Mobile Satellite (Route) Service (“AMS(R)S”) authority.¹ In a letter dated August 7, 2015, the International Bureau requested that Iridium amend each application by submitting a Schedule B and responding to five questions the Bureau posed.² A Schedule B is being submitted for each application, and Iridium’s responses to the five questions are below. The responses include information that is pertinent to Schedule B, and Iridium is attaching a copy of the responses to Schedule B.

1. Please ensure that each Schedule B is fully completed, including: (1) Antenna ID or Antenna IDs for AMS(R)S terminals; (2) antenna operational parameters; (3) frequencies of operation; and (4) appropriate exhibits. The Schedule B exhibits should include: (1) a radiation hazard study; (2) the name and telephone number of the network control center for AMS(R)S earth stations; (3) 24/7 contact person(s) at the control center; (4) a picture of the antenna itself (not its cover and base plate); (5) measured antenna gain or EIRP patterns in both azimuth and elevation planes; and (6) the manufacturer's data sheets, if available. If the antenna is directional, please explain how the antenna acquires and tracks signals from satellites.

Response:

Iridium has uploaded a completed Schedule B to IBFS for each of its two modification applications in which it seeks authority to operate transmit and receive AMS(R)S antennas. Each Schedule B is limited to the AMS(R)S emission types that Iridium seeks authority to add in its corresponding modification application. Iridium is not seeking to modify the authority for any of the emission types that are already licensed. Each Schedule B includes AMS(R)S antenna IDs, antenna operational parameters, and frequencies of operation.

Each antenna listed in Schedule B will be paired with one or two Iridium transceivers. Iridium only seeks authority in this application to pair the Schedule B antennas with the Iridium 9523 L-Band transceiver to provide AMS(R)S. To obtain authority to pair these antennas with other transceiver models to provide AMS(R)S, Iridium will either: (1) notify the Commission of a minor modification, if the conditions for minor modifications set forth in Section 25.118(a) (2) of the rules are satisfied; or (2) file a modification application.

Explanation of certain Schedule B entries

E19 (coordination with other countries). By responding “yes” to item E19 of Schedule B, Iridium has indicated that coordination with other countries is required for Iridium’s AMS(R)S operations. ITU coordination has been completed under RR Nos. 9.21 and 9.12 with

¹ See FCC File Nos. SES-MOD-20130416-00322 and SES-MOD-20130416-00323.

² Letter from Paul E Blais, Chief, Systems Analysis Branch, to Joseph A. Godles, Esq., counsel to Iridium.

181 countries. ITU coordination is ongoing with 10 GSO networks and five NGSO networks that were filed for by the thirteen countries that are listed in Attachment A. The coordination contours with these countries consists of all territory within 1,000 km of the borders of those countries. These coordination contours are based on ITU RR Appendix 7, which has a predetermined coordination distance of 1000 km between an aeronautical mobile earth station and a mobile aircraft station located on separate aircraft.

E29 (number of units). In item E29 of Schedule B, Iridium is requesting authority to operate up to 20,000 AMS(R)S units. Although the 20,000 unit figure appears on the line for Iridium's first antenna ID, it is intended to cover all of the antenna IDs, *i.e.*, Iridium seeks authority to operate up to 20,000 AMS(R)S units using any combination of antenna IDs.

E38 (input power at flange). The maximum total input power at the flange is shown in item E38 of Schedule B as 5.16 watts, which is 7.126 dBW. Adding to this figure the 2 dBi antenna gain shown in Schedule B in theory could produce a maximum EIRP of 9.126 dBW, which would exceed the maximum EIRP shown in Schedule B of 9 dBW. In practice, however, the EIRP never will exceed 9 dBW, because to be conservative the EIRP figures shown in Schedule B do not take into account line loss that always will exceed 1.2 dB and that, therefore, always will bring the total EIRP below 9 dBW. The maximum EIRP permitted by the Federal Aviation Administration, moreover, is 9 dBW, so the power would be restricted if that were necessary to maintain a 9 dBW EIRP limit.

E41/42 (antenna gain). In item E41/42 of Schedule B, Iridium has provided a single antenna gain figure rather than separate transmit and receive antenna gain figures. Iridium's AMS(R)S antennas transmit and receive in the same frequency bands and have the same gain in the transmit direction as in the receive direction. Although Iridium's current request for AMS(R)S authority is limited to the 1618.725 – 1626.5 MHz band, Iridium's AMS(R)S antennas are capable of operating across a broader range of frequencies.

E49 (EIRP density per carrier). The maximum EIRP density per carrier (dBW/4 kHz) shown in item E49 of Schedule B has been computed based on a bandwidth of 35 kHz, which is a typical bandwidth for the AMS(R)S proposed in this application, and which takes into account the short duration burst of the transmission over the TDM frame, which is 8.28 ms of carrier-on time in a 90 ms TDM frame. The 41K7Q7W emission designator shown in item E47 of Schedule B, on the other hand, is based on a bandwidth of 41.7 kHz, which is the maximum bandwidth that would be used for the AMS(R)S proposed in this application.

Link budgets

Two sets of link budgets are provided in Attachment B. These link budgets cover the full range of AMS(R)S proposed in this application. One set of link budgets illustrates the scenarios in which maximum link margin is realized on the uplink and downlink sides of the transmission. The other illustrates the minimum link margins required to sustain communications for each side of the transmission link.

- The maximum link budget was calculated using the maximum transceiver transmit power for AMS(R)S, which is employed for voice service, combined

with the maximum 3 dBi gain antenna and minimum implementation losses for a combined 39 dBm maximum EIRP. The resulting maximum Link Margin calculated for the transceiver transmission to the satellite is 14.92 dB and from the satellite to the transceiver is 15.82 dB.

- The minimum link budget was calculated using the minimum transceiver power for AMS(R)S, which is employed for data service, with a 0 dBi antenna and maximum implementation losses for a combined 24.7 dBm minimum EIRP. The resulting minimum Link Margin calculated for the transceiver transmission to the satellite is 0.62 dB and from the satellite to the transceiver is 7.05 dB.

Other information provided with Schedule B

Iridium has provided with each Schedule B: (i) a radiation hazard study, which is based on the maximum transmit power that would be used with any of Iridium's AMS(R)S systems; and (ii) data sheets that include the antenna pictures and measured antenna gain patterns for representative AMS(R)S devices that are available from the antenna manufacturers. The antenna sizes in Schedule B are based on the dimensions shown in the manufacturers' data sheets.

The name and telephone number of the network control center for Iridium's AMS(R)S earth stations is: Iridium Tempe AZ Gateway; 480-752-5111.

The 24/7 contact at the control center is: Network Operations, 480-752-5111.

As stated above, the only transceiver Iridium seeks authority for in this application is the Iridium 9523 L-Band transceiver. The maximum output power of the transmit portion of this transceiver is 5.16 watts, which is 7.126 dBW. The resultant transmit power into the antenna has been assumed for purposes of this application also to be 5.16 watts/7.126 dBW, based on a conservative assumption that there is no line loss. In practice, the line loss always will exceed 1 dB, and if necessary the power would be restricted to stay within the Federal Aviation Administration EIRP limit of 9 dBW.

On the receive side, the minimum power that needs to be delivered to the receiver through the antenna for the most sensitive emission type covered by this application is -112 dBm, which is based on a system design Bit Error Rate of 2% or less.

2. Please clarify how the operation of the proposed AMS(R)S subsystem will comply with the Commission's rules to protect radio navigation satellite service (RNSS) and adjacent channel operators as specified in 47 C.F.R. § 25.2 16(c), (f), (g), (i), and (j).

Response

The AMS(R)S terminals operated pursuant to this license, which will consist of one or more transceivers and an antenna, will in all cases comply with the requirements of Sections 25.2 16(c), (f), (g), (i), and (j) of the Commission's rules.

The AMS(R)S terminals will utilize a transceiver for which the FCC has issued an equipment authorization under Parts 2 and 25 of its rules.³ The applications for these transceiver equipment authorizations include test reports that demonstrate compliance with Section 25.216 of the Commission's rules,⁴ based on a maximum antenna gain of 3 dBi.⁵ As reflected on the Schedule B associated with this application, the antennas that will be paired with Iridium transceivers to provide AMS(R)S have a gain of less than 3 dBi. Per the test reports that have been submitted to the FCC, therefore, the AMS(R)S terminals operated pursuant to this license will comply with the emissions limits specified in Sections 25.216 of the rules.⁶

In addition to complying with the emission limits in Section 25.216, the combined antenna/transceiver AMS(R)S systems will satisfy the emission limits in Section 25.202(f) of the rules.

3. Please indicate whether the L-band transceivers that will be used by Iridium for AMS(R)S will be submitted for equipment certification at an appropriate regulatory body, such as the Commission or the Federal Aviation Administration.

Response

Yes. All L-Band transceivers that will be used by Iridium for AMS(R)S have been or will be submitted for equipment certification at the Federal Communications Commission and have been or will be submitted at the Federal Aviation Administration ("FAA"), as part of an L-band transceiver/antenna combination, for a Supplemental Type Certification or Technical Standard Order.

4. Please confirm that only one transceiver, as shown in the diagram of page 3 of your August 3 ex parte letter, can be connected to an aircraft's low-gain antenna. If more than one can be connected, please include appropriate entries in your Schedule B submissions to reflect the composite EIRP.

Response

The diagram in the August 3 ex parte letter showed a typical installation, but it does not encompass all installations. Some installations will include two transceivers – one of which can be used for voice communications and the other of which can be used for data communications. If an antenna has two transceivers connected to it, the two transceivers will be assigned different time slots; the transceivers will not operate simultaneously. Accordingly, there is no "composite" EIRP to identify in Schedule B.

³ 47 C.F.R. Parts 2 and 25.

⁴ 47 C.F.R. §25.216.

⁵ See, e.g., Grant of Equipment Authorization, FCC ID Q639603 (dated July 3, 2012).

⁶ See, e.g., UL LLC, *Certification Test Report for Iridium Satellite LLC Model Number: 9603* at 22, 36, FCC ID Q639603 (dated May 21, 2012).

5. Please confirm that only the cockpit voice and data inputs to the transceiver shown in the diagram on page 3 of your August 3 ex parte letter would be enabled for AMS(R)S communications.

Response

Confirmed.

Attachment A:
International Coordination

Coordination is ongoing with NGSO and GSO networks filed for by the following countries: Canada, China, Luxembourg, Russia, Australia, the Netherlands, France, Pakistan, Thailand, Turkey, Indonesia, the UAE, and Saudi Arabia.

Attachment B:
Link Budget Calculations

Iridium AMS(R)S Minimum Link Budget Calculations

Transceiver (TRANSMITTER) to Satellite (RECEIVER)

TRANSMITTER (Transceiver)			
	DQPSK		
Tx Power (min)	W		1.48
Tx Power (min)	dBm	Input	31.70
Freq	MHz	Input	1626.00
Transmit Antenna Gain (min)	dBi	Input	0.00
Implementation losses (max)	dB	Input	7.00
EIRP (min)	dBm	Calc	24.70
Channel Loss			
Elevation angle	degrees	Input	8.00
Earth center angle	degrees	Calc	20.09
Range	Km	Calc	2483
FSPL		Calc	164.56
RECEIVER (Satellite)			
Rcvd Power (isotropic)	dBm	Calc	-139.86
Implementation losses (max)	dB	Input	0.00
Receive Antenna Gain	dBi	connected	24.87
Received Power	dBm	Calc	-114.99
aperture temp	K°	input	350.00
Noise Power	dBm/Hz	Calc	-173.16
Receiver Noise Figure	dB	Input	3.00
Noise PSD	dBm/Hz	Calc	-170.16
Channel BW	MHz	Input	0.035
Received Eb/No	dB	Calc	6.72
Required Eb/No	dB	Input (fixed)	6.10
Link Margin Uplink	dB		0.62
Sensitivity $s=k(T_a + T_{rx})B \cdot E_b/N_0$	dBm	Calc	-115.61

Satellite (TRANSMITTER) to Transceiver (RECEIVER)

TRANSMITTER (Satellite)			
	DQPSK		
Tx Power (min)	W		4.00
Tx Power (min)	dBm	Input	36.02
Freq	MHz	Input	1626.00
Transmit Antenna Gain (min)	dBi	connected	24.87
Implementation losses (max)	dB	Input	0.00
EIRP (min)	dBm	Calc	60.89
Channel Loss			
Elevation angle	degrees	connected	8.00
Earth center angle	degrees	Calc	20.09
Range	Km	Calc	2483
FSPL		Calc	164.56
RECEIVER (Transceiver)			
Rcvd Power (isotropic)	dBm	Calc	-103.67
Implementation losses (max)	dB	Input	7.00
Receive Antenna Gain	dBi	input	0.00
Received Power	dBm	Calc	-110.67
aperture temp	K°	input	290.00
Noise Power	dBm/Hz	Calc	-173.98
Receiver Noise Figure	dB	Input	3.00
Noise PSD	dBm/Hz	Calc	-170.98
Channel BW	MHz	Input	0.035
Received Eb/No	dB	Calc	11.85
Required Eb/No	dB	Input (fixed)	4.80
Link Margin Downlink	dB		7.05
Sensitivity	dBm	Calc	-117.72

see AntGain

at 8 °

based on angle
between earth and SV

35K0G1W Designator
Necessary Bandwidth

CCL coherent
demodulation

see AntGain

Iridium AMS(R)S Maximum Link Budget Calculations

Transceiver (TRANSMITTER) to Satellite (RECEIVER)

Satellite (TRANSMITTER) to Transceiver (RECEIVER)

TRANSMITTER			
	DQPSK		
Tx Power (max)	W		5.16
Tx Power (max)	dBm	Input	37.13
Freq	MHz	Input	1626.00
Transmit Antenna Gain (max)	dBi	Input	3.00
Implementation losses (min)	dB	Input	1.13
EIRP (max)	dBmi	Calc	40.70
Channel Loss			
Elevation angle	degrees	Input	8.00
Earth center angle	degrees	Calc	20.09
Range	Km	Calc	2483
FSPL		Calc	164.56
RECEIVER			
Rcvd Power (isotropic)	dBmi	Calc	-125.56
Implementation losses (min)	dB	Input	0.00
Receive Antenna Gain	dBi	connected	24.87
Received Power	dBm	Calc	-100.69
aperture temp	K°	input	350.00
Noise Power	dBm/Hz	Calc	-173.16
Receiver Noise Figure	dB	Input	3.00
Noise PSD	dBm/Hz	Calc	-170.16
Channel BW	MHz	Input	0.035
Received Eb/No	dB	Calc	21.02
Required Eb/No	dB	Input (fixed)	6.10
Link Margin Uplink	dB		14.92
Sensitivity $s=k(T_a + T_{rx})B \cdot E_b/N_0$	dBm	Calc	-115.61

based on angle
between earth and
SV

35K0G1W Designator
Necessary
Bandwidth

CCL coherent
demodulation

TRANSMITTER			
	DQPSK		
Tx Power (max)	W		4.00
Tx Power (max)	dBm	Input	36.02
Freq	MHz	Input	1626.00
Transmit Antenna Gain (max)	dBi	connected	24.87
Implementation losses (min)	dB	Input	0.00
EIRP (max)	dBmi	Calc	60.89
Channel Loss			
Elevation angle	degrees	connected	8.00
Earth center angle	degrees	Calc	20.09
Range	Km	Calc	2483
FSPL		Calc	164.56
RECEIVER			
Rcvd Power (isotropic)	dBmi	Calc	-103.67
Implementation losses (min)	dB	Input	1.13
Receive Antenna Gain	dBi	input	3.00
Received Power	dBm	Calc	-101.80
aperture temp	K°	input	290.00
Noise Power	dBm/Hz	Calc	-173.98
Receiver Noise Figure	dB	Input	3.00
Noise PSD	dBm/Hz	Calc	-170.98
Channel BW	MHz	Input	0.035
Received Eb/No	dB	Calc	20.73
Required Eb/No	dB	Input (fixed)	4.80
Link Margin Downlink	dB		15.93
Sensitivity	dBm	Calc	-117.72

see AntGain

Attachment C:

Antenna Data Sheets

Antenna 1.

Aero Antenna: AT1621-23
Dual Patch Iridium Antenna



AT1621-23

Dual Iridium Antenna

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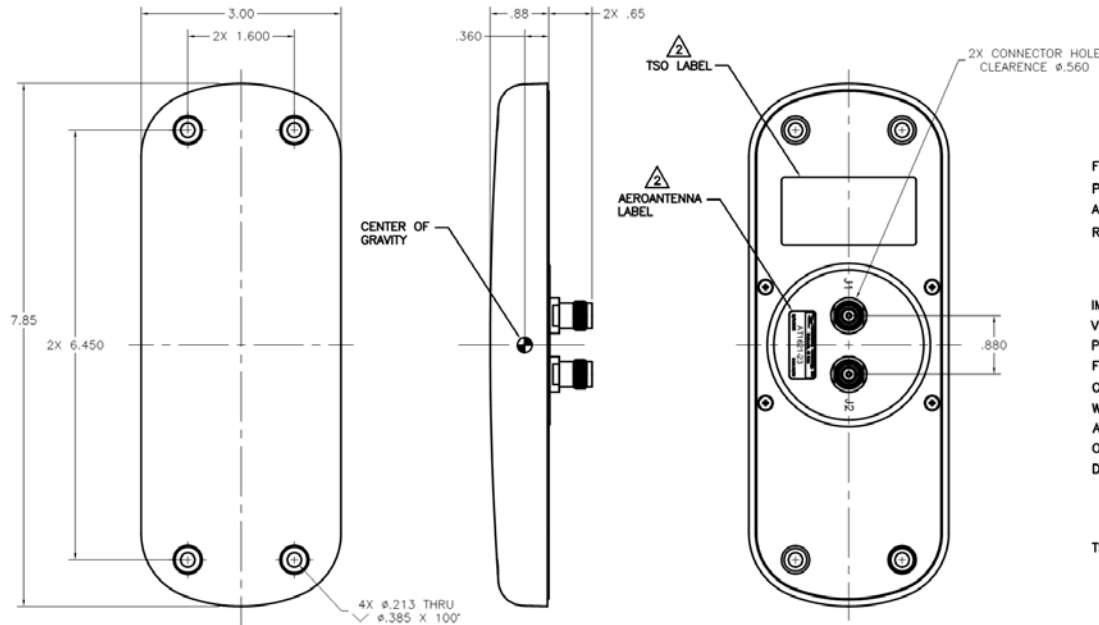
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Outline Drawing

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- 3. TOLERANCES: .XX = ±.03
.XXX = ±.010

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED
A	PRODUCTION RELEASE PER ECO 9827	07/05/11	



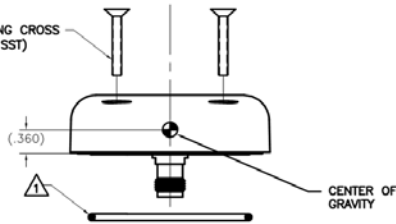
SPECIFICATION:


FREQUENCY: 1616-1626 MHz
 POLARIZATION: RIGHT HAND CIRCULAR
 AXIAL RATIO: 3 dB MAX @ BORE SIGHT
 RADIATION COVERAGE:
 +3.1 dBic $\theta = 0^\circ$
 +2.0 dBic $0^\circ < \theta = 45^\circ$
 +0.1 dBic $45^\circ < \theta = 70^\circ$
 -3.4 dBic $70^\circ < \theta = 82^\circ$

IMPEDANCE: 50 OHMS
 VSWR: ≤1.8:1
 POWER HANDLING: 1 WATT
 FINISH: POLYURETHANE ENAMEL, FLUID RESISTANT
 CONNECTOR: TNC FEMALE X2
 WEIGHT: 1.1 LB
 ALTITUDE: 55,000'
 OPERATING TEMP: -55°C TO +71°C
 DESIGNED TO: D0-160F
 ENV. CAT., F2-AB[BD]
 [S(CLMY)U2(FF1)]XSF5FSZXXXXXX2A2ACAC
 RTCA/D0-262A

TSO: C159a

⚠
 4X MOUNTING SCREWS
 MS24693-C276
 (10-32 UNF-2A X 1.00 LONG CROSS
 RECESSED FLAT HEAD 100', SST)



DO NOT SCALE THIS DRAWING	DRAWN	A. GUTIERREZ	05/20/11	 AeroAntenna Technology Inc AS9100 CERTIFIED CO.
REMOVE BURRS AND BREAK SHARP EDGES.	CHECKED			
PART TO BE CLEAN AND OIL FREE	ENGR	E. NABOYSHCHIKOV	07/05/11	TITLE
ALL DIMENSIONS ARE IN INCHES	MFG	D. LEVY	07/05/11	DUAL IRIDIUM ANTENNA
DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994	Q.A.	B. RUBENI	07/05/11	SIZE
TOLERANCES:	APPROVED	Y. ZADEH	07/05/11	CAGE CODE
-.001 - .004 FRACT = 1/32				DRAWING NO.
-.006 - .008 ANG. = 1/2"				AT1621-23
✓ SURFACE ROUGHNESS MACHINED PARTS VES MOLDED PARTS V22				REV
HOLE DIA. TOLERANCE				A
.0135 - .125 +.001				SCALE
.126 - .250 +.001				NONE
.251 - .500 +.001	DRAWN IN	CAD		FILE: \CAD\AT1621\ -23\AT1621-23_A
.501 - .750 +.001	NEXT ASSY			SHEET 1 of 1

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AT1621-23





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Antenna 2.

Aero Antenna: AT2775-110
Single Patch Iridium Antenna



AT2775-110

GPS/Iridium Antenna

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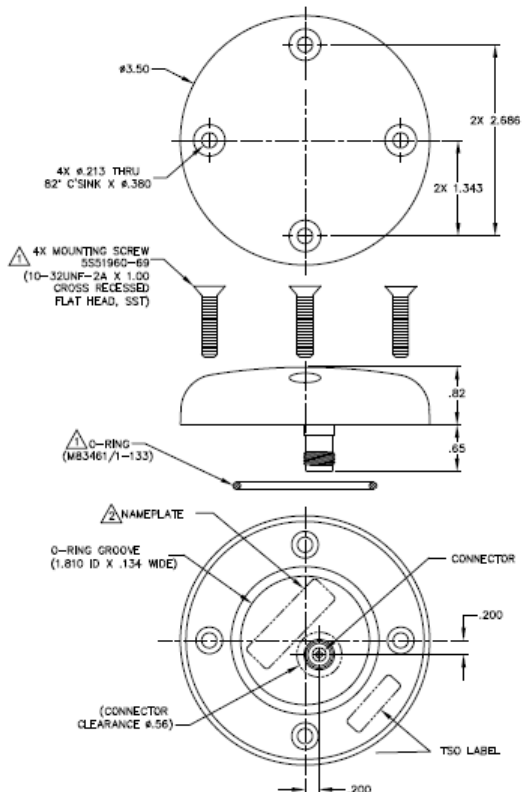
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.XXX = .010

4. SYMBOL \oplus INDICATES CHANGES SINCE LAST REVISION.



REVISED BY:		DATE:		REVISIONS			
I. ECLEVA		08/12/15		REV.	DESCRIPTION	DATE	APPROVED
				F			

SPECIFICATION:

FREQUENCY: 1565-1828.5 MHz
 POLARIZATION: RIGHT HAND CIRCULAR
 AXIAL RATIO: 3.0 dB MAX
 RADIATION COVERAGE: 1.1 dBic $\theta = 0^\circ$
 1.0 dBic $0^\circ < \theta \leq 45^\circ$
 0.9 dBic $45^\circ \leq \theta \leq 70^\circ$
 -2.5 dBic $70^\circ \leq \theta \leq 82^\circ$

IMPEDANCE: 50 OHMS
 VSWR: $\leq 2.0:1$
 POWER HANDLING: 10 WATTS
 WEIGHT: 8.0 OZ MAX
 MATERIAL: A380 ALUMINUM ALLOY-CASTING BASE PLATE
 ULTEM 2200 RADOME

FINISH: POLYURETHANE ENAMEL, FLUID RESISTANT
 ALTITUDE: 70,000'
 OPERATING TEMP: -55°C TO +85°C
 DESIGNED TO: DO-160D
 ENV CAT: E1-ABB[S(CLMY)U(FF1)]XSFDFSAZAAZYH[A3][2A]CX
 TSO: C-144



AT2775-110GA

PART NO. DESIGNATION:

AT2775-110GA-XXXX-XX-XX-XX

CUSTOMER: G = GMPCS
 PERFORMANCE: A = AUGMENTED
 COLOR: W = WHITE, O = OLIVE, B = BLACK
 CONNECTOR: TNCF = TNC FEMALE, SMAF = SMA FEMALE
 CABLE LENGTH: 000 = N INCHES
 STANDARD MODEL = AT2775-110GAW-TNCF-000-00-00-NM

MAGNET: NM = NO MAGNET
 GAIN (± 2 dB): 00 = PASSIVE
 VOLTAGE: 00 = PASSIVE

DO NOT SCALE THIS DRAWING	DRAWN	DATE	AeroAntenna Technology Inc AS9100 CERTIFIED CO.	
REWORK SURFACES AND BREAK SHARP EDGES	K. RERKSAWAT	03/14/03	TITLE GPS/IRIDIUM ANTENNA	
PART TO BE CLEAN AND OIL FREE	CHECKED			
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED PER ASME Y14.5M-1994	ENGR		SIZE B	
TOLERANCES: UNLESS OTHERWISE SPECIFIED: FRACT = 1/32, DEC = 0.0005, ANG = 1/2°	K. RERKSAWAT	08/17/15		
SURFACE ROUGHNESS: MACHINED PARTS V32, MOUNTED PARTS V32	MFG		DRAWING NO. AT2775-110GA	
	WAYNE FORD	08/13/15		
	G.A.		REV F	
	B. RUBENI	08/13/15		
	APPROVED		SCALE NONE	
	YOUSFI ZADEH	08/13/15		
HOLE DIA. TOLERANCE	DRAWN IN		SHEET 1 OF 1	
.0125 - .125 $\pm .001$	CAD			
.126 - .250 $\pm .002$				
.251 - .500 $\pm .003$				
.501 - .750 $\pm .005$				

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Antenna 3.

Sensor Systems: S67-1575-409
Single Patch Iridium Antenna



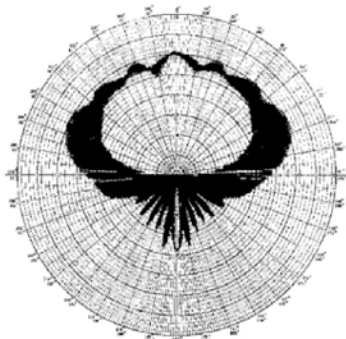
DESCRIPTION

S67-1575-409: TSO-approved Iridium antenna covers the Iridium frequency range of 1616 MHz to 1626.5 MHz for world-wide Iridium system operations. Supports FOI (FANS over Iridium) and ADS-B over Iridium. The S67-1575-409 is approved as Iridium Compatible Equipment (ICE).

The low-profile, molded radome material and design insures superior protection against lightning strikes, rain and ice. The rugged antenna is DC-grounded and hermetically sealed. Qualified for high-speed military aircraft as well as ARINC applications.

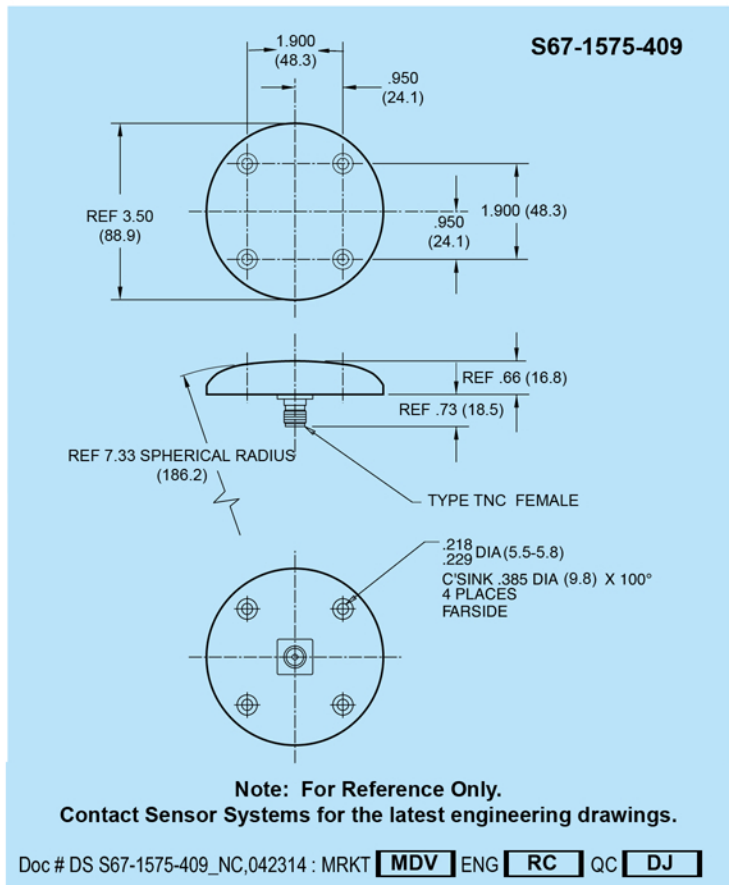
FEDERAL & MILITARY SPECS: TSO-C159a, DO-160D/E, DO-262A, MIL-DTL-5541, MIL-HDBK-5400, MIL-STD-810.

RADIATION PATTERN



1616.0 to 1626.5 MHz

SPECIFICATIONS	
MODEL	S67-1575-409
ELECTRICAL	
Frequency	1616.0 - 1626.5 MHz
VSWR	≤1.5:1
Polarization	RHCP
Impedance	50 ohms
Power Handling	60 watts CW
Gain	+2.0 dBic 0° ≤ θ ≤ 20° +0.5 dBic 20° ≤ θ ≤ 60° -1.0 dBic 60° ≤ θ ≤ 75° -2.5 dBic 75° ≤ θ ≤ 80° -4.5 dBic 80° ≤ θ ≤ 82°
Lightning Protection	DC grounded
MECHANICAL	
Weight	6 oz. (170 g)
Height	.66 in. (16.8 mm)
Diameter	3.50 in. (88.9 mm)
Material	6061-T6 aluminum / thermoset plastic
Finish	Skydrol-resistant Polyurethane Enamel
Connector	TNC Female
ENVIRONMENTAL	
Temperature	-55°C (-67°F) to +85°C (+185°F)
Altitude	-100 ft. to 55,000 ft.
Vibration	10 G's



Antenna 4.

Sensor Systems: S67-1575-365
Dual Patch Iridium Antenna



DESCRIPTION

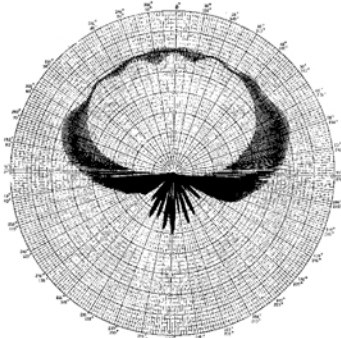
S67-1575-365: TSO-approved, dual-element Iridium antenna providing coverage from 1616 MHz to 1626.5 MHz for full Iridium coverage.

The dual-element design provides the capability to connect two Iridium devices to the antenna with one antenna installation. Provided with two TNC female connectors. The special molded radome provides superior protection against rain, ice and lightning strikes. The unit is hermetically-sealed and DC-grounded.

The S67-1575-365 has been approved as Iridium Compatible Equipment (ICE).

FEDERAL & MILITARY SPECS: TSO-C159a, DO-160D/E/G, DO-262A, SAE ARP5416, MIL-HDBK-5400, MIL-STD-810C/D.

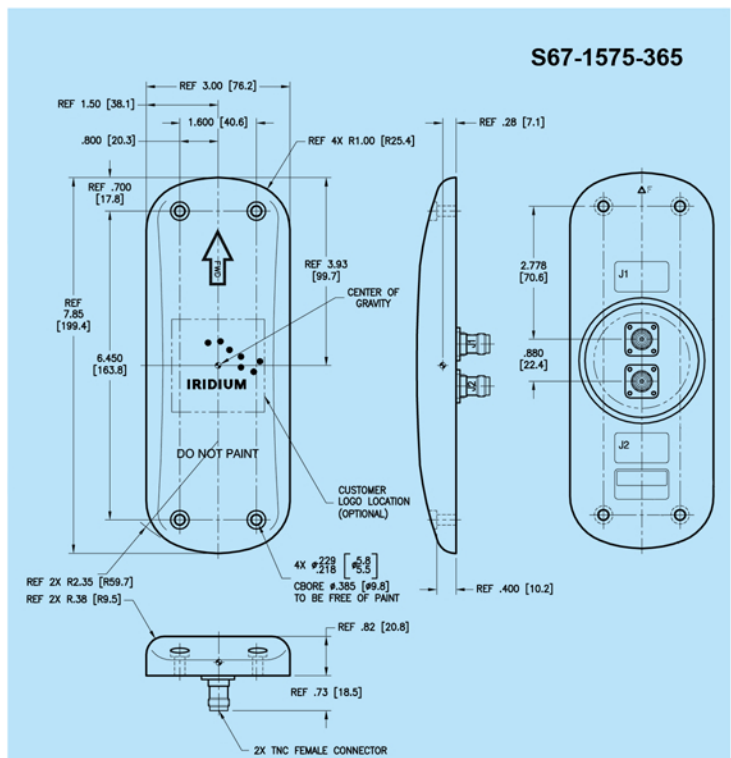
TYPICAL RADIATION PATTERN



1616.0 - 1626.5 MHz



SPECIFICATIONS	
MODEL	S67-1575-365
ELECTRICAL	
Frequency	1616.0 - 1626.5 MHz
VSWR	≤1.8:1
Polarization	RHCP
Impedance	50 ohms
Power Handling	60 Watts
Gain	>3.0 dBic @ Zenith
Lightning Protection	DC grounded
Isolation, J1 to J2	>25dB @ 1616 - 1626.5 MHz
MECHANICAL	
Weight	16.5 oz. (468 g)
Height	.82 in. (20.8 mm)
Length	7.85 in. (199.4 mm)
Material	6061-T6 aluminum / thermostet plastic
Finish	Skydrol-resistant Polyurethane Enamel
Connector	TNC Female
ENVIRONMENTAL	
Temperature	-62°C (-80°F) to +95°C (+203°F)
Altitude	-100 ft. to 70,000 ft.
Vibration	10 G's



Note: For Reference Only.
Contact Sensor Systems for the latest engineering drawings.

Doc # DS S67-1575-365_A, 042314: MRKT **MDV** ENG **RC** QC **DJ**

Antenna 5.

Sensor Systems: S67-1575-168
Single Patch + L1/L2 GPS



DESCRIPTION

S67-1575-168: Dual Band Iridium and GPS L1/L2 antenna is designed for military applications with low voltage requirements such as UAV's and DAGR/MAGR receivers. The GPS port features a 26.5 dB LNA with special filtering and an internal voltage regulator which accepts 3.3 to 5 volts. DC-grounded.

The S67-1575-168 is approved as Iridium Compatible Equipment (ICE).

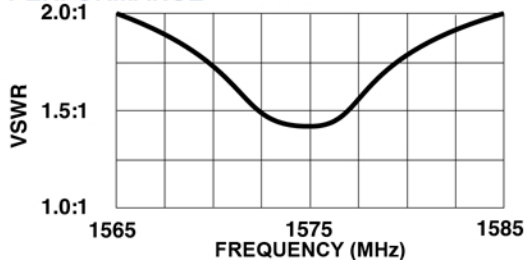


NSN: 5985-01-564-3737

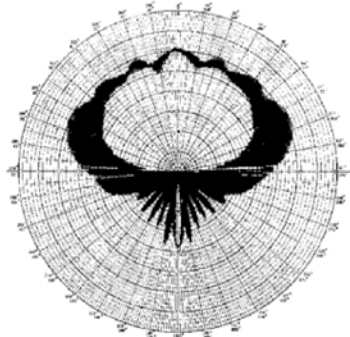
FEDERAL & MILITARY SPECS: TSO-C129, MIL-STD-810, MIL-STD-877, MIL-HDBK-5400.

SPECIFICATIONS	
MODEL	S67-1575-168
ELECTRICAL	
Frequency	J1: L1: 1565-1585 MHz, L2: 1217-1237 MHz J2: 1610-1626 MHz
VSWR	J1, J2: ≤ 2.0:1
Polarization	RHCP
Impedance	50 Ohms Nominal
Power Handling	J1: 1 Watt J2: 60 Watts
Gain J1, J2	-1.0 dBic 0° ≤ θ ≤ 75° -2.5 dBic 75° < θ ≤ 80° -4.5 dBic 80° < θ ≤ 85° -7.5 dBic θ = 90° @ Horizon
Gain (Preamplifier)	J1: 26.5 ±3 dB
Supply Voltage	+3.3 to +5.0 VDC @ 65 mA MAX
Lightning Protection	DC Grounded
MECHANICAL	
Weight	16 oz.
Height	.92 in.
Length	7.86 in.
Width	3.00 in.
Material	6061-T6 Aluminum Alloy / Thermoset Plastic
Finish	Skydrol Resistant Polyurethane Enamel
Connectors	TNC Female (2)
ENVIRONMENTAL	
Temperature	-54°C (-65°F) to +110°C (+230°F)
Vibration	10 Gs
Altitude	-1500 to 70,000 ft

PERFORMANCE



RADIATION PATTERN



S67-1575-168

**Note: For Reference Only:
Contact Sensor Systems for the latest engineering drawings.**

Doc # DS S67-1575-168_B, 052014: MRKT **MDV** ENG **RC** QC **DJ**



Antenna 6.

Sensor Systems: S67-1575-160
Single Patch Iridium and GPS WAAS



DESCRIPTION

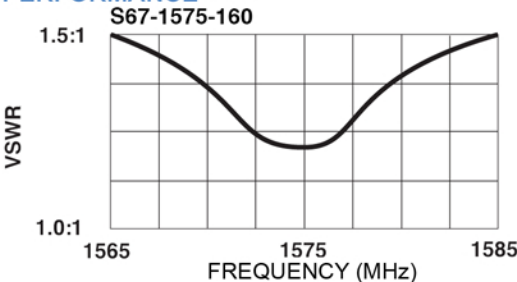
S67-1575-160: Low-profile, dual-band antenna features a GPS WAAS LPV antenna element and a 29.5 dB amplifier combined with a passive Iridium element. The dual element design simplifies installation when GPS WAAS LPV receivers are required and Iridium voice and data are also utilized. The advanced radome design and material provides superior protection against lightning, rain and ice. The unit is DC-grounded and hermetically sealed.

The S67-1575-160 is approved as Iridium Compatible Equipment (ICE) and is TSO C190 certified.

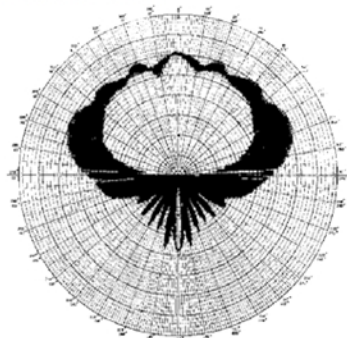


FEDERAL & MILITARY SPECS: FAA TSO-C190, C144, C129a & C159a, DO-160, DO-301, DO-262a, MIL-HDBK-5400, MIL-STD-810.

PERFORMANCE



RADIATION PATTERN

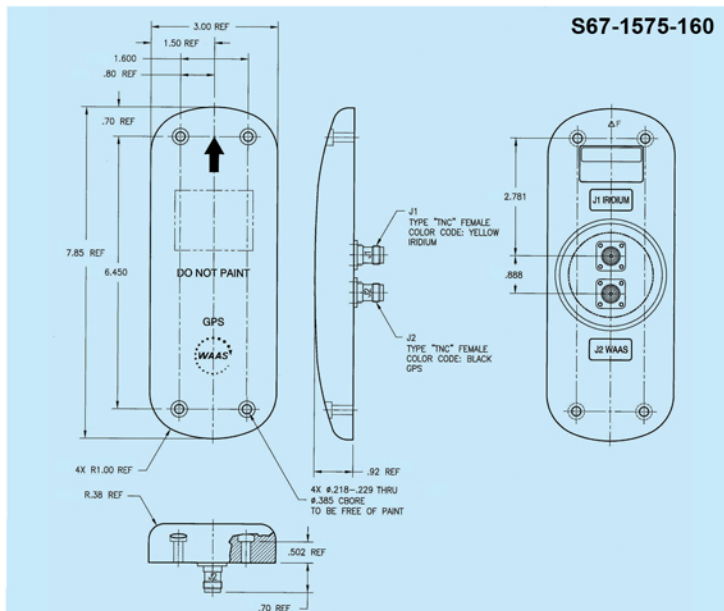


1565 - 1585 MHz



SPECIFICATIONS	
MODEL	S67-1575-160
ELECTRICAL	
Frequency	J1: 1616.0 - 1626.5 MHz J2: 1575.42 ± 10.23 MHz
VSWR	J1, J2: ≤ 1.5:1
Polarization	RHCP
Impedance	50 Ohms
Power Handling	J1: 6 Watts J2: 1 Watt (+30 dBm for 5 mins)
Gain (J1)	+2.0 dBic 0° ≤ θ ≤ 20° +0.5 dBic 20° < θ ≤ 60° -1.0 dBic 60° < θ ≤ 75° -2.5 dBic 75° < θ ≤ 80° -4.5 dBic 80° < θ ≤ 82°
Gain (J2)	-1.0 dBic 0° ≤ θ ≤ 75° -2.5 dBic 75° < θ ≤ 80° -4.5 dBic 80° < θ ≤ 85° -7.5 dBic θ = 90° @ Horizon
Gain (Preamplifier)	29.5 ±3 dB
Supply Voltage	+4 to +24 VDC @ 60 mA MAX
Lightning Protection	DC Grounded
MECHANICAL	
Weight	18 oz.
Height	.92 in.
Length	7.85 in.
Width	3.00 in.
Material	6061-T6 Aluminum Alloy / Thermoset Plastic
Finish	Skydrol-Resistant Polyurethane Enamel
Connectors	TNC Female (2)
ENVIRONMENTAL	
Temperature	-55°C (-67°F) to +85°C (+185°F)
Vibration	10 G's
Altitude	-100 to 55,000 ft

New Product: May not conform to standard lead times.



Note: For Reference Only.

Contact Sensor Systems for the latest engineering drawings.

Doc # DS S67-1575-160_A, 052114: MRKT **MDV** ENG **RC** QC **DJ**

Antenna 7.

Cobham: Comant CI 490-1
Single Patch Iridium

Comant CI 490-1

Iridium™ SATCOM

COBHAM

2008 Data Sheet

The most important thing we build is trust

CI 490-1 Iridium™ SATCOM

Dual-band passive antenna operates at Iridium™ frequencies, with continuous transmit and receive coverage from 1616 to 1626.5 MHz. Can also operate separately as a passive GPS antenna.

The ComDat CI 490-1 is a high performance communications antenna specifically designed for Iridium™ systems, and features our standard round-format footprint and mounting.

Through a constellation of 66 low-earth orbiting (LEO) satellites, Iridium™ delivers essential communications services to and from areas where terrestrial communication are not available.

Applications

Most aircraft up to and including business jets. Consult your FBO or installation shop for best application information.

Frequencies Covered

Iridium™ 1616-1626.5 MHz
GPS 1575.42 +/- 10 MHz

Specifications

RF Characteristics

Iridium TX/RX 1616-1626.5 MHz

GPS 1575.42 MHz

VSWR 1.5:1 Maximum

Polarization RHCP

Radiation Pattern Hemispherical

Impedance RF 50 Ohms

Power Handling - TX 60 Watts

Lightning Protection DC Grounded

Gain +3 dBic @ zenith

Mechanical

Weight 5.0 lb

Speed 330 KIAS @ Sea Level

Finish Gloss White Paint

Federal Specifications

FAA TSO C144

RTCA Environmental DO-160D



WARNING: Use factory supplied drawings and specifications for installation. Refer to FAA AC 43.13-2B for installation guidelines.

For further information please contact:

Cobham SATCOM Airborne Systems
577 Burning Tree Road
Fullerton, California 92833 USA
Tel: (01) 714-870-2420
Fax: (01) 714-870-5133
Email: comant@cobham.com

Antenna 8.

Antcom: S4IR16RR-P-XX-X
Iridium Single Patch



IRIDIUM Approved Antennas, P/N: S4IR16RR-P-XX-X (3.4" x 2.2") Mini Arinc Configurations



ISO 9001:2008/FAA Approved Facility Antenna Mounts/Adapters: <http://www.antcom.com/documents/catalogs/PeripheralAntennaProducts2.pdf>

ANTCOM CORPORATION . 367 Van Ness Way, Suite 602 . Torrance, CA 90501, USA . Tel: (310) 782-1076 . Fax: (310) 782-1086 . E-mail: antennas@antcom.com . <http://www.antcom.com>

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SPECIFICATIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED

ELECTRICAL:

FREQUENCY:	(1610.0 - 1626.5) MHz
RADIATION PATTERN:	HEMISPHERICAL
POLARIZATION:	RHCP
VSWR:	< 1.5:1
GAIN (dB):	4 ft G.P. Free Space
@ 90° (Zenith):	+4.9 +5.0
@ 10° Elevation (Ave):	-1.0 -2.5
@ 20° Elevation (Ave):	+1.5 -0.5
@ 30° Elevation (Ave):	+2.4 +1.0
@ 45° Elevation (Ave):	+3.3 +2.7
@ 70° Elevation (Ave):	+4.7 +4.5
Beam Width (3dB):	129 ° 98 °-106 °
AXIAL RATIO @ Zenith:	2.0 dB
IMPEDANCE:	50 Ohms
POWER HANDLING:	200 Watt
DC GROUNDING:	YES (LIGHTNING PROTECTION)

MECHANICAL:

SIZE: WIDTH = 2.20 in. [55.88 mm], LENGTH = 3.40 in. [86.36 mm], HEIGHT = 0.588 in. [14.94 mm]

WEIGHT: 4.7 oz. (133 g)

FINISH: SKYDROL RESISTANT POLYURETHANE ENAMEL
BASE IRIDITE PER MIL-C-5441

COLOR: GLOSS WHITE #17925 PER FED-STD-595B
LUSTERLESS GRAY #36320 PER FED-STD-595B
OLIVE DRAB GREEN #34031 PER FED-STD-595B
LUSTERLESS BLACK #37038 PER FED-STD-595B

MATERIAL: 6061-T6 ALUMINUM ALLOY BASE
COMPOSITE RADOME, IMPACT, ABRASION,
UV, SOLVENT AND SKYDROL RESISTANCE,
FIRE RETARDANT

CONNECTOR: TNC FEMALE CONNECTOR,
(OPTION- SMA, TNC Bulkhead, N, N Bulkhead
MCX, MMCX, or Cable)

MOUNTING: FLAT FIXED MOUNT; GASKET &
4 x 10-32 MOUNTING SCREWS PROVIDED

ENVIRONMENTAL:

TEMPERATURE: -67 °F TO +185 °F [-55 °C TO +85 °C]

ALTITUDE: 70,000 ft.

VIBRATION: > 80 G's

LEAKAGE: HERMETICALLY SEALED

FEDERAL & MILITARY SPECIFICATIONS:

DESIGN TO: FAA TSO-C144, DO-160D, DO-228, MIL-C-5541,
MIL-E-5400, MIL-I-46208A, MIL-STD-810, AND
SAE J1456

CONFIGURATION:	POLARIZATION:	LNA:	CABLE'S LENGTH:	CONNECTOR:	COLOR:
1: 2" SQ. (FLAT)	LL: TX: LHCP, RX: LHCP	A1: WITH +34 dB LNA	X: NO CABLE	S: SMA; P: PINS	-1: GLOSS WHITE #17925 PER FED-STD-595B
1.9: 1.9" SQ. (FLAT)	LR: TX: LHCP, RX: RHCP	A1: WITHOUT LNA	M: WITH MAG. MOUNT	M: MCX; MM: MMCX	-2: LUSTERLESS GRAY #36320 PER FED-STD-595B
2: 2.6" DIA. (FLAT)	RL: TX: RHCP, RX: LHCP	P: WITHOUT LNA	#: CABLE LENGTH (IN)	N: N; NB: N-Bulkhead	-3: OLIVE DRAB GREEN #34031 PER FED-STD-595B
3: 3.5" DIA. (FLAT)	RR: TX: RHCP, RX: RHCP		R: RIGHT ANGLE CON.	T: TNC; TB: TNC-Bulkhead	-4: LUSTERLESS BLACK #37038 PER FED-STD-595B
4: MINI ARINC (FLAT)					
53: (HELIX ROD)					
5B: (HELIX BLADE)					
3D: (HELIX HANDHELD)					

QUANTITY	DESCRIPTION	PART NO	MATERIAL	FINISH	QTY
4	MOUNTING SCREWS: 10-32, 3/4"	MS24693C274	-	-	5
1	ADHESIVE GASKET	123456-3M-4G	-	-	3
1	O-RING	2-031/N756-75	-	-	1
-2	-1	DESCRIPTION	PART NO	MATERIAL	FINISH
PARTS LIST					

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONS SHALL BE DECIMALS
± 1/64 DEC. DIMS ± .010
TOLERANCE .010 PER ANSI Y14.5

REMOVE ALL BURRS
BREAK SHARP EDGES AND TO .015
FLATTEN ALL CORNERS TO .005
SHOW DIMENSIONS FROM DIMENSION
DATE ON A COMMON BLENDED
MACHINED SURFACES

DO NOT SCALE DRAWING

NOTES: UNLESS OTHERWISE SPECIFIED:
1. DIMENSIONS IN BRACKETS ARE IN MILLIMETERS [mm]
2. ALL SCREWS ARE SUPPLIED BY ANTCOM CORPORATION

P/N: S4IR16RR-P-XS-1

NMO Connector is Now Available for Some Antennas

Antenna 9.

Antcom: S5GIR1216RR-AP-XTN-X
Single Patch Iridium and L1 or L1/L2 GPS



Active L1/L2 GPS & (IRIDIUM/Inmarsat) Antenna, P/N: S5GIR1216RR-AP-XTN-X
P/N: S5GIR1216RR-AP-XTN-1-HF (with Higher Iridium Rejection Filters)
 (5.03"x2.08"x0.69"), Flat or Pipe mount,



ISO 9001:2008/FAA Approved Facility Antenna Mounts/Adapters: <http://www.antcom.com/documents/catalogs/PeripheralAntennaProducts2.pdf>

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5.026 [127.66]
 4x.800 [20.32]
 4x2.119 [53.82]
 2.200 [55.88]
 4x.201 [Ø5.11]
 ✓ Ø.385 [Ø9.78] X 100°
 for 10-32 MOUNTING SCREWS
 .721 [18.31]
 R6.000 [R152.40]
 <0.57" [14.53](TNC), <0.72" [18.29](N,N-Bulkhead)
 <0.357"[9.07](SMA), <0.83"[21.00](TNC-Bulkhead), <0.200" [5.08](MCX)
 .784 [19.91]
 .148 [3.77]
 .937 [23.80]
 .143 [3.63]
 O-RING (2-038)
 GPS: TNC Female (OPTION: TNC, N, MCX) (+2.5 to +30) Volts DC
 DATE STAMP/NAMEPLATE
 Iridium: N Female (OPTION: SMA, N, MCX)

SPECIFICATIONS

ELECTRICAL:

	IRIDIUM	L1 OR L1/L2 GPS		
FREQUENCY:	(1610.0 - 1626.5) MHz	L1: (1575.42 ±13)	L2: (1227.60 ±13)	MHz
RADIATION PATTERN:	HEMISPHERICAL	HEMISPHERICAL		
POLARIZATION:	RHCP	RHCP		
VSWR:	< 1.5:1	< 1.5:1		
GAIN (dB):	4 ft G.P. Free Space	F.S.	4 ft G.P.	F.S.
@ 90° (Zenith):	+4.9	+5.0	+4.6	+2.9
@ 10° Elevation:	-1.0	-2.5	-2.5	-1.8
@ 20° Elevation:	+1.5	-0.5	-1.1	+0.7
@ 30° Elevation:	+2.4	+1.0	+0.5	+1.7
@ 60° to 90° Elevation:	>+3.3	>+2.7	>3.6	>2.1
BEAM WIDTH (3dB):	129 °	98 °-106 °	103 °	146 °
AXIAL RATIO @ Zenith:	2 dB	2 dB		
POWER HANDLING:	30 W	1 Watt		
LIGHTNING PROTECTION:	DC GROUNDING	DC GROUNDING		
FILTER (REJ. @1616 MHz):		> 60 dB		
LNA GAIN:	N/A	(33.0+/-1.0) dB		
LNA P 1dB Out:	N/A	+16 dBm		
LNA NOISE FIGURE:	N/A	2.8 dB (Filter loss is Included)		
VOLTAGE/CURRENT:	N/A	(±2.8 TO ±28) Volts DC / (30 TO 50) mA		

MECHANICAL:

SIZE: WIDTH: 2.20 in. [55.88 mm], LENGTH: 5.026 in [127.66 mm], HEIGHT: 0.721 in. [18.31 mm]
 WEIGHT: 8.0 oz. (226 g)
 FINISH: SKYDROL RESISTANT POLYURETHANE ENAMEL BASE IRIDITE PER MIL-C-5441
 MATERIAL: 6061-T6 ALUMINUM ALLOY BASE COMPOSITE RADOME, IMPACT, ABRASION, UV, SOLVENT, AND SKYDROL RESISTANCE, FIRE RETARDANT
 CONNECTOR: GPS: TNC FEMALE, IRIDIUM: N FEMALE (OPTION: SMA, TNC, TNC Bulkhead, N, N Bulkhead, MCX, MMCX, or Cable)
 MOUNTING: FLAT FIXED MOUNT: O-RING & 4 x 10-32 MOUNTING SCREWS PROVIDED

ENVIRONMENTAL:

TEMPERATURE: -67 °F TO +185 °F [-55 °C TO +85 °C]
 ALTITUDE: 70,000 ft.
 VIBRATION: > 30 G's
 LEAKAGE: HERMETICALLY SEALED

FEDERAL & MILITARY SPECIFICATIONS:

DESIGN TO: FAA TSO-C144, DO-160D, DO-228, MIL-C-5541, MIL-E-5400, MIL-I-45208A, MIL-STD-810, AND SAE J1455

QTY	DESCRIPTION	PART NO	MATERIAL	FINISH	UNIT
4	MOUNTING SCREW: (10-32, 1")	MS24693C276	-	-	5
1	ADHESIVE GASKET	12345G-3M-4G	-	-	3
1	O-RING	2-038-N756-75	-	-	1

UNLESS OTHERWISE SPECIFIED
 DIMENSIONS ARE IN INCHES
 FRACTIONS SHALL BE IN 16ths UNLESS OTHERWISE SPECIFIED
 ± 1/64 DECIMALS ± .005 ANGLES ± 1°
 TOLERANCE 5MIL PER ANS Y14.5
 REMOVE ALL BURRS
 BREAK EXTERNAL EDGES .005 TO .015
 FILED & POLISHED TO .005
 SMOOTH THREADS FOR ALL S-8879
 DIA'S ON A CONE OF 1:20
 MACHINED SURFACES
 DO NOT SCALE DRAWING

ANTCOM CORP. TORRANCE CALIFORNIA
 FLAT FIXED MOUNT
 ACTIVE IRIDIUM/L1/L2 GPS
 ANTENNA

APPROVED: S. HUYNH DEC-13-02
 DRAWN: D 3CWE1
 SHEET 1 OF 1

CONFIGURATION: FREQ. BAND: GPS/IRIDIUM LNA: CABLES LENGTH: GPS/IRIDIUM CONNECTOR: COLOR:

1: 2" SQ. (FLAT) 1516: L1 GPS & IRIDIUM A: WITH LNA X: NO CABLE S: SMA; P: PINS -1: GLOSS WHITE #17925 PER FED-STD-595B

1.8: 1.8" SQ. (FLAT) 1216: L1/L2 GPS P: WITHOUT LNA M: WITH MAG. MOUNT N: MCX; MM: MMCX -2: LUSTERLESS GRAY #36320 PER FED-STD-595B

2: 2.6" DIA. (FLAT) GPS & IRIDIUM #: CABLE LENGTH (IN) N: N; NB: N-Bulkhead -3: OLIVE DRAB GREEN #34031 PER FED-STD-595B

3: 3.5" DIA. (FLAT) R: RIGHT ANGLE CON. T: TNC; TB: TNC-Bulkhead -4: LUSTERLESS BLACK #37038 PER FED-STD-595B

4: MINI ARING (FLAT)

53: (HELIX ROD)

5B: (HELIX BLADE)

3D: (HELIX HANDHELD)

P/N: S5GIR1216RR-AP-XTN-X

NOTES: UNLESS OTHERWISE SPECIFIED:
 1. DIMENSIONS IN BRACKETS ARE IN MILLIMETERS [mm]
 2. ALL SCREWS ARE SUPPLIED BY ANTCOM CORPORATION

NMO Connector is Now Available for Some Antennas