



Carroll
International

Satcom & Antenna Technologies Family of Small Deployable Antennas



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Table of Contents

1.0	INTRODUCTION.....	4
2.0	FAMILY OF SMALL DEPLOYABLE ANTENNAS.....	4
2.1	Small-Lightweight (0.6m thru 1.4m).....	4
2.1.1	810 Controller.....	5
2.1.2	810 User Interface.....	6
2.2	Medium Weight (1.8m, 2.4m, and 1.25m QDMA).....	6
2.2.1	820/825/830 Controller.....	7
2.2.2	820/825/830 GUI.....	7
2.3	Miscellaneous Performance Metrics.....	7
3.0	DESIGN / INTERCHANGEABILITY SUMMARY.....	8
4.0	ENVIRONMENTAL COMPLIANCE SUMMARY.....	8
5.0	TECHNICAL COMPLIANCE SUMMARY.....	9
6.0	RF PERFORMANCE SUMMARY.....	9
7.0	PRODUCTION CAPABILITITES AND PRODUCT AVAILABILITY.....	10
8.0	WARRANTY INFORMATION FOR SDA AND/OR SMALL DEPLOYABLE ANTENNAS.....	10
9.0	APPENDIX: DEFINITIONS.....	11

Figures and Tables

Figure 1. C060FM, C100FM, C125FM, C140FM	4
Figure 2. 815 Motorization Unit & Control Unit	5
Figure 3. Small Lightweight Antenna with Motorization	5
Figure 4. C100FA (C100FM with 810 Series controller) + 8W Ku SSPB	5
Figure 5. Motorization Kit Integration with Antenna Pedestal	6
Figure 6. 815 Series Controller Web UI	6
Figure 7. 815 Series Controller Dashboard UI	6
Figure 8. C180F and C240F	6
Figure 9. 1.25m QDMA Antenna	6
Figure 10. 820A/825A Antenna Control Unit (ACU)	7
Figure 11. 830A Antenna Control Unit (ACU)	7
Figure 12. 820A/825A System Block Diagram	7
Figure 13. 830A Front Panel and Satellite Window	7
Table 1. SDA Weight Summary	7
Table 2. SDA Design/Interchangeability Summary	8
Table 3. SDA Environmental Compliance Summary	8
Table 4. High Level Technical Compliance Summary and Comments	9
Table 5. C060F thru C140F RF Performance Summary	9
Table 6. C180F thru C240F RF Performance Summary	10

Small Deployable Antennas

1.0 INTRODUCTION

CPI Satcom & Antenna Technologies is pleased to introduce our Small Deployable Antenna (SDA) Family of Antennas. In addition to the new line of antennas we will continue to mature the existing Small Deployable Antenna product lines. CPI Satcom & Antenna Technologies has a strong background and decades of experience in SATCOM operation, compliance with WGS and other SATCOM regulatory agencies, ability to leverage a matrix organization structure for expedited and mil-spec solutions, and most importantly, a strong desire to develop the SDA product line with both internally and externally funded development opportunities.

The SDA product family is categorized into two subsets:

- 0.6m to 1.4m manually operated or fully automated antennas with interchangeable X, Ku, and Ka Band feed systems
- Larger 1.8 to 2.4 meter manually operated or fully automated antennas with interchangeable L, S, C, X, Ku and Ka-Band feed systems. Product family also includes the 1.25m QDMA antenna

The long term technical roadmap includes merging these two product offerings into a common antenna architecture. CPI Satcom & Antenna Technologies will begin development given a better understanding of future business and market opportunities.

2.0 SDA FAMILY OF ANTENNAS

The SDA Family of Antennas include the following

- C060F, C100F, C125F, and C140F small, light-weight man portable flyaway antennas
- C180F, C240F, and 1.25m QDMA medium weight man portable flyaway antennas

Each of the product offerings is scalable, modular, and offers interchangeable feed systems to support various RF frequency bands. CPI Satcom & Antenna Technologies can customize the product to best suit a particular CONOPS or customer need. Summary tables for environmental, RF, and design interchangeability metrics have been included to best illustrate the modular design architecture and capabilities of CPI Satcom & Antenna Technologies.

2.1 Small-Lightweight (0.6m thru 1.4m)

The C060F, C100F, C125F and C140F range of antenna systems support aperture sizes from 0.6m to 1.4m and are available with interchangeable X-Band, Ku-Band and Ka-Band feed cartridge systems. The antennas can be deployed in minutes without the use of standard tools and are manually operated in their base configuration. However, when fitted with the optional clip-on 815 series controller, they become fully automated auto-pointing antennas. The 815 controller can quickly be fitted to the C060 thru C140 antenna systems by a field operator, providing single-button satellite acquisition. More advanced control and configuration is available via an intuitive graphical Web User Interface (UI) or remote Applications Programming Interface (API). Options with this series of antenna include optional handheld controller, beacon receiver, DVB receiver, and feed options.

The pedestal architecture takes advantage of light-weight but structurally stiff carbon fiber technology for the reflector while light-weight 6061 grade aluminum coupled with stainless steel fixtures are used for the mount/pedestal. The pedestal drive is constructed around a low maintenance, high reliability worm wheel construction offering reduced backlash for accurate acquisition and pointing within a compact package. The antenna systems can be supplied with a variety of Solid-State Power Amplifiers /Block up Converters (SSPB's) and Low-noise amplifiers / block down converters (LNB's) including custom integration kits and packaging solutions.



Figure 1: (from left to right) C060FM, C100FM, C125FM, C140FM

The antenna nomenclature is detailed as such: **CxxxFM** denotes a manual flyaway antenna only. **CxxxFA** is the same antenna but with the addition of the CPI 815 series controller. The 815 controller can be added to an existing fielded CxxxFM at a later date to add auto-pointing capability, or a single 815 controller can be shared between multiple CxxxFM antennas.

▶ 2.1.1 815 Controller

The 815 series control system consists of two main electronic units: (1) the motorization unit and (2) control unit. The motorization unit kit interfaces to the antenna system and contains:

- AZ / EL motors / multi-axis motor drivers
- POL / EL limitswitches
- Bi-axial inclinometer (for tilt compensation) and integrated GPS receiver
- Incremental AZ (With motor mounted absolute encoder) and optical absolute EL encoder
- Magnetic compass (GPS compass support is an option)
- Interface to external systems including SSPB/LNB and customer-furnished GPS

The externally-mounted control unit is multi-purpose and provides the following system functionality:

- Houses the PC-based control system (PC-104 architecture)
- Beacon receiver (Option) and Digital Video Broadcast (DVB) receiver for satellite acquisition and logic. Beacon receiver and DVB receiver can be installed simultaneously
- AC-DC and DC-DC power supplies provided as part of standard configuration
- Heat sink and fans for thermal management
- Ethernet interface for Web UI access
- External Modem M&C and remote M&C interface
 - A full API protocol is available to enable third party equipment/user interfaces to control all features of the system



Small Deployable Antennas

Development began on the 815 series controller technology in 2009. Product improvements and technical advancements have been integrated ever since. At the current time, the 815 controller utilizes sky search and peaking algorithm to point the antenna to the target satellite. Once peaked, the motors are disabled and the antenna remains positioned on target. This approach reduces the duty cycle of motor operation, increasing reliability and extending use in the field. CPI Satcom & Antenna Technologies has a long term objective to integrate tracking capabilities within the 815 controller.

Figure 2 shows the 815 Motorization Unit and Control Unit required for automated satellite acquisition.



Figure 2. 815 Motorization Unit & Control Unit

The 815 controller block diagram is presented in **Figure 3**.

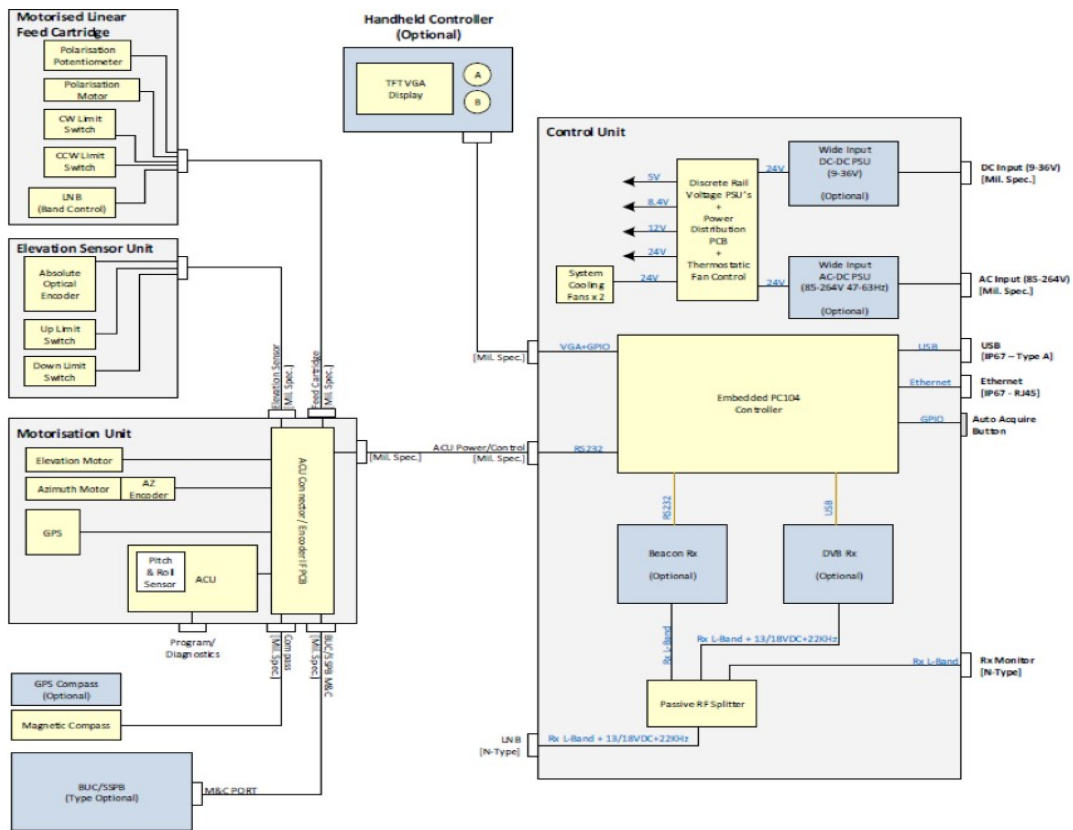


Figure 3. Small Lightweight Antenna with Motorization

Figure 4 shows the C100FA with 8W Ku-Band SSPB with ancillary motorization kit mounted directly to the tripod-based antenna pedestal, and the control unit placed in proximity to the antenna.

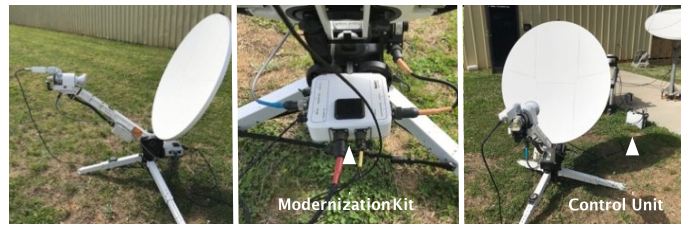


Figure 4. C100FA (C100FM with 810 Series controller) + 8W Ku SSPB

Integration of the motorization kit is a straight-forward exercise leveraging the design's state-of-the-art modular architecture. The user simply slides the controller box into the pedestal location designated for the AZ and EL hand crank. Once engaged, the kit is locked in place and active servo control is established. The user subsequently connects the appropriate cables (encoder, power, etc.) from motorization assembly to their respective antenna modules. (See **Figure 5**).



Small Deployable Antennas

22 Medium Weight (1.8m, 2.4m, and 1.25m QDMA)

The C180F, C240F, and 1.25m QDMA range of antenna systems are medium and lightweight man portable flyaway antenna with aperture sizes from 1.8m and 2.4m respectively which are available with interchangeable C, X, Ku and Ka-Band feed systems.

The antennas are ACU operated in their base configuration and can be manually operated by hand-crank. The controller is fully automated for auto-pointing antennas. The 825A controller provides simple control and satellite acquisition via a single button, optional handheld controller or more advanced control and configuration is available via an intuitive graphical Web UI.

The antennas can be supplied with a range of SSPB's and LNB's including custom integration kits and packaging solutions.

The medium-weight design approach is inherently different than the smaller aperture variants. However, we are actively "closing the gap" between the product families with respect to configuration management, controller support, and overall product architecture. **Figure 8** and **Figure 9** illustrate the antennas in their deployed configuration.

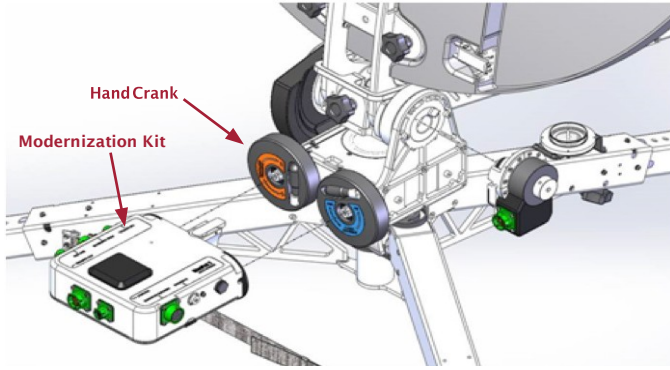


Figure 5. Motorization Kit Integration with Antenna Pedestal

► 2.1.2 815 User Interface

Figure 6 illustrates the Web-based User Interface capable of support satellite parameter management, IP Ethernet address configuration, system configuration, and remote software upgrades.

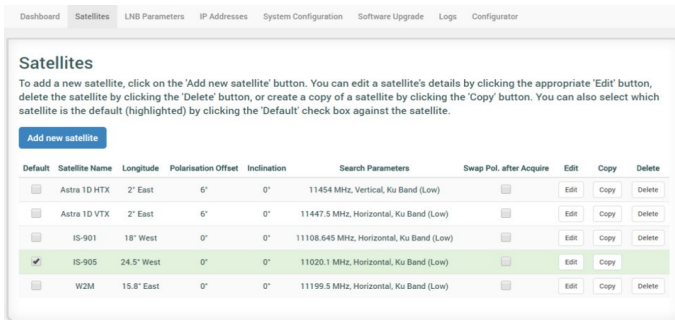


Figure 6. 815 Series Controller Web UI

The dashboard shown in **Figure 7** highlights observable states from the controller/antenna pedestal including, positioning data, beacon and modem receive signal levels, and component status. Other information that can be made available includes built-in-test (BIT) status, transmitter enable/disable functionality, and temperature monitors. The controller also provides a simple interface to commission and configure the system software where configuration files can be imported and exported.

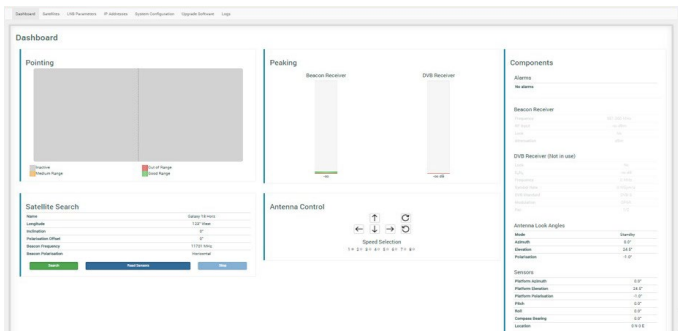


Figure 7. 815 Series Controller Dashboard UI

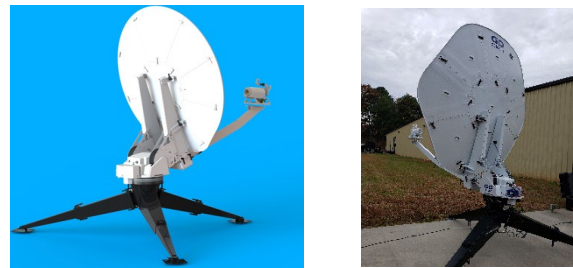


Figure 8. C180F (Left) and C240F (Right)



Figure 9. 1.25m QDMA Antenna

The medium-weight antenna systems contain the following key components. CPI Satcom & Antenna Technologies offers customers a wide variety of options that can be included (or excluded) depending on customer use.

- Custom high inductance Az/EI/Pol motor drives
- Motor-mounted absolute encoders for AZ and EL



Small Deployable Antennas

- 12 bit position sensors (on-axis resolvers are an option)
- Integrated 3-axis compass for base tilt and magnetic heading
- GPS receiver (option) / Embedded spectrum analyzer (option)
- Interface for external systems including SSPB/LNB, limit switches, and ancillary equipment
- Customer-furnished modem / Monitor and Control Interface
- 825A can support beacon and DVB receiver options. 830A can support beacon receiver option

The C180F and C240F share a common pedestal with the only difference being the size and shape of the aperture.

▶ 2.2.1 820A/825A/830A Controller

The medium-weight antennas are compatible with the 820A/825A/830A Antenna Control Unit (ACU) designed and developed by CPI Satcom & Antenna Technologies. They are not compatible with the 815 controller. A technical roadmap anticipates a common controller for the entire SDA product line. The 820A/825A ACU provides a sophisticated software suite of commands that have been developed and enhanced over the course of 2 decades. Automatic tracking capabilities can be supported as an option. CPI Satcom & Antenna Technologies leverages a lower-cost ACU to facilitate the 820A/825A offerings and have years of engineering and experience supporting the 830A SATCOM architecture for large antennas, small SDA and other positioning systems. The 820/825A and 830A are shown in **Figure 10** and **Figure 11**, respectively. The block diagrams identifying the key interfaces are detailed in **Figure 12**.

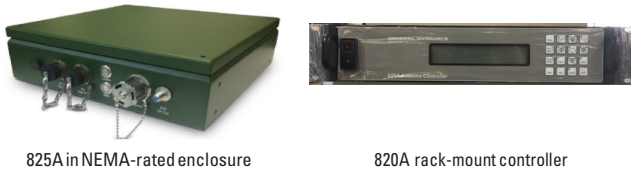


Figure 10. 820A/825A Antenna Control Unit (ACU)



Figure 11. 830A Antenna Control Unit (ACU)

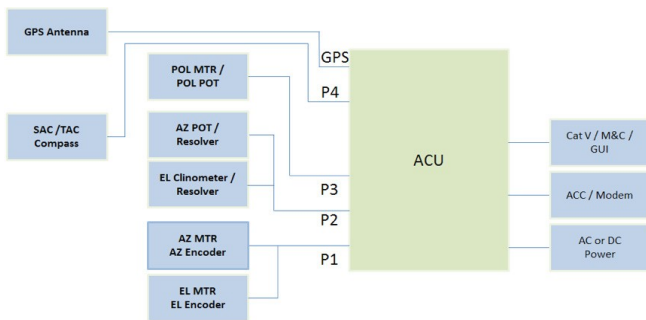


Figure 12. 820A/825A System Block Diagram

Although not shown, the SSPB and LNB signals are also routed thru, and supported by, the CPI Satcom & Antenna Technologies signal infrastructure.

▶ 2.2.2 820A/825A/830A GUI

The 830A series controller offers a touch-screen interface for push-button control or communications interface to a host computer. CPI Satcom & Antenna Technologies has designed the product such that the user is not limited in options during integration and deployment. **Figure 13** illustrates the touch screen.

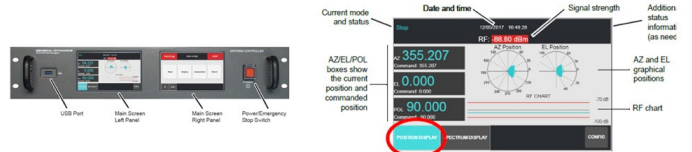


Figure 13. 830A (Shown) Front Panel and Satellite Window

23 Miscellaneous Performance Metrics

CPI Satcom & Antenna Technologies currently supports a standard M&C communication protocol. Each pedestal can support either a non-SAASM or SAASM compliant GPS receiver. CPI Satcom & Antenna Technologies has an established and valid account to receive and keep SAASM-compliant components. Ku-band operation, which requires linear polarization, achieves appropriate cross-polarization isolation based on the transmit and receive cross-pol performance along with the attitude performance of the on-axis tilt sensor mechanism.

The C060FA thru C140FA consumes ~40W during idle conditions and 100W during acquisition. Setup-time and acquisition time are both less than < 5 minutes each. The C180F and C240F consume 100W during idle conditions and 500W during acquisition. The acquisition time is conservative based on high load wind conditions. Setup time is ~30 minutes with an acquisition time of < 5 minutes. A weight summary of the CPI Satcom & Antenna Technologies SDA family of products shown below.

Table 1. SDA Weight Summary		
Product	Weight	Packaging
C060FM	23Kg (50lbs) including case	Single IATA Compliant Pelican Case
C100FM	32Kg (70lbs) including case	Single IATA Compliant Pelican Case
C125FM	50Kg (110lbs) + case	2 or 3 case options
C140FM	52Kg (115lbs) + case	2 or 3 case options
815 Series Controller	16Kg (35lbs) inc. case	Single IATA Compliant Pelican Case
C180F	300Kg (663lbs) includes cases	6 Case Solution
C240F	410Kg (903lbs) includes cases	7 Case Solution
1.25M QDMA	68Kg (150lbs) includes cases	2 Case Solution* - depending on options
820A-830A Controller	11.34 kg (25 lbs)	TBD



Small Deployable Antennas

3.0 DESIGN / INTERCHANGEABILITY SUMMARY

Table 2 provides a high level overview of the design approach for each proposed antenna with specifics on the reflector structure, tripod design, feed configuration, and control system summary.

	C060FM/C060FA	C100FM/C100FA	C125FM/C125FA	C140FM / C140FA	C180F	C240F	1.25m QDMA
Reflector	3 piece segmented carbon fiber Splash plate	6 piece segmented carbon fiber offset	8 Piece Segmented Carbon Fiber Offset		9 Piece Segmented Carbon Fiber Offset		9 Piece Segmented Carbon Fiber Center fed
Feed-arm/backing structure	Single piece backing structure	Folding Design	Folding Design	Folding Design	3 Piece Backing structure		Built-in Positioner in Case
Pedestal	EL over AZ worm drive pedestal with manual control		EL over AZ worm drive pedestal with manual control		EL over AZ cable drive pedestal with manual control		
Tripod	Folding/Telescopic Design		Folding/Telescopic Design		Telescopic Design		NA
Feed - C Band	NA				Offset, Linear or Circular, Standard Band or Extended Band, 2 port feed system		NA
Feed - X Band	Center Fed, Circular, 2 Port	Offset, Circular, 2 port feed system			Offset feed, Circular, 2 port feed system		Center Fed, Circular, 2 port feed system
Feed - Ku Band	Center Fed, Linear, 2 Port, Motorized	Offset, Linear, 2 port feed cartridge system, Motorized			Offset feed, Linear, 2 port, motorized		Center Fed Feed, Linear, 2 Port, Motorized
Feed - Ka Band	Centre Feed, Circular, 4 Port	Offset, Circular, 2 port feed cartridge system			Offset feed, Circular, 2 or 4 port feed		Center Fed, Circular, 2 Port Feed
Control System	Optional 815 Series quick fit auto pointing control system with single button operation, Web UI, GPS, Compass, Tilt compensation, Beacon Receiver, DVB Receiver, Modem Interface, AC Power, DC power				825A Series quick fit auto pointing control system with single button operation, Web UI, GPS, Compass, Tilt compensation, Beacon Receiver, DVB Receiver, Modem Interface and AC Power or DC power		
Transit Cases	Supplied with C060F thru C140F as standard				Transit cases supplied with antenna. Cases are designed for secured cargo.		

4.0 ENVIRONMENTAL COMPLIANCE SUMMARY

Table 3 summarizes the environmental compliance for the CPI Satcom & Antenna Technologies SDA product line. The 1.25m QDMA was not exercised thru any formal environmental test profile. The 1.25m QDMA has 300 units to both Army and Marines under the SWANN project and many more with various other agencies including the THAAD program.

Method	Test	Procedure	Criteria	Condition	C060FM/A	C100FM/A	C125FM/A	C140FM/A	C180F	C240F
500.6	Low Pressure (Altitude)	Procedure I	≈ 16404ft (5000m), -30°C, 1 hr	Storage/ Transit	Pass	Pass	Pass	Pass	Not Tested	Not Tested
		Procedure II	≈ 9842ft (3000m), -10°C, 1 hr	Operational	Pass	Pass	Pass	Pass	Not Tested	Not Tested
501.6	High Temperature	Procedure I	A1) 160F (71C), 7-24hr cycles	Storage/Transit	Pass	Pass	Pass	Pass	Pass	Pass
		Procedure II	(A1) 120F (49C), 3-24hr cycles, testing at max temp	Operational	Pass	Pass	Pass	Pass	Pass	Pass
502.6	Low Temperature	Procedure I	(C2) -35F (-37C) to -50F (-46C), 4 hr dwell	Storage/ Transit	Pass	Pass	Pass	Pass	Pass	Pass
		Procedure II	(C1) -5F (-21C) to -4F (-20C), 2 hr dwell	Operational	Pass	Pass	Pass	Pass	Pass	Pass
505.6	Solar Radiation	Procedure I	355 BTU/ft ² /hr (1120 W/m ²) and 120F (49C), 3-24hr cycles full spectrum lamps	Operational	Pass	Pass	Pass	Pass	Pass	Pass
506.6	Rain	Procedure I	4in/hr (10.16cm/hr), winds 40mph (64km/hr), 30 min, 4 side	Deployed	Pass	Pass	Pass	Pass	Not Tested	Not Tested
507.6	Humidity	Procedure II	95% RH and 86F (30C) to 140F (60C); 10-24hr cycles	Operational	Pass	Pass	Pass	Pass	Pass	Pass
509.6	Salt Fog	General Procedure	4-24hr periods (two wet and two dry)	Operational	Pass	Pass	Pass	Pass	Not Tested	Not Tested
510.6	Sand & Dust	Procedure I (Dust)	120F (49C), <30% RH, 1750 ±250 ft/min (8.9 ±1.3 m/s), 6 hrs at ambient, 6 hrs at high temp, 4 sides	Operational	Pass	Pass	Pass	Pass	Not Tested	Not Tested
		Procedure II (Sand)	120F (49C), 40 mph (18 m/s), 90 min per side, 4 sides	Operational	Pass	Pass	Not Tested	Not Tested	Not Tested	Not Tested
514.7	Vibration	Procedure I	Figure 514.7E-1. Category 24 - General minimum integrity exposure	Storage/ Transit	Pass	Pass	Pass	Pass	Not Tested	Not Tested
516.7	Shock	Procedure IV	Table 516.7-VII. Logistic transit drop test	Storage/ Transit	Not Tested	Not Tested	Pass	Pass	Not Tested	Not Tested
521.4	Ice/Freezing Rain	General Procedure	1 in (25.4 mm), once ice is deposited allowed 4 hrs to harden, operate after de-icing	Operational	Pass	Pass	Pass	Pass	Not Tested	Not Tested
GD/ES	Wind	Dynamic/Eutelsat Pull	Eutelsat Static Push/Pull Test, GD dynamic wind test	Operational	Pass	Pass	Pass	Pass	Not Tested	Not Tested



Small Deployable Antennas

5.0 TECHNICAL COMPLIANCE SUMMARY

Table 4 summarizes key technical considerations and responses for each product offering. Further details can be provided upon request. The 1.2mQDMA was ARSTRAT & WGS Certified through DoD SWANN variant.

Table 4. High Level Technical Compliance Summary and Comments											
Aperture/Frequency	REQUIREMENT					C060FA	C100FA	C125FA	C140FA	C180F	C240F
	C	X	Ku	Ka Comm	Ka Military	0.6m	1.0m	1.25m	1.4m	1.8m	2.4m
X/Ka Band ARSTRAT / WGS	Required - Certified or WIP					On Roadmap	On Roadmap	On Roadmap	On Roadmap	On Roadmap	On Roadmap
C/Ku Band - Intelsat, Inmarsat, Eutelsat, SES compliant	Required					TBD				TBD	TBD
15/Global Xpress certified	Desirable					Not currently available				Not currently available	Not currently available
HTS Capability	Desirable					Not currently available				Not currently available	Not currently available
Auto Pointing	Required					Compliant				Compliant	
Tracking	Required					On Roadmap				Compliant	
Embedded iDirect Modem	Required					CPI has existing M&C interface with iDirect modems for C060 to C140F.				Partial - iDirect modem could be housed separately	
Integrated GPS	Required					Compliant				Compliant	
Support external SAASM/GPS	Required					Compliant				Compliant	
Common controller GUI interface	Desirable					815 Controller Common for C060F to C140F				820A/825A/830A controller common to C180F and C240F	
Open AMIP support	Desirable					Can support. SW Development required.				Can support. SW Development required.	

6.0 RF PERFORMANCE SUMMARY

Table 5. C060F thru C140F RF Performance Summary				
Antenna Model	Frequency	X-Band (CP)	Ku-Band (LP)	Ka-Band
	Antenna Model	Transmit	7.90 to 8.40 GHz	13.75 to 14.5 GHz
Receive		7.25 to 7.75 GHz	10.95 to 12.75 GHz 10.70 to 12.75 GHz (C060F)	19.2 to 21.2 GHz
C060F	Tx Gain (Midband)	31.8 dBi	36.2 dBi	42.3 dBi
	Rx Gain (Midband)	30.4 dBi	34.6 dBi	38.3 dBi
	G/T @ 20 degrees	9.7 dB/K	14.4 dB/K	15.2 dB/K @ 19.7 GHz
C100F	Tx Gain (Midband)	36.6 dBi	41.4 dBi	46.6 dBi
	Rx Gain (Midband)	35.6 dBi	39.2 dBi	42.5 dBi
	G/T @ 20 degrees	15.7 dB/K	19.1 dB/K	19 dB/K @ 19.95 GHz
C125F	Tx Gain (Midband)	37.8 dBi	43 dBi	49.5dBi
	Rx Gain (Midband)	37.2 dBi	41.5 dBi	46.8dBi
	G/T @ 20 degrees	16.45 dB/K	19.17 dB/K	23.1 dB/K
C140F	Tx Gain (Midband)	38.8 dBi	44.5 dBi	51.1dBi
	Rx Gain (Midband)	38.1 dBi	42.8 dBi	48.5dBi
	G/T @ 20 degrees	17.45 dB/K	21.8 dB/K	25.1 dB/K



Small Deployable Antennas

Table 6. C180F thru C240F RF Performance Summary

	Frequency	C-Band	X-Band	Ku-Band	Ka-Band
Antenna Model	Transmit	5.85 to 6.425 GHz	7.90 to 8.40 GHz	13.75 to 14.5 GHz	29.5 to 31 GHz
	Receive	3.625 to 4.20 GHz	7.25 to 7.75 GHz	10.95 to 12.75 GHz	19.7 to 21.2 GHz
C180F	Tx Gain (Midband)	39.3 dBi	42.0 dBi	46.5 dBi	52.3 dBi
	Rx Gain (Midband)	35.6 dBi	41.3 dBi	44.9 dBi	49.1 dBi
	G/T @ 20 degrees	17 dB/k @ 3.9GHz w/35K LNA	20.8 dB/k @ 7.5GHz w/60K LNA	24.1 dB/k @ 11.8GHz w/70K LNA	25.3 dB/k @ 20.7GHz w/120K LNA
C240F	Tx Gain (Midband)	42.00 dBi	44.2 dBi	49.0 dBi	55.3 dBi
	Rx Gain (Midband)	38.2 dBi	43.5 dBi	47.1 dBi	52.3 dBi
	G/T @ 20 degrees	19.5dB/k @ 4.0GHz w/35K LNA	23.2 dB/k @ 7.5GHz w/55K LNA	25.5dB/k @ 10.95GHz w/70K LNA	28.1dB/k @ 20.7GHz w/150K LNA
1.25m QDMA	Tx Gain (Midband)	NA	37.6 dBi	43.6 dBi 41.6 dBi	48.4 dBi
	Rx Gain (Midband)	NA	36.7 dBi		45.3 dBi
	G/T @ 20 degrees	NA	15.7dB/k @ 7.5GHz w/60K LNA	20.4dB/k @ 11.7GHz w/70K LNA	21.5dB/k @ 20.2GHz w/120K LNA

7.0 PRODUCTION CAPABILITIES AND PRODUCT AVAILABILITY

Typical lead time for long lead components for CPI Satcom & Antenna Technologies Manual Flyaway Antennas is 12 weeks. Therefore, production lead times are ~14 weeks ARO at a production level of 2 units per week. This is primarily based on long lead components and factory loading. If the customer has a long term demand for higher quantities, factory scheduling and loading can be increased.

8.0 WARRANTY INFORMATION FOR SDA AND/OR SMALL DEPLOYABLE ANTENNAS

CPI Satcom & Antenna Technologies has provided the standard warranty terms and conditions. If further clarification is required, please contact CPI Satcom & Antenna Technologies.

Basic Warranty Coverage - All equipment shall conform to seller’s applicable specifications and are warranted against defects in materials and workmanship for a period of one (1) year from the date of shipment or for a longer period if specified and agreed in the order or in the equipment’s published documentation. If a defect arises during the warranty period, seller will, at its option, repair and return such equipment from its factory at no charge, or ship functionally-equivalent replacement equipment, at no charge (Delivered at Place (DAP), buyer’s designated location, Incoterms 2010).

RMA Process - Before returning any equipment, the buyer must contact seller’s customer service representative and provide proof of purchase and details of the alleged defect. Seller will provide Return Material Authorization (RMA) instructions and confirmation as to whether the equipment is under warranty. The defective equipment must be returned to seller’s facility within the period specified in the RMA instructions at buyer’s expense.

Warranty on Repaired or Replaced Equipment - Seller shall warrant all repaired or replaced equipment for ninety (90) calendar days after shipment or the remaining warranty term, whichever is longer. Seller’s total liability is limited to the original purchase price of the defective equipment.

Exclusions - This warranty does not apply to any equipment which seller determines has been subjected, by buyer or otherwise, to (a) testing for other than specified electrical characteristics, (b) operating and/or environmental conditions in excess of the maximum values established, (c) lightning strike, (d) mishandling, abuse, misuse, or neglect, (e) improper installation, testing, repair, alteration, modification, damage, assembly or processing that alters physical or electrical properties, (f) shipment by rail when special rail packing was not purchased, or (g) other causes that are not defects in materials or workmanship. Seller’s warranty will not be enlarged by and no obligation or liability will arise out of seller’s rendering of technical advice or provision of facilities in connection with any equipment sold hereunder. In addition, this warranty shall not apply to any customer furnished equipment that is included with seller’s equipment deliverables.

Software - Seller warrants that under normal use, any antenna control system Software shall perform the functions specified in its documentation. If the software’s functional performance does not materially conform to its documentation and seller is notified in writing and provided proof of purchase within ninety (90) days from the purchase date, then seller shall replace the software as buyer’s exclusive remedy.

Services - Seller warrants that its employees assigned to perform any services hereunder shall have the proper skill, training and background to perform in a competent and professional manner and that all work will be performed in accordance with the applicable statement of work. SELLER EXPRESSLY DISCLAIMS ANY WARRANTY RELATED TO TESTING OR SERVICES PROVIDED UNDER THE ORDER INCLUDING ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY, OR WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.



Small Deployable Antennas

Commercial Test Equipment - If buyer has purchased commercial test equipment, then the warranty for the equipment, the license for any software and the related software warranty provided with the equipment, is incorporated herein and made a part of these Terms.

Limitation of Liability - Seller's maximum warranty liability shall be limited to the price paid by buyer for the non-conforming or defective item(s). THIS WARRANTY EXTENDS TO BUYER ONLY AND MAY BE INVOKED ONLY BY BUYER

ON BEHALF OF ITS CUSTOMER(S). SELLER WILL NOT ACCEPT WARRANTY RETURNS DIRECTLY FROM BUYER'S CUSTOMERS OR USERS OF BUYER'S PRODUCTS. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, CONDITIONS OR REPRESENTATIONS WHATSOEVER, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS, ALL OF WHICH ARE HEREBY EXPRESSLY EXCLUDED.

9.0 APPENDIX: DEFINITIONS

Table of Abbreviations and Definition

Abbreviation	Definition	Abbreviation	Definition
API	Applications Programming Interface	K	degrees Kelvin
ARO	After receipt of order	KPP	Key Performance Parameters
BDC	Block Down Converter	lbs	Pounds
BUC	Block Up Converter	LDPC	Low-density parity-check
C	Degrees Celsius	LNA	Low Noise Amplifier
CDR	Critical Design Review	LNB	Low Noise Amplifier / Block Down Converter
Comm	Communication	LOS	Line of Sight
CONOPS	Concept of Operations	MMIC	Monolithic Microwave Integrated Circuit
COTS	Commercial Off-The-Shelf	MODCOD	Modulation and Coding
dB	Decibel	Msp	Mega samples per second
dBc	Ratio of a non-carrier power component expressed to the total power in a carrier, expressed in dB	MTBF	Mean Time Between Failure
dBd	decibel isotropic	OMT	Ortho-mode transducer
dBm	dB relative to 1-milliwatt	OQPSK	Offset Quadrature Phase Shift Keying
dBW	dB relative to 1-watt	Psat	Saturated Output Power
DC	Direct Current	PDR	Preliminary Design Review
EGI	Embedded GPS/INS	QPSK	Quadrature Phase Shift Keying
EIRP	Effective Isotropic Radiated Power	RF	Radio Frequency
EI	Elevation	RFI	Request for Information
ESS	Environmental Stress Screening	RX	Receive
FCC	Federal Communications Commission	SIL	System Integration Lab
FET	Field Effect Transistor	SME	Subject Matter Expert
FoA	Family of Antennas	SRR	System Requirements Review
G/T	Antenna Gain-to-noise Temperature	SSPA	Solid State Power Amplifier
GHz	Gigahertz	SSPB	Solid State Power Amplifier / Block Up Converter
GPS	Global Positioning System	SWAP	Size, Weight, and Power
Hz	Hertz	TIM	Technical Interchange Meeting
IAW	In Accordance With	TLNB	Tunable LNB
ICD	Interface Control Document	TRB	Tracking Receiver
IDD	Interface Description Document	TRL	Technology Readiness Level
IF	Intermediate Frequency	TX	Transmit
IMFET	Internally Matched Field Effect Transistor	UI	User Interface
INS	Inertial Navigation System	VDC	Volts DC
IRAD	Internal Research and Development	W	Watts
		WG	Waveguide



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