



PATHFINDER

An informal electronic newsletter published for the GPS user community by PM GPS. Information presented is based on published and submitted news items of interest to the general user. Widest dissemination and reproduction is encouraged. Newsworthy items are solicited for inclusion. Editor Don Mulligan at PM GPS, Ft Monmouth NJ DSN 992-6137 or (732) 532-6137 or email: Donald.Mulligan1@us.army.mil

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PM GPS Clears the Air on GPS Accuracy

From The Product Manager



Hello GPS Users!

I recently addressed the issue of GPS accuracy at an Army test facility. The lead article in this issue tells the story, but I would like to highlight two basic observations that are valid 24-7 for every DoD service member.

First, the accuracy of any GPS receiver depends on the antenna having a reasonable view of the sky in order to collect line-of-sight signals.

Second, the accuracy of military GPS receivers also depends on having a current crypto key so the receiver can access the military-only Precise Positioning Service (PPS) element of the signal.

I cannot over-stress the importance of using a keyed military GPS receiver for all missions! Its not only essential to make the most of military GPS, it is required OSD policy!

Train to use crypto and maintain Situational Awareness of the influences on your signal!

If you have a GPS problem, contact me or any member of my staff!

Jay Spencer

**LTC, QM,
Product Manager, GPS**



NET students at a recent training session in Yongsan Korea where instructors provide students with advice about situational awareness and the importance of a crypto key, see story page 6

A test fact sheet issued after a recent test of an Army C4ISR weapon system stated that the DAGR used in the test did not provide the expected level of GPS accuracy.

PM GPS reviewed the report and visited the test facility to determine what may have caused the problem since our experience indicates the DAGR to perform "as advertised".

Our assistance team found several contributing factors that adversely affected the performance of the DAGR. The teaching points are classic: Key your receiver for optimum performance and the DAGR remote antenna installation must provide reasonable direct-path signal access.

(Continued Page 2)

**REMEMBER! PPS is not just GPS,
It's SECURE GPS!**

GPS Accuracy

Continued from Page One

If you operate a DAGR (or any military GPS receiver for that matter) without a crypto key you are greatly reducing the capabilities of the receiver. And almost as important, GPS receivers rely on signal reception to generate position location data. If your GPS antenna doesn't have a clear view of the sky, it is not going to receive signals from multiple satellites. If your view is obstructed by vegetation or structures, you may get a "multi-path" effect where the signal bounces before it reaches your GPS receiver.

Military GPS receivers with active crypto keys have performance features that compensate for these atmospheric or environmental effects on the signal.

Commercial GPS receivers (or military receivers without crypto keys) usually can't compensate for this interference.

When the DAGR (or other military GPS receiver) sees a problem with the environment, they use the Figure of Merit or FOM feature to warn the operator. In the DAGR, look for the FOM display in the corner of the navigation screen. In the PLGR, FOM is outputted for display to the connected weapon system (handheld PLGR users check FOM via the menu). Commercial receivers may or may not have counterpart indicators or warnings of sub-par performance.

The investigation of the recent test event serves to remind everyone that GPS signals are not "magic"!

GPS receivers collect signals from multiple satellites in orbit some 11,000 nautical miles above the earth's surface. Your antenna needs clear sky access to get signals! Train to use a valid key all the time! Operating without a key renders your military GPS no better than a commercial GPS receiver.

PM GPS has extensive data concerning GPS receiver performance under a wide range of conditions. This information is not appropriate for publication in an unclassified newsletter but is available to authorized DoD weapons system managers. Contact PM GPS.

FOM stands for the Figure of Merit which estimates position error.

FOM values ranges from 1 to 9 (1 is the best). A FOM above 3 is considered to be a high level of position error.

See TM 11-5820-1172-13, C2 date 1 Oct 06, Table 9-1

Recognizing and Countering

Factors that can affect GPS accuracy

Since GPS Signals are low-power and line-of-sight, they are prone to accidental or intentional interference from a variety of sources. Some factors affecting GPS signal accuracy can be countered or minimized; some are beyond user control. Consider the following:

Sources of potential trouble

Ionosphere and Troposphere delays. Satellite signals slow down as they pass through the atmosphere. GPS uses a built-in model to calculate an average amount of delay to partially correct this error.

Signal Multi-path. This occurs when one signal reflects off objects such as tall buildings or large rock surfaces and reaches your receiver via two paths. This increases the 'travel' time of the signal thereby causing errors.

Terrain Masking & Satellite Visibility. The more satellites a receiver can see, the better. Buildings, terrain, electronic interference and dense foliage can block signal reception, causing position errors or possibly no position reading at all. GPS receivers typically do not work indoors, underwater or underground!

Intentional degradation. Selective Availability (SA) is intentional degradation of the GPS signal intended to prevent military adversaries from using GPS. The government turned off SA in 2000.

Unintentional radio interference. Nearby radios (even your own!) can interfere. Beware the TOC is usually a buzzing source of GPS signal interference.

Intentional jamming. Hostile emitters that imitate GPS signals to throw off your receiver calculation.

What can you do?

Before the mission: Load the key! Confirm proper remote antenna installation in your vehicles.

During the mission: Maintain electronic Situational Awareness (how terrain, structures or 'friendly' radios may affect your GPS reception) and periodically check your "FOM" (see box at left). As you move past sources of high electronic energy you have to expect momentary signal loss. The same with passing through terrain or structures that may block signal reception. Protecting your GPS antenna's view of the sky is critical.

You might also consider the "auto averaging" mode which is easier to use in the new DAGR software. If you keep these potential sources of interference in mind, you should be able to maintain a reliable GPS signal. For more on practical counter-measures to signal interference, go to the FAQ section of the PM GPS website.

"YES, YOU WANT THE NEW DAGR SOFTWARE!"

"AND THE UPDATED COMPUTER BASED TRAINING (CBT) TO GO WITH IT!"

FEATURES OF NEW DAGR OPERATING SOFTWARE

(1) Improved DAGR Operations

Improved signal reception in mountainous terrain, under dense foliage or in structures.

Easier access to the Averaging Mode.

(2) Improved DAGR Mapping Functionality

Better interface with the mapping tool kit.

- Preview maps in Map Loader
- Annotate maps in Map Creator
- Load maps into multiple DAGRs
- Configure Vector Map detail settings

Auto zoom between map scales

High-speed serial port data processing for faster map downloading (PSN-13A only)

Support for new Map Memory Device (PSN-13A only).

(3) Safety

Improvements in the Close Air Support (CAS) mode (Advanced Function Users Only)

FEATURES OF NEW DAGR CBT

To accompany your new DAGR Software, the updated companion training product, DAGR CBT addresses two of the new DAGR software features described at left:

(1) Improved DAGR Operations

Improved signal reception in mountainous terrain, under dense foliage or in structures.

Easier access to the Averaging Mode.

(2) Improved DAGR Mapping Functionality

Better interface with the mapping tool kit.

High-speed serial port data processing for faster map downloading.

Okay, you noticed that the new CBT addresses 2 of the 3 new improvements. CBT is based on the standard function set presented during New Equipment Training (NET). The CAS function is part of the DAGR advanced function set so it is not part of standard NET or CBT.

PM GPS recommends the CAS function be used only by those personnel with advanced NET training.

However, PM GPS is working on a 2008 update of the CBT which will add a new module that addresses the Advanced functions set including CAS. In the meantime get the new CBT to make the most of DAGR today.

Updates on DAGR Software for 2007

TO 31R4-2PSN13-502 MWO 11-5820-1172-20-2 dated 31 Jan 2007.

Get the new Software!

Here are the version numbers:

Product	Prior SW Version	New SW Version
AN/PSN-13	984-2461- 011	984-2461- 012
AN/PSN-13A	984-3006- 001	984-3006- 002

Obtain the new software via internet download at the GPS website. If you don't have good internet connectivity you can request a mail-out CD from the site. Since the DAGR software is being distributed as a TCTO MWO, you can also contact your local MWO Coordinator.

Load the New Software!

Once you've downloaded the software or obtained a copy via CD, the program file operates off a desktop or laptop PC connected to DAGR. Get the MWO for your GPS receivers and update your software as soon as you can.

But wait, there is more!

To get full benefit of the new software during sustainment training, you will also want the new updated Computer Based Training (CBT) for DAGR:

DAGR Computer Based Training (CBT)

Product	Prior Version	New Version
AN/PSN-13 and AN/PSN-13A	CD 11-64 30 June 2005	CD 11-64 V2 01 October 2006

Unlike the DAGR Operating software, one version works for both versions of DAGR. The update CBT addresses everything in the original version plus some of the features in the new DAGR Operating Software.

As is the case with software, if you don't have good internet connectivity you can request a mail-out CD from the website at <https://gps.army.mil>

Update on the Interoperability of GPS Receiver Accessories

Their cables are interchangeable, but Hockey Pucks are not!

INTEROPERABILITY

What does “Interoperability” mean?

When the DAGR was developed as the replacement for the PLGR, one of the design strategies to save money was to have DAGR and its accessories be “backwards compatible” with PLGR and its accessories whenever possible.

In the July 2005 issue of PATHFINDER we highlighted the following cables as being “interoperable”, meaning they provide the same functionality to PLGR and DAGR:

DAGR-to-PC Cable	5995-01-521-3198
DAGR-to-HAVEQUICK cable	5995-01-521-2680
DAGR-to-DAGR cable	5995-01-521-2713
PLGR-to-PC cable	6150-01-375-8664
PLGR-to HAVEQUICK Cable	6150-01-375-8665
PLGR-to-PLGR cable	6150-01-375-8663

Fast forward to April 2007: Lets update the status of GPS receiver accessory interoperability.

Since DAGR and PLGR share similar performance design standards and the same Interface Control Document, it makes sense that some accessories can be used for both PLGR and DAGR. As you can see from the descriptions at left, the interoperable cables can be used to connect GPS with a PC or HAVEQUICK radio.

Recently several new cable adapters have been made available to allow the user to connect DAGR with other devices using a PLGR cable. One of these adapters, the intended to allow the use of a PLGR remote antenna cable with DAGR has caused a bit of confusion.

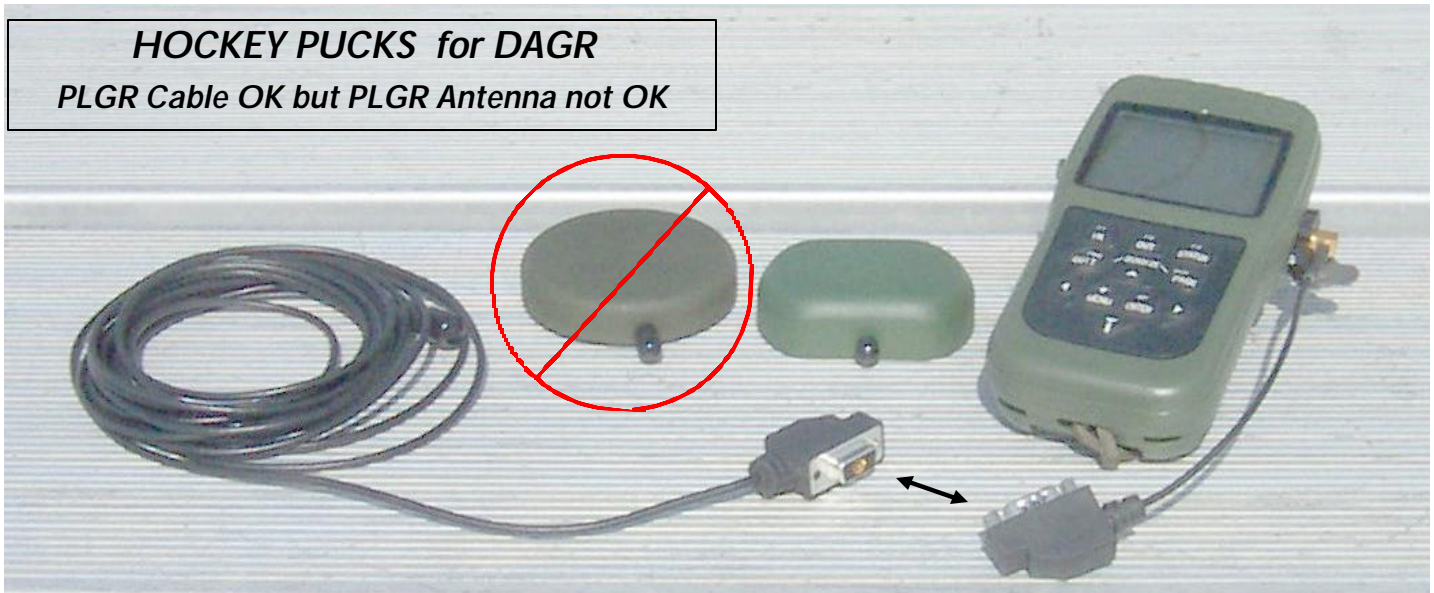
By providing an adapter that converts the receiver end of the cable from a DAGR to a PLGR type connector, the user can replace PLGR with DAGR in host vehicle installations but still use the existing PLGR cables. The inexpensive adapters simply convert the existing PLGR remote power or antenna cable to service the DAGR.

But when we said the PLGR and DAGR remote antenna cables were interchangeable (with adaptor) we did not mean to say the antennas were also interchangeable!

Please read the article below for the “rest of the story”!

HOCKEY PUCKS for DAGR

PLGR Cable OK but PLGR Antenna not OK



(From left to right): A PLGR remote antenna cable, PLGR remote antenna, DAGR remote antenna and DAGR with the PLGR remote antenna cable adapter installed so you can connect DAGR to a PLGR antenna cable.

So what's a GPS hockey puck?

The remote antennas for PLGR and DAGR are commonly referred to as 'hockey pucks' since they have rounded shapes. Although they look similar, and there is a new DAGR accessory called the PLGR remote antenna cable adapter, the antennas themselves are not interoperable for the reasons discussed in this article.

The first reason is that they have different power requirements. DAGR provides its antenna with 3.3 volts while the PLGR antenna requires 5 volts to function.

The reason for the difference in power is that the Low Noise Amplifier (LNA) in the DAGR antenna uses newer technology and operates on less power.

(Continued next page)

HOCKEY PUCKS (Cont'd)

The LNA in a GPS antenna amplifies or boosts the relatively weak GPS signal coming from space into a more usable signal for receiver processing). Using the wrong antenna provides the wrong power level and limits the performance of your receiver.

The second reason is frequency reception. The DAGR antenna is dual band while the PLGR is single band.

The newer technology in the DAGR antenna uses two frequencies for better performance including atmospheric corrections, which a PLGR cannot perform.

Using the wrong antenna prevents DAGR from operating as designed while connecting a DAGR antenna to PLGR provides signal input that PLGR cannot use.

So the PLGR antenna can't be used with DAGR, got it!

Unlike the antennas, the cables ARE interchangeable but you'll need an adaptor (see illustration on facing page). Why would PM GPS make the cables interchangeable when the antenna are not?

At the antenna end, PLGR and DAGR cables have the same connector. At the receiver end, the cables are different: DAGR uses an SMA coaxial connector that screws in place (similar to the one that connects your TV to the cable outlet) while the PLGR connector is aligned and then pushed into place. If you insert the PLGR Adapter Cable (NSN 5995-01-521-3120) at the receiver end of the PLGR cable, you can hook-up to a DAGR.

The reason for making this adapter available is that the PLGR antenna cable is sufficient to pass electrical current and signal data for either DAGR or PLGR despite the different connectors. You might want to use an existing PLGR cable to hook-up your DAGR in a vehicle installation where you worked hard to get that PLGR cable routed all the right places! Just swap **antennas**, install the **adapter** at the receiver end and you can use that existing PLGR cable to connect DAGR to a DAGR remote antenna and you are in business.

Bottom Line: "Hockey Puck" cables are interchangeable. The hockey pucks antennas are not!

For further assistance with installing DAGR or PLGR to a vehicle, contact PM GPS!

Installation Technical Assistance

Assistance is available from PM GPS on any aspect of installing GPS receivers to host platforms or connecting GPS receivers to other electronics or communication devices. Submit your question through the website User Query form under the Help tab or contact one of our offices listed on the back page of this newsletter.

Why Do I need a Key in a GPS Receiver?

A crypto variable key is critical for mission performance! Both the PLGR and the DAGR use a crypto variable key to access the military-only GPS signal for enhanced accuracy and anti-jam and anti-spoof protection. You can operate a PLGR or DAGR without a crypto key, but it is like buying a high definition TV and then de-tuning it for a fuzzy black and white picture!

DoD only authorizes operation of un-keyed receivers for stateside training and R&D projects. If you are deployable, your equipment should be deployable and for GPS that means your unit COMSEC Custodian is prepared to load current crypto keys in unit GPS equipment.

Receivers without a key are susceptible to accidental or intentional jamming and spoofing. Accidental? Yes, most interference is accidental. A keyed receiver can resist 10 times the level of interference that might jam an un-keyed receiver!

How Can I tell if my Receiver has a Key?

On power-up DAGR will display one of these screens:

- * No CV Keys Loaded *
- * Have Today's CV Key *
- * No CV Key for Today *

Each of these messages is explained further:

If the DAGR has *no key*, it will display: "Warning No CV Keys Loaded".

If the DAGR has a *key* and was operating recently it will display: "Have today's CV Key". Press to acknowledge and the DAGR will move to the Navigation Page.

If the DAGR has a *key* but has been turned off for a while, when you turn it on it will display: "No CV key for today". Press to acknowledge and the DAGR will display: "Note! Collecting SV information" This is your indication that the DAGR has a *good key* and is now searching for satellites to download today's message in order to convert to PPS mode!

"Waiting for SV Info" indicates it is collecting satellite information (up to 15 minutes). Once it has collected sufficient SV info, it will move to the Navigation Page.

If the DAGR has an *expired key* it will first display: "No CV key for today". When you press to acknowledge, the DAGR will display: "Warning, Check GUV Issue Number". This is your indication the receiver has an *expired key*! Contact your COMSEC Custodian!

(Note: all the above applies to users with GUV key. Users with red or black weekly keys don't have to wait for satellite data to download).

TM 11-5820-1172-13, Ch 7.

Feedback from the Road - New Equipment Training (NET)

PM GPS has nine two-person teams traveling the world to provide Army personnel with high-quality hands-on training for the DAGR.

During the course of training, our instructors collect a lot of feedback from soldiers about their experiences with GPS. This article addresses a frequent misunderstanding reported during NET team feedback.

All military GPS receivers should be operated with a current crypto key to gain access to the PPS element of the GPS signal so they can perform as designed. Operating a military GPS receiver without a key is like having one arm tied behind your back.

The problem is that many units hesitate to load keys to GPS receivers because they mistakenly think that doing so makes the GPS receiver a classified item. The GPS receiver is unclassified even when keyed because the key cannot be removed from the receiver! Check with your unit COMSEC Officer! Your COMSEC custodian is responsible for safeguarding the keys and the key loading devices.

The only thing "classified" about a GPS receiver are the waypoints or objectives you load as mission data. In that sense you need to safeguard the GPS receiver as a sensitive item but since the key cannot be copied out of the GPS receiver, the NSA does not rate the PLGR or DAGR as a Controlled Crypto Item (CCI).

You wouldn't perform a mission without other essential gear like your rifle or radio in a ready-state, so don't start a mission without a properly keyed GPS receiver!



ARINC personnel working for PM GPS recently provided NET training at Camp Casey, Korea. Above at right, Senior instructor Vennis Reid. Below, students compare screen displays before setting off on a route to confirm classroom entry of waypoints. Staff photos



UPDATE TO DAGR TM

TO 31R42PSN13-1 TM 11-5826-1172-13 PCN 18409880200 / TM 09880C-01

	Operators Manual	Date	Pocket Guide/Checklist	Date
		First Issue Date		First Issue Date
DAGR	TM 11-5820-1172-13	6-Jun-04	TB 11-5820-1172-10	6-Jun-04
DAGR	TM 11-5820-1172-13	Revised 1 Mar 05	TB 11-5820-1172-10	Revised 1 Mar 05
DAGR C1	TM 11-5820-1172-13	Chg One 1 Jun 2005	TB 11-5820-1172-10	Chg One 1 Jun 2005
DAGR C2	TM 11-5820-1172-13	Chg Two 1 Oct 2006	TB 11-5820-1172-10	Chg Two 1 Oct 2006

The current DAGR TM O&M Manual and Pocket Guide are available as softcopy download from the GPS website. Agencies with poor internet connectivity may order a CD containing these documents from the GPS website. Any DoD user requiring a

printed hard copy of these documents who cannot obtain local printing services using the CD or download documents may contact the Army Georgia Field Office at 570cbss.gben.loghelp@robins.af.mil for assistance in ordering printed copies.



How to Contact PM GPS <https://gps.army.mil>

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Who to Call for Army Issues?

Call the Army Logistics Manager for:

- Army GPS User Equipment Policy
- User Equipment Authorizations & Procurement
- Maintenance Status or GPS Loans

Call the Army Fielding Manager for Army DAGR fielding and NET issues.

Other Service/Civilian Agencies?

Contact our representatives at the GPS Joint Service Support Office at Warner Robins AFB, Georgia: Frank Rowe or Willie Jackson as listed in the column at left.

Or use the User Information Request Form

Go to <https://gps.army.mil>

Click on the “Contact PM GPS” tab at the homepage.

Or use the GPS Help Line

by contacting Mr Willie Jackson at Warner Robins GA (see his contact info at left column)

Please Note

We have had some recent personnel changes.

If you have trouble reaching anyone listed, please use the “contact PM GPS” tab at our homepage to submit your question or comment and we will route your query to the right person.

Why Use Military instead of Commercial GPS?

Soldier Safety! Mission Accuracy! Signal Protection!

View the video on the GPS homepage! <https://gps.army.mil>