



Technical Note

Compatibility Test of CAMINO-108 GPS Function between u-blox AMY-6M and u-blox EVA-M8M

Document No : TN-CAMINO-108-GPS-01

Issue : 1.0

Released Date : 2019_1211

File Name : TN_CAMINO-108_GPS_2019_1211.doc

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Document status

Amendment NO.	Date	Version	Page(s)	INCORP. By	Change Note (EM)
1	2019/12/11	1.0	19	Jack, Ch	New Release



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1 General Information

The original design of CAMINO-108 product family (including CAMINO-108, CAMINO-108W and CAMINO-108S) GPS function was to use the u-blox AMY-6M GPS module. u-blox announced the end-of-life (EOL) of AMY-6M production at the end of 2017 and the last-time-buy was in June 2018. Therefore, the new GPS module u-blox EVA-M8M is selected to replace the AMY-6M. This compatibility test is to verify that the GPS function of EVA-M8M on CAMINO-108 is fully compatible with AMY-6M.

1.1 Technical data for AMY-6M (Key Performance)

The key performance of AMY-6M is shown in the figure 1. The key features are listed below:

- receiver type: 50 channels; GPS L1 band C/A code; SBAS etc.
- Time to first fix (TTFF): 27s second under cold start condition
- Sensitivity: -159 dBm during tracking and navigation
- Horizontal position accuracy: 2.5m (GPS); 2.0m (SBAS)



1.3 GPS performance

Parameter	Specification	
Receiver type	50 Channels GPS L1 frequency, C/A Code SBAS: WAAS, EGNOS, MSAS	
Time-To-First-Fix ¹	Cold Start (without Aiding)	27s
	Warm Start (without Aiding)	27s
	Hot Start (without Aiding)	1 s
	Aided Starts ²	4 s
Sensitivity ³	Tracking & Navigation	-159 dBm
	Reacquisition	-159 dBm
	Cold Start (without Aiding)	-147 dBm
Maximum Navigation update rate		5 Hz
Horizontal position accuracy ⁴	GPS	2.5 m
	SBAS	2.0 m
Configurable Timepulse frequency range		0.1 Hz to 1 kHz
Accuracy of Timepulse signal ⁴	RMS	30 ns
	99%	<60 ns
	Granularity	21 ns
Velocity accuracy ⁵		0.1m/s
Heading accuracy ⁵		0.5 degrees
Dynamics		≤ 4 g
Operational Limits ⁶	Altitude	50,000 m
	Velocity	500 m/s

Table 2: AMY-6M GPS performance

Figure 1 GPS Performance of AMY-6M



1.2 Technical data for EVA-M8M (Key Performance)

The key performance of EVA-M8M is shown in the figure 2. The key features are listed below:

- Receiver type: 72 channels; GPS/QZSS L1C/A, GLONASS L1OF, BeiDou B1I, Galileo E1B/C, SBAS L1C/A etc.
- Time to first fix (TTFF): 26 seconds under cold start condition (GPS and GLONASS mode)
- Sensitivity: -164 dBm during tracking and navigation
- Horizontal position: 2.5m (GPS& GLONASS; GPS); 4m (GLONASS); 3m (BeiDou)



EVA-M8M - Data Sheet

1.3 Performance

Parameter	Specification					
Receiver type	72-channel u-blox M8 engine GPS/QZSS L1C/A, GLONASS L1OF, BeiDou B1I, Galileo E1B/C, SBAS L1C/A: WAAS, EGNOS, MSAS, GAGAN					
Accuracy of time pulse signal	RMS	30 ns				
	99%	60 ns				
Frequency of time pulse signal	0.25 Hz...10 MHz (configurable)					
Operational limits ¹	Dynamics	≤ 4 g				
	Altitude	50,000 m				
	Velocity	500 m/s				
Velocity accuracy ²	0.05m/s					
Heading accuracy ²	0.3 degrees					
GNSS	GPS & GLONASS	GPS	GLONASS	BeiDou	Galileo	
Horizontal position accuracy ³	2.5 m	2.5 m	4.0 m	3.0 m	TBD	
Max navigation update rate	ROM	10 Hz	18 Hz	18 Hz	18 Hz	18 Hz
	FLASH	5 Hz	10 Hz	10 Hz	10 Hz	10 Hz
Time-To-First-Fix ⁴	Cold start	26 s	30 s	31 s	39 s	57 s
	Hot start	1 s	1 s	1 s	1 s	1 s
	Aided starts ⁵	3 s	3 s	3 s	7 s	7 s
Sensitivity ⁶	Tracking & Navigation	-164 dBm	-164 dBm	-163 dBm	-160 dBm	-154 dBm
	Reacquisition	-160 dBm	-159 dBm	-156 dBm	-155 dBm	-152 dBm
	Cold start	-148 dBm	-147 dBm	-145 dBm	-143 dBm	-133 dBm
	Hot start	-157 dBm	-156 dBm	-155 dBm	-155 dBm	-151 dBm

Table 1: EVA-M8M performance in different GNSS modes

Figure 2 Performance of EVA-M8M

2 GPS Function Related Schematic and Layout at CAMINO-108 product family

This section will briefly describe the corresponding circuit and layout of AMY-6M and EVA-M8M modules at CAMINO-108 devices separately.

2.1 AMY-6M Related Schematic and Layout at CAMINO-108

Please refer to figure 3 and figure 4 for the related schematic and layout of AMY-6M GPS

module at CAMINO-108.

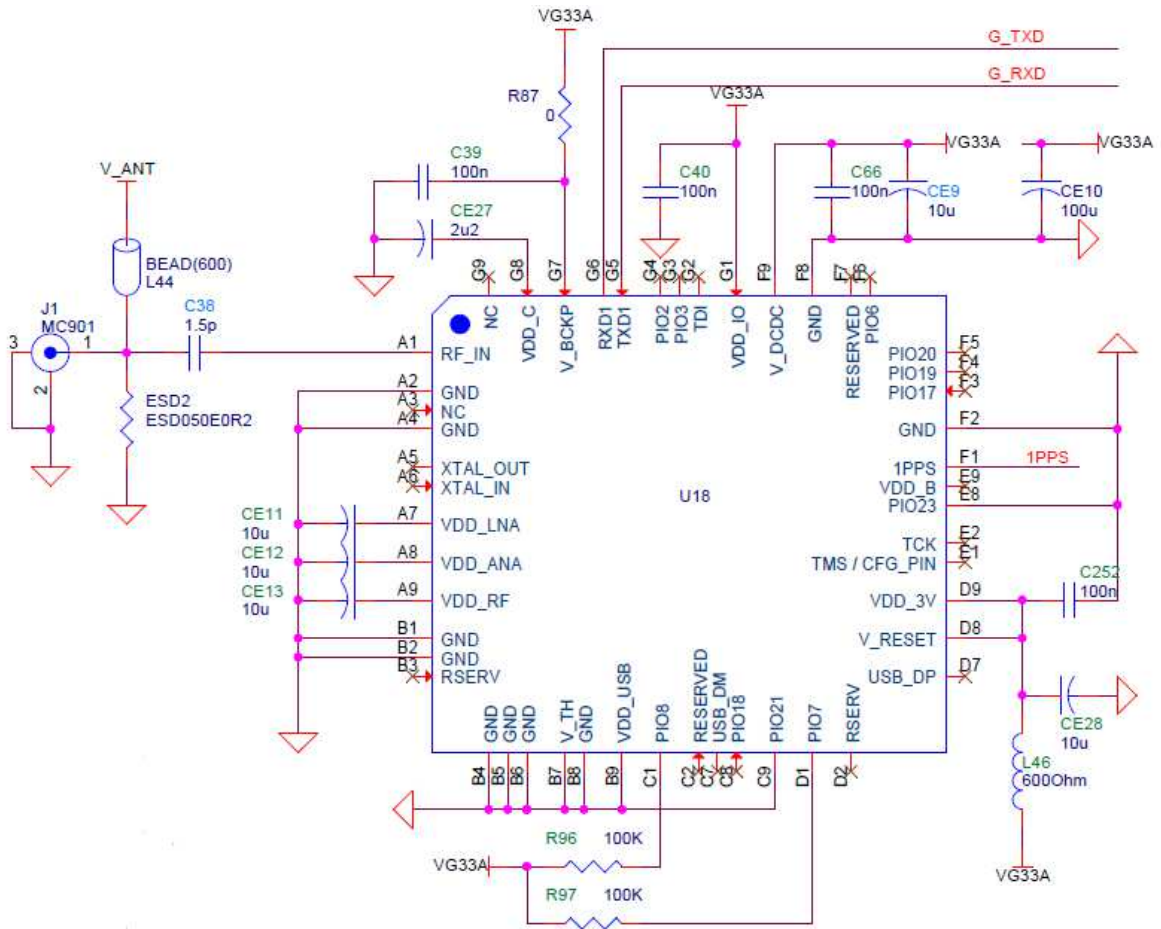


Figure 3 Related Schematic of AMY-6M at CAMINO-108

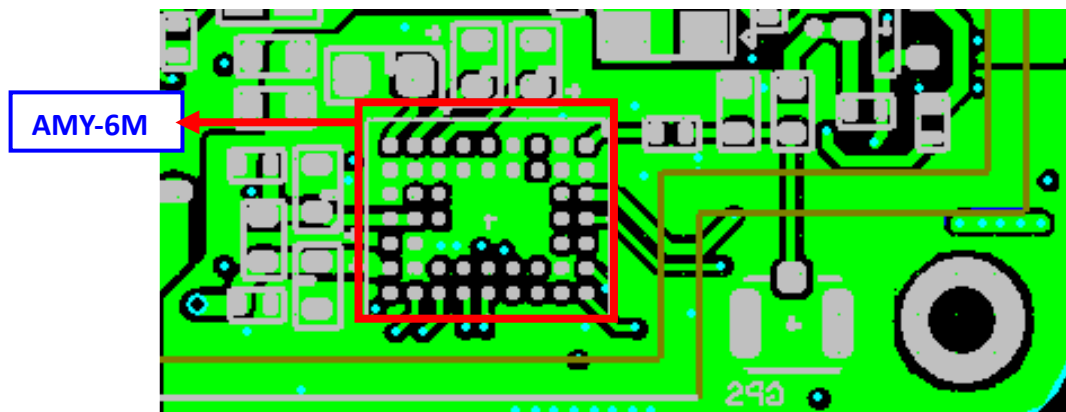


Figure 4 Related Layout of AMY-6M at CAMINO-108

2.2 EVA-M8M Related Schematic and Layout at CAMINO-108

Please refer to figure 5 and figure 6 for the related schematic and layout of EVA-M8M module at CAMINO-108.

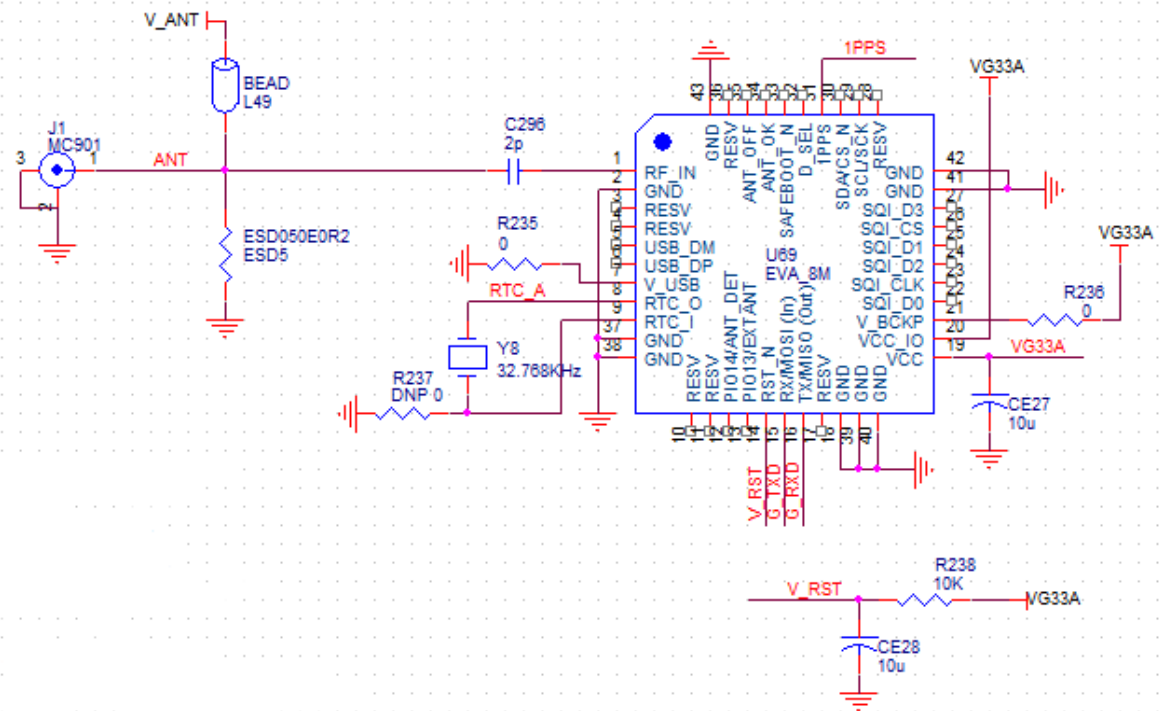


Figure 5 Related Schematic of EVA-M8M at CAMINO-108

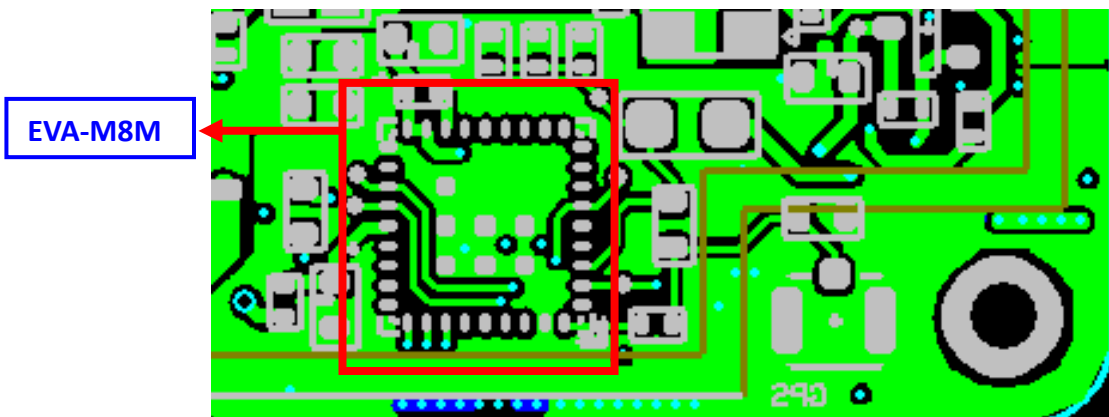


Figure 6 Related Layout of EVA-M8M at CAMINO-108

3 Test Environment Set up

Please refer to Figure 7, the setup of test environment for AMY-6M and EVA-M8M GPS function compatibility test. There are two CAMINO-108 devices, which equipped with AMY-6M and EVA-M8M GPS modules separately and placed side by side on the table (Please refer to Figure 8, the left-hand-side is CAMINO-108 with AMY-6M and the right-hand-side is CAMINO-108 with EVA-M8M). Figure 9 is the snapshot of AMY-6M and Figure 10 is the snapshot of the EVA-M8M). Two GPS antennas were used for this test. Both of these GPS antennas are placed outside the window with clear sky and keep around 1m distance to avoid signals Interference from each other (refer to Figure 11). Because this test is mainly focus at GPS function verification, the VHF antennas were not connected to CAMINO-108 devices. The DC power supply was set to 12V for

these two CAMINO-108 operation. A laptop computer is used to record the GPS output sentences and analyze the received satellite signals by two GPS module at CAMINO-108 devices.



Figure 7 Test Set up for of AMY-6M and EVA-M8M at CAMINO-108



Figure 8 AMY-6M (left-hand-Side) and EVA-M8M (right-hand-side) at Different CAMINO-108 Mainboards



Figure 9 Snapshot of AMY-6M at CAMINO-108

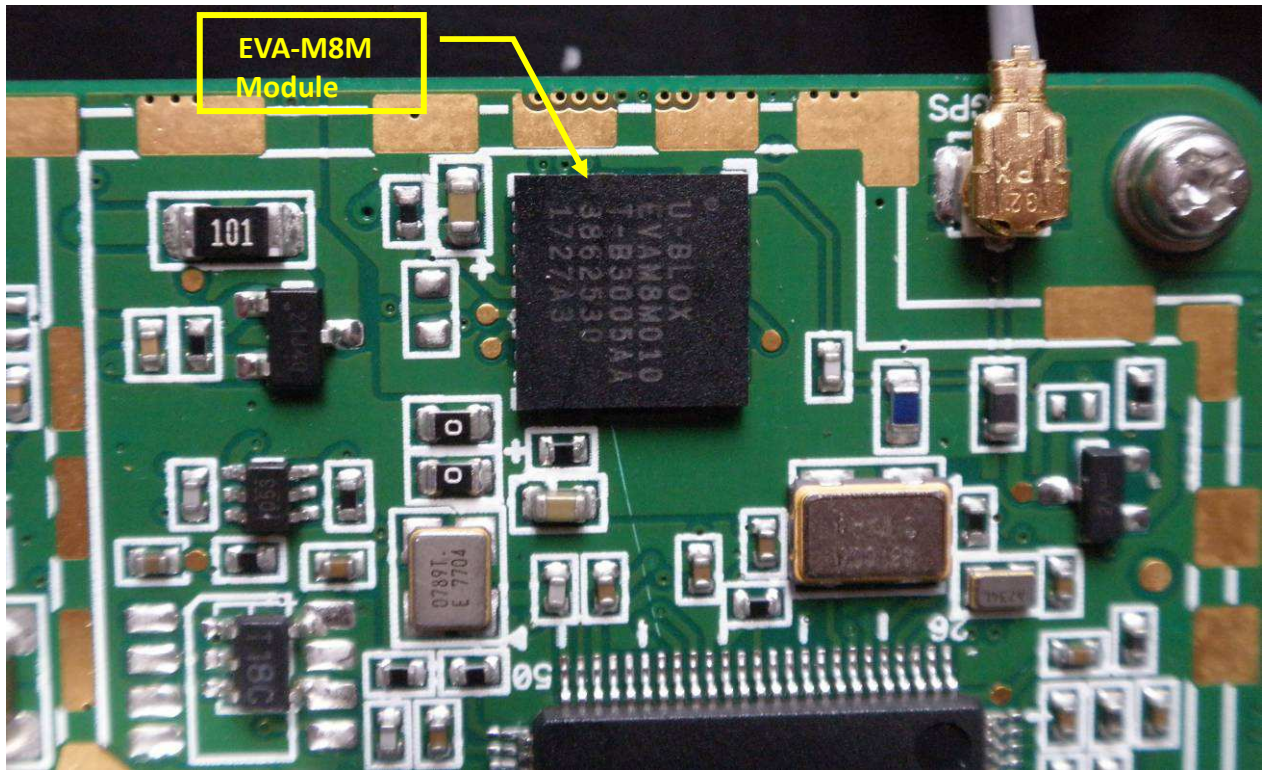


Figure 10 Snapshot of EVA-M8M at CAMINO-108

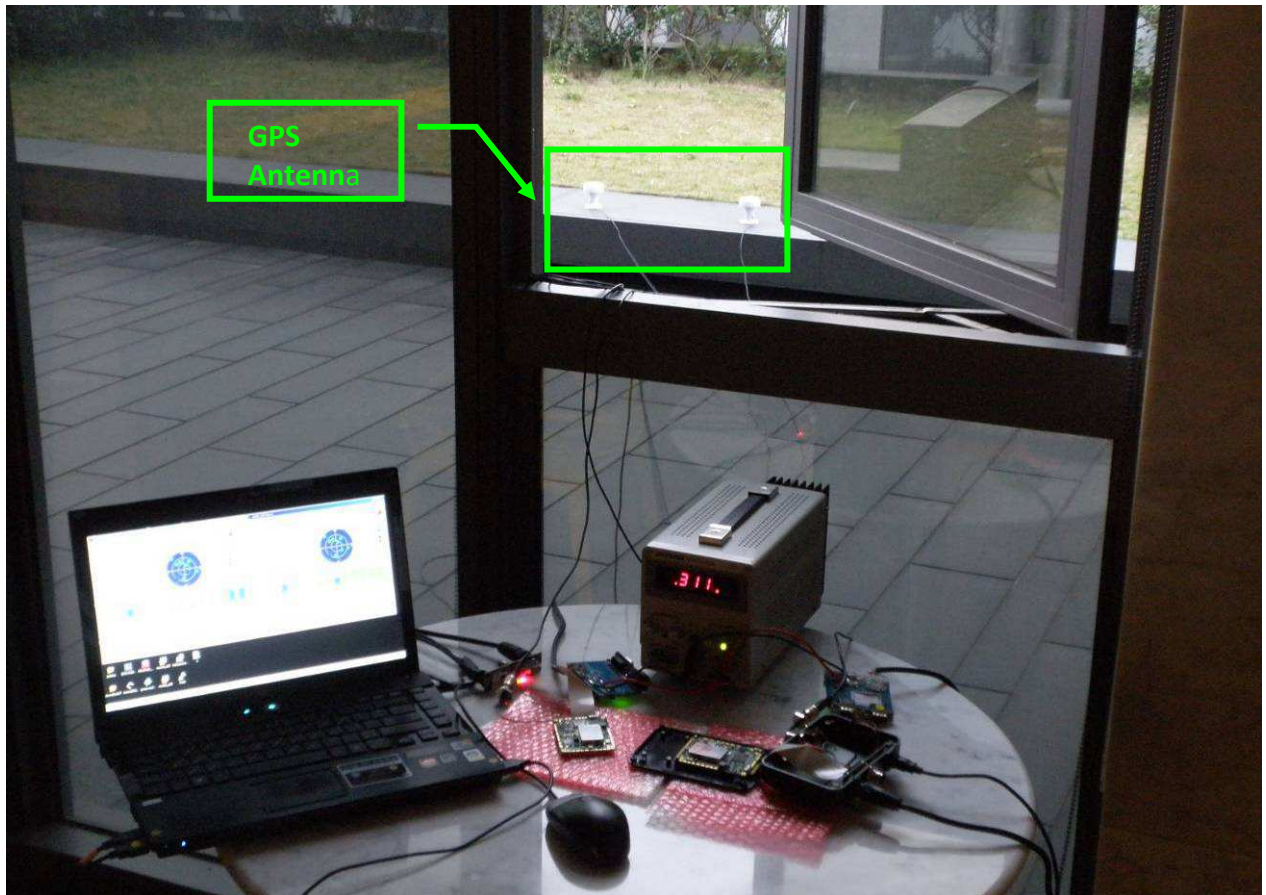


Figure 11 Two GPS Antennas were used for test

3.1 Test Requirement for GPS function Compatibility Test

This GPS function compatibility test is to verify the normal operation of the CAMINO-108 GPS function when using EVA-M8M replaced AMY-6M. For analyzing the test data, the strength of the received C/N value after the GPS 3D fixed is used as comparison reference. The TTFF times from cold start to 3D fixed of two CAMINO-108 devices are sampled and recorded as the judgement for compatibility.

4 Test Result and Summary

C/N values and TTFF times are recorded in sections 4.1 and 4.2 respectively. The conclusion of the compatibility test is described in Section 4.3.

4.1 Comparison of C/N Value

The received C/N value is recorded at figure 12. The left side is data output from AMY-6M and the right side is data output from EVA-M8M. It can be seen from the figure that the two modules have equivalent receiving capabilities for GPS satellites. Except that GPS satellites, The EVA-M8M module also presents the C/N values of GLONASS satellites.

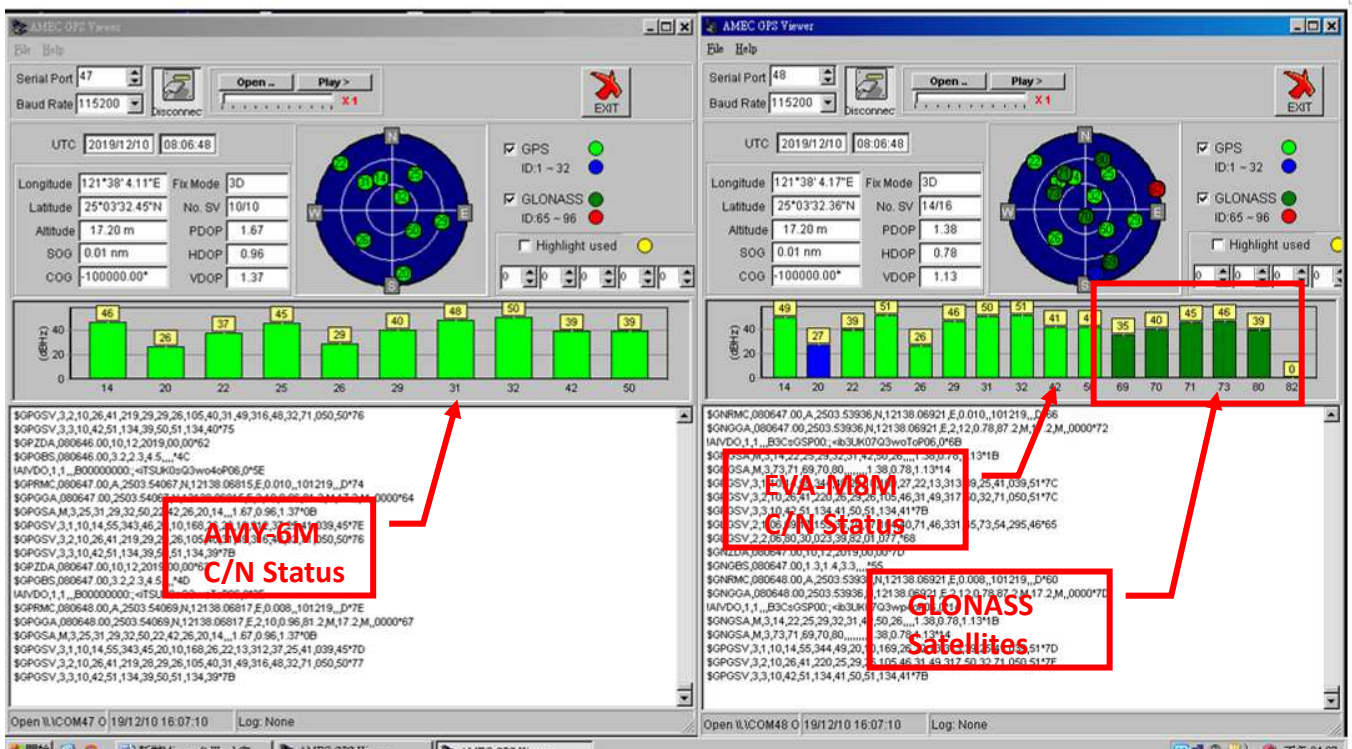


Figure 12 Comparison of C/N value between AMY-6M and EVA-M8M

4.2 Comparison of TTFF from cold start to 3D fixed

The following tables records the 3D positioning time of the AMY 6M and EVA M8M for five times (from cold start), and then repeated tests with swapping the GPS antennas to CAMINO-108 devices are carried out again. Base on the tables, the TTFF time for EVA-M8M is also close to AMY-6M.



Table 1 Test Record of TTFF for AMY-6M and EVA-M8M

Test Run	AMY-6M (S)	EVA-M8M (S)	Record of C/N value
1	38	44	Figure 13
2	33	34	Figure 14
3	38	44	Figure 15
5	38	44	Figure 16
5	42	42	Figure 17

Table 2 Test Record of TTFF for AMY-6M and EVA-M8M after swapping GPS antenna

Test Run	AMY-6M (S)	EVA-M8M (S)	Record of C/N value
1	40	46	Figure 18
2	36	41	Figure 19
3	42	42	Figure 20
5	33	33	Figure 21
5	36	44	Figure 22

4.3 Summary

After analyzing the test results, we are confidence that EVA-M8M is fully compatible with AMY-6M and it can be used to replace AMY-6M at CAMINO-108 product family.

5 Appendix

The figures of 3D positioning corresponding to each TTFF time tests are shown as below:

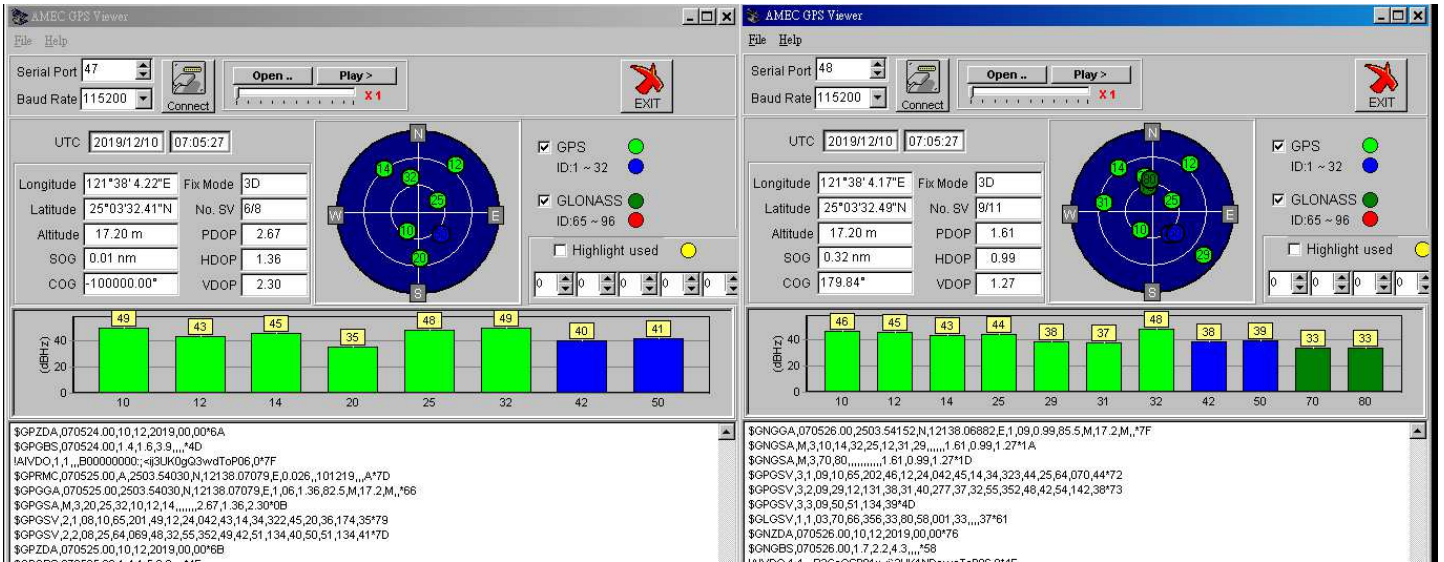


Figure 13 Record of 3D positioning during TTFF time test -1

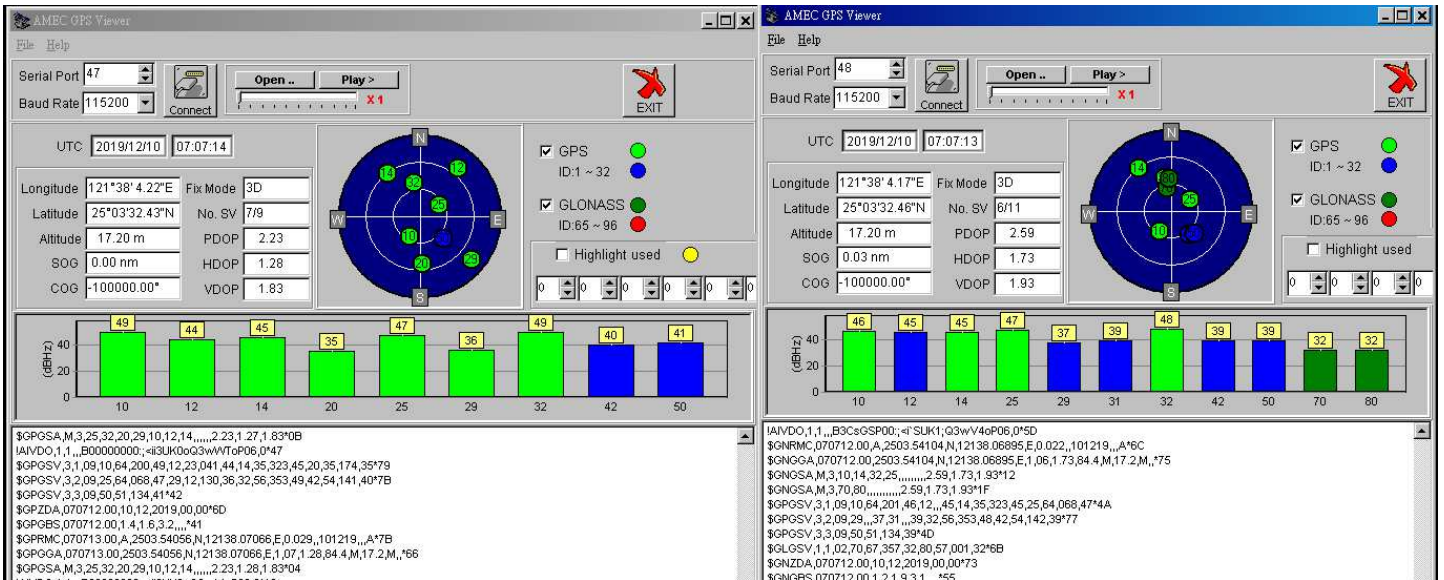


Figure 14 Record of 3D positioning during TTFF time test -2

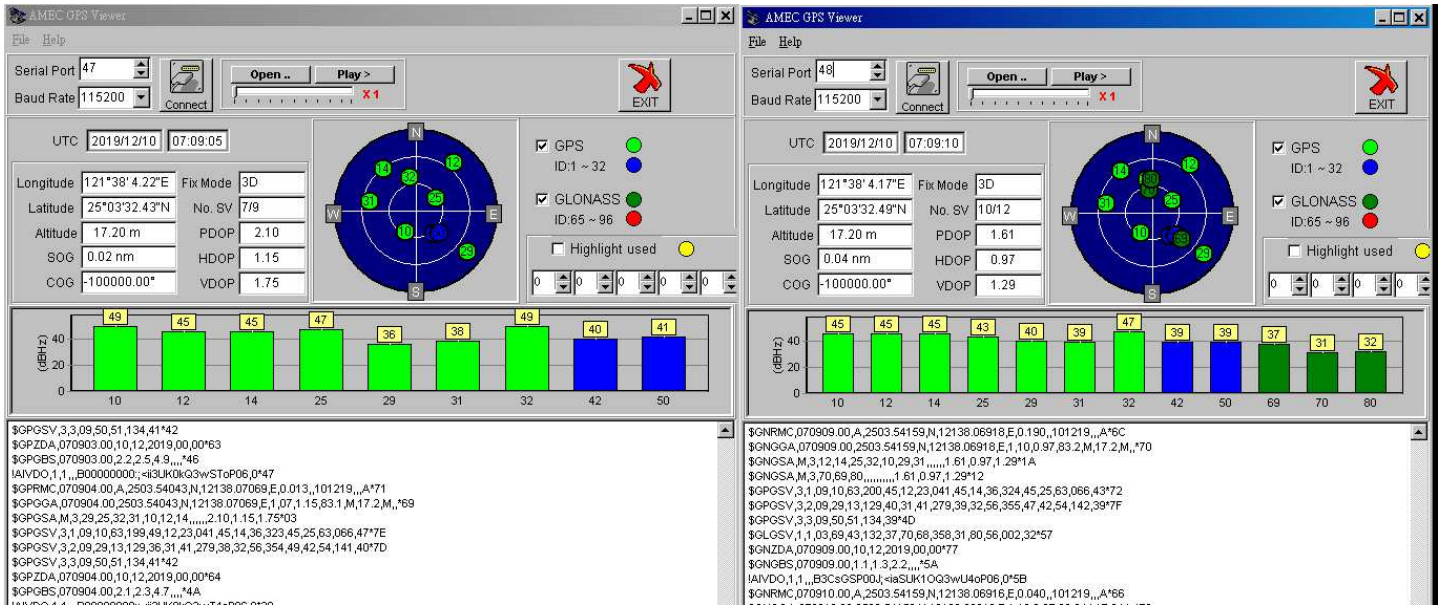


Figure 15 Record of 3D positioning during TTFF time test -3

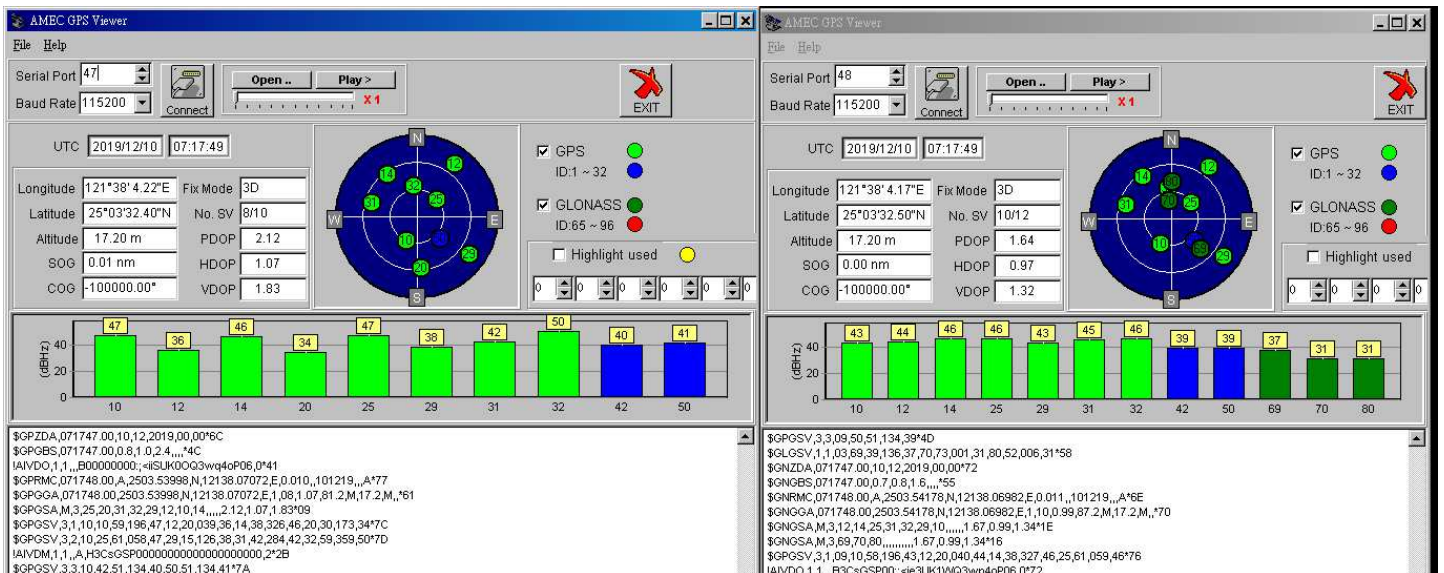


Figure 16 Record of 3D positioning during TTFF time test -4

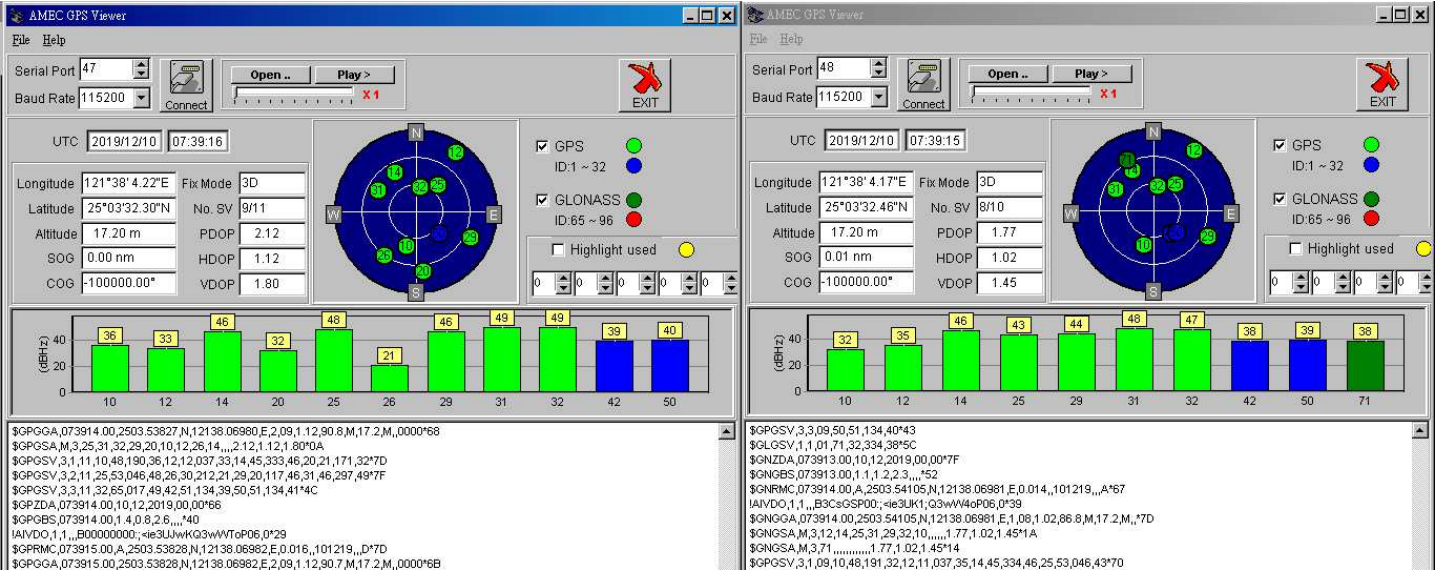


Figure 17 Record of 3D positioning during TTFF time test -5

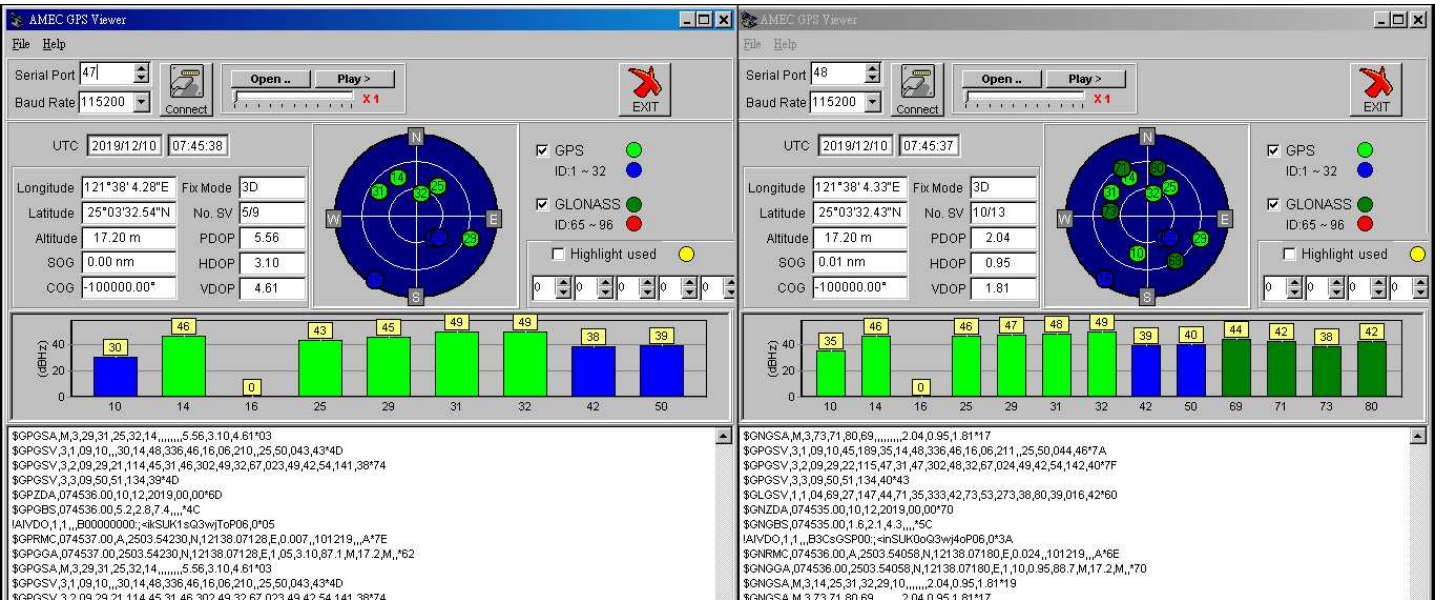


Figure 18 Record of 3D positioning during TTFF time test -1 (GPS Antenna Swap)

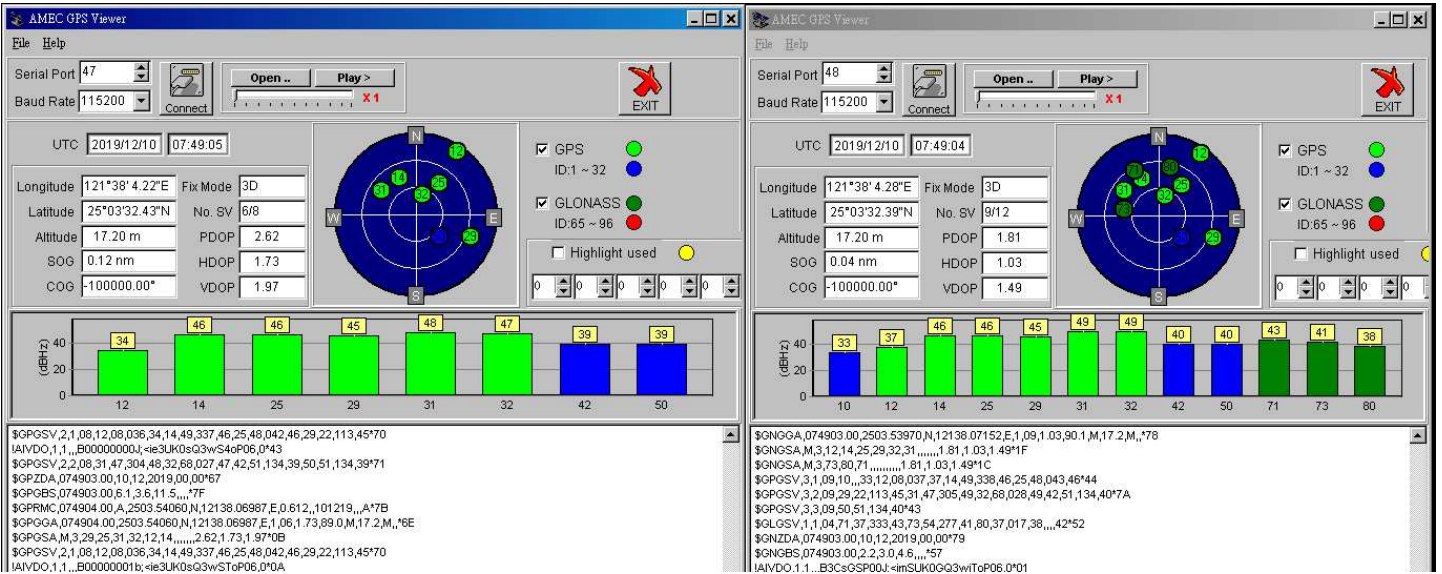


Figure 19 Record of 3D positioning during TFF time test -2 (GPS Antenna Swap)

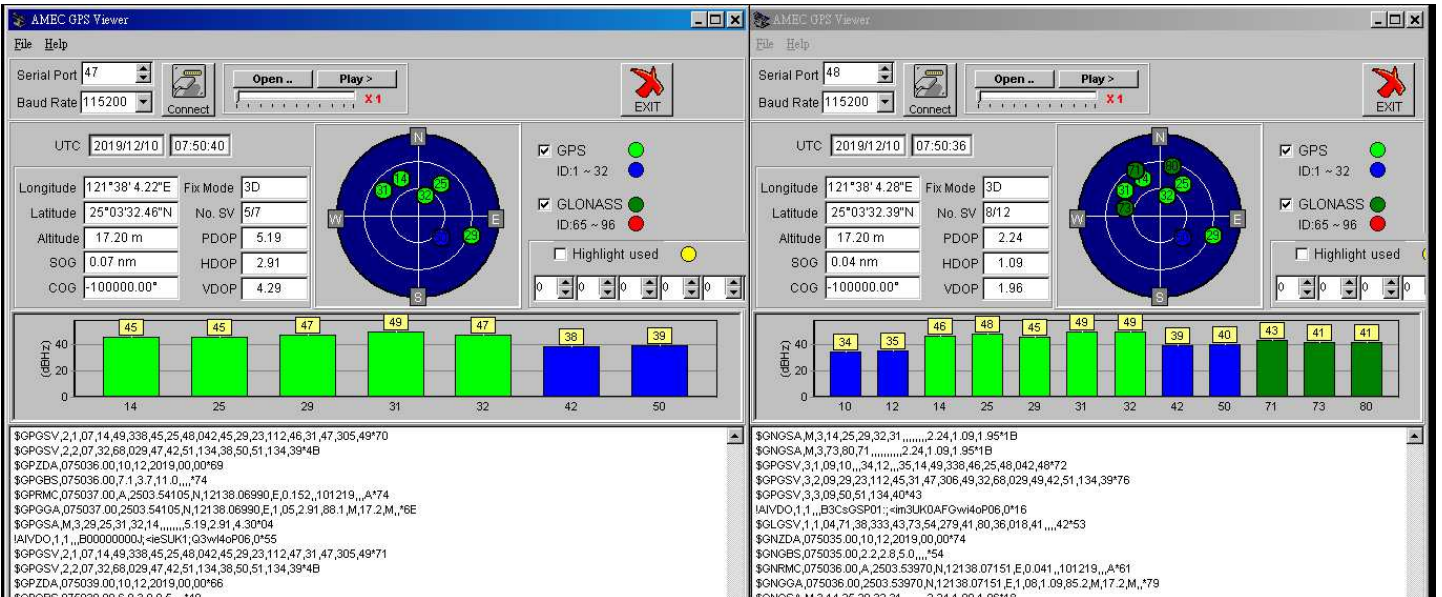


Figure 20 Record of 3D positioning during TFF time test -3 (GPS Antenna Swap)

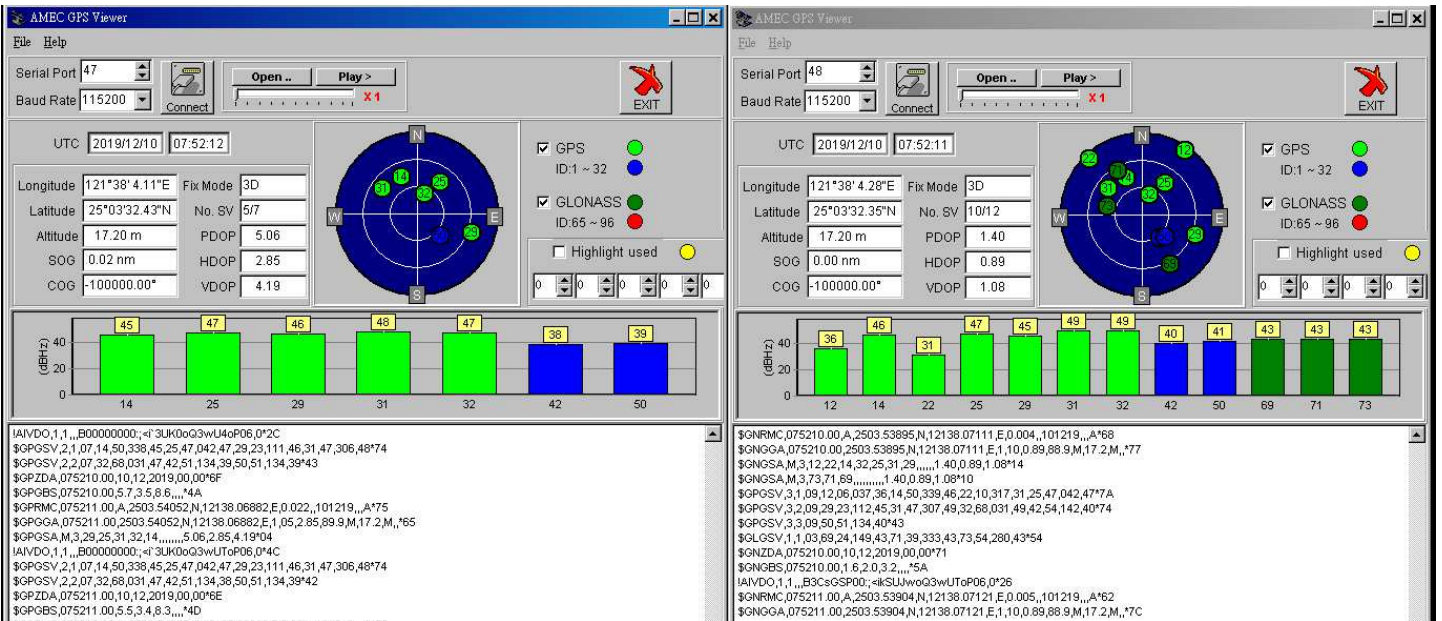


Figure 21 Record of 3D positioning during TFF time test -4 (GPS Antenna Swap)

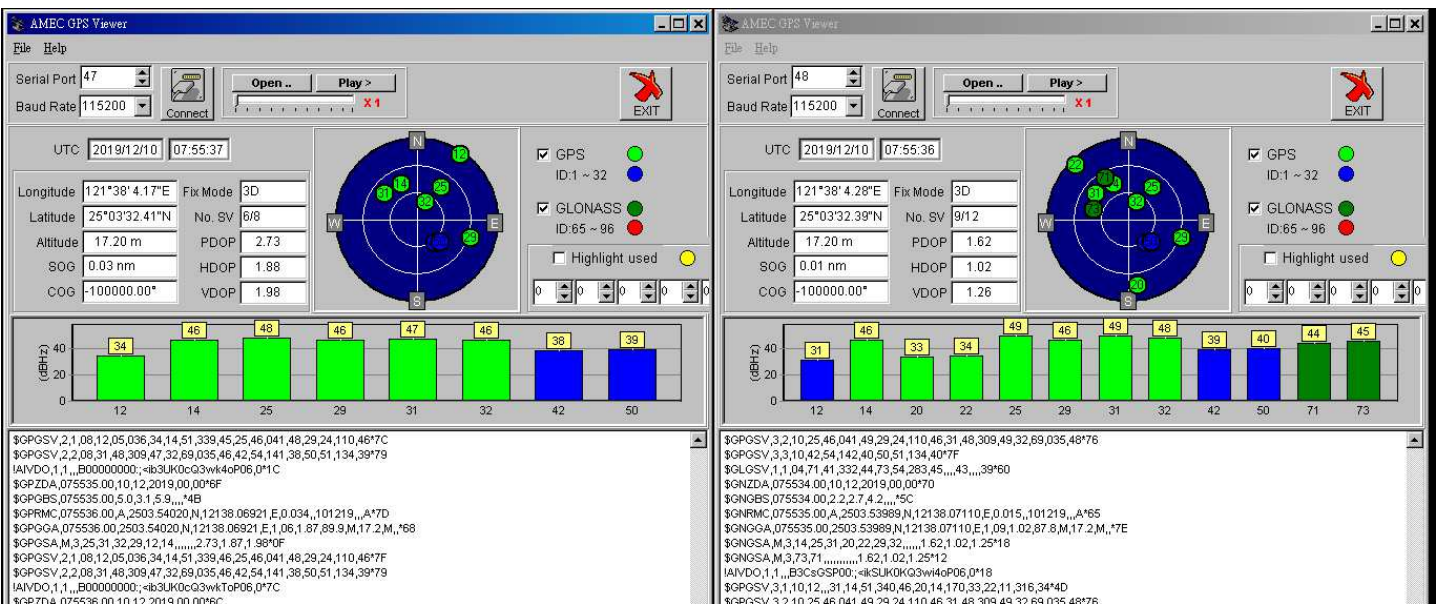


Figure 22 Record of 3D positioning during TFF time test -5 (GPS Antenna Swap)