Enabling GNSS Innovation for Operators

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« GPS » and « Innovation » …. ?

- **When we think GPS for aviation, what comes to mind?**
  - Just a position source?
  - It's so standard! Almost like a commodity…
  - Like we have on our phones, or to navigate with our cars?
  - Even small general aviation aircrafts have GPS today

- **A GPS receiver can be much more than what meets the eye**
  - How can that little box provide even more added value to you, the operator?

- **Keyword is INNOVATION**

Innovation has always been within CMC's DNA

- **Guglielmo Marconi: true innovator, inventor of wireless telegraphy in the 1890s**
  - The first actual text message!
  - Co-laureate of the 1909 Nobel Prize for physics

120 YEARS OF INNOVATION

- **Creation of Marconi's Wireless Telegraph Company of Canada in 1903**
  - 1925: name changed to **C**anadian **M**arconi **C**ompany : → **CMC**

- **Pioneers in developing and manufacturing the first Doppler Velocity Sensors in the 50s and 60s**
  - Standalone navigation solution

- **Canadian Marconi Company naturally switches towards high-end aviation products, introducing its GNSS receivers**

- **2001: becomes CMC Electronics Inc to reflect its focus on avionics, while still honoring its rich history as an innovator**

Enabling GNSS Innovation for Operators

- **With more than 30 Years of excellence in GNSS innovation, CMC Electronics is globally renowned as an industry-leading GNSS supplier, recognized for delivering products with exceptionally high reliability in the most challenging environments**

- **What is the differentiator?**
  - Constantly innovate → think outside the box
  - Never compromise on quality

- **The key is to develop and deliver niche products and innovative functionalities, bringing <u>true added-value to our customers</u>**

- **We propose solutions others can't do and won't do**
  - We are customer oriented
  - We customize
  - We are agile

Enabling GNSS Innovation for Operators: Top-Level

- **Be a visionary on how GPS technology best serves the industry**
- **For example: CMC historically led the way to Satellite Based Augmentation System (SBAS), wrote and oversaw most of the DO-229D MOPS development when many other industry participants gave up on SBAS at that time**
- **Today, SBAS is a world standard – and it's still growing**
  - Active: WAAS, EGNOS, GAGAN, MSAS, KASS
  - In development: BDSBAS, SDCM, ANGA, SouthPAN
- **Benefits of SBAS are used in many aviation applications today**
  - Surveillance: ADS-B compliance in growing regions in the world
  - Navigation: Performance Based Navigation (PBN)
  - Approach capabilities: Localizer Performance with Vertical Guidance (LPV)

Enabling GNSS Innovation for Operators: Design

- **The philosophy:**
  - Can't be a me-too
  - Never compromise on quality

- **Examples?**
  - ✓ CMC was first to use Narrow Correlator™ technology in aviation - technology that drastically improves the pseudo-range accuracy
  - ✓ CMC invented & patented a super-stable oscillator technology, eliminating "micro-jumps" that could cause loss of lock due to "micro" oscillator upsets
  - ✓ CMC developed an advanced carrier to noise density algorithm, superior to the ones published
  - ✓ CMC developed a proprietary multipath mitigation solution

Narrow Correlator™ is trademark of NovAtel Inc.

Enabling GNSS Innovation for Operators: Design

- **These innovative design choices better serves you, the operator:**
  - ✓ High quality design – making for an exceptionally robust and reliable GNSS receiver
  - ✓ Designed to operate in the most challenging environments
  - ✓ Very tolerant to GNSS jamming
- **The track record speaks for itself:**
  - ✓ Fielded MTBF is in the order of 100k's of flight hours (more on that soon)
  - ✓ No Airworthiness Directive was ever issued against any of CMC's GPS products since its original inception, covering decades of operation

Enabling GNSS Innovation for Operators: System

- **"A GPS receiver can be much more than what meets the eye"**
  - This receiver can be more than your standard A743 sensor for Position, Velocity and Time

- **Proposing more value to the operator that nobody has never thought of**
  - Innovation is the key

- **Examples?**
  - ✓ CMC was first to field a completely standalone LPV solution
  - ✓ CMC was first and only to field a completely standalone, non-MMR GBAS solution
  - ✓ CMC was first to field a commercial, non-ITAR Have Quick timing interface
  - ✓ CMC was first to develop a Doppler Velocity Sensor look-alike

- **Standalone and customizable: makes it much easier to integrate on your platform**

CMC's Current SBAS Products

- **CMA-3024 GNSSU**
  - TSO-C145 SBAS GPS receiver
  - Fully ADS-B Out compliant
  - Fielded MTBF >= 190,000FH

CMA-3024 GNSSU

- **CMA-5024 GLSSU**
  - All capabilities of CMA-3024, plus:
    - TSO-C146: **standalone LPV (equivalent to CAT-I)**
    - Embedded GVS functionalities and Have Quick timing
    - Certified up to DAL-A
    - Fielded MTBF >= 550,000FH

CMA-5024 GLSSU

- **CMA-6024 GLSSU**
  - All capabilities of CMA-5024, plus:
    - TSO-C161 & TSO-C162 for **GBAS GLS precision approaches**
    - Integrated VDB receiver built-in
    - Fielded MTBF >= 400,000FH

CMA-6024 GLSSU

CMC's Current SBAS GPS Products

- **CMA-4124 GNSSA**
  - Designed for incorporation into all avionics applications such as Multi-Mode Receivers (MMRs)
  - TSO-C145 SBAS GPS receiver
  - TSO-C146 for LPV (equivalent to CAT-I)
  - Fully ADS-B Out compliant
  - MTBF of 80,000FH

CMA-4124 GNSSA

CMA-4124 GNSSA Receiver Module — Specifications

DESIGN REQUIREMENTS	
ARINC	743B Characteristic 755-4 Characteristic
RTCA	DO-229D DO-246D (planned) DO-253C (planned)

CERTIFICATION	
FAA	TSO-C145c Beta-3 equivalent for an electronics card TSO-C146c Delta-4 equivalent for an electronics card TSO-161a (planned)

RECEIVER	
Type	2 Active Antenna Ports with 2 GPS L1 RF channels, 24 parallel Narrow Correlator ® digital processing channels
Frequency	L1, 1575.42 MHz, C/A code
Acquisition Sensitivity	-134 dBm @ 32.87 dB Hz C/No
Tracking Sensitivity	-134 dBm @ 31.04 dB Hz C/No
Time to First Fix	< 75 seconds maximum, 95% confidence
Hor. Position Accuracy	15 meters, 95%, S/A off
Differential	Better than 1.0 meters, 95%
Altitude Accuracy	20 meters, 95%, S/A off
Velocity Accuracy	0.5 knots, 95%, S/A off (0.33kts horizontal, 68 ft/min. vertical)
Position Update	10 independent solutions per seconds (10Hz solution rate)

SOFTWARE	
Language	Ada
Level	DO-178B Level A design DO-178B, Level B certified

HARDWARE	
Level	DO-254 Level A Design DO-254 Level B Certified
Processor	Pentium Equivalent

OTHER FEATURES	
FDE & Predictive RAIM	Fault detection and isolation incorporated High-performance parity space technique uses pressure altitude automatically
Data Loader	On-aircraft software upload via ARINC 615 Data Loader (optional)
Pressure Altitude	Automatic calibration and use in navigation and RAIM
BITE	Continuous coverage, >95% fault detection

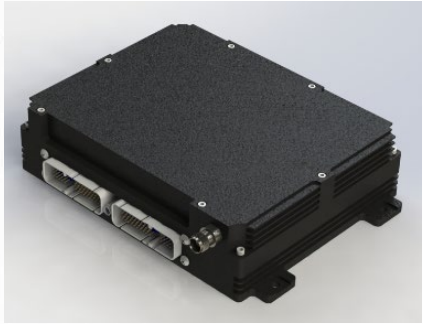
PHYSICAL	
Size	6.6" x 4" x 0.6" (168 x 102 x 15 mm)
Weight	<0.5 lb (0.23 kg)
Input Power	+3.3, +5.0, +/-12.0 VDC
Consumption	12 W maximum 10 W typical (full configuration)
MTBF	60,000 hours

ENVIRONMENTAL	
The CMA-4124 GNSSA receiver is designed to meet the following DO-160E categories when properly installed in a unit enclosure:	
Temperature	-55°C to + 70°C
Altitude	55,000 feet (16,500 meters)
Humidity	Supports DO-160E, Cat. C
HIRF	Designed for 200 V/m when properly enclosed

INTERFACES	
Inputs	9 ARINC 429 4 RS-422/232 11 discrete inputs
Outputs	5 Independent ARINC 429 4 RS-422/232 2 discretes 3 time marks (1 Hz)

CMC's NextGen MCMF GNSS Receiver

- **With this excellent track record, the future looks bright for what comes next!**
- **CMC is currently developing its Next Generation, Multi-Constellation Multi-Frequency (MCMF) GNSS Receiver**
- **This new product will support all the legacy functionalities, but will also be ready to support the upcoming GNSS constellations as they become available:**
  - Galileo, Beidou, IRNSS, QZSS, etc…
  - CMC is driving and fully aligned with the latest and future Minimum Operational Performance Standards
- **Sneak preview:**
  - SWaP reduction
  - Velocity Integrity
  - Jamming and Spoofing defensive measures
  - And many more innovative features



Closing Arguments

- **To be successful in today's modern and very competitive ecosystem: innovation**
  - This is and always been CMC's model, driven by its legacy inherited from the Marconi era

- **If you have the same mindset in your own line of business, we want to hear you out**
  - You are an operator / integrator, and you are geared towards innovation?
  - You want to succeed and keep your competitors at bay?
  - You have a business proposition / innovative idea involving GNSS?

- **We can help you!**
  - CMC is agile and customer oriented, we will customize to meet your requirements

- **We are interested to hear your own story, and listen to what you have in mind**

- **CMC is dedicated into enabling GNSS innovation for you**

- **Thank you for your attention**