Republic of the Philippines
CIVIL AVIATION AUTHORITY OF THE PHILIPPINES

MEMORANDUM CIRCULAR NO.: 019-17

TO	:	**ALL CONCERNED**
FROM	:	**DIRECTOR GENERAL**
SUBJECT	:	**AMENDMENT TO PHILIPPINE CIVIL AVIATION REGULATIONS - AIR NAVIGATION SERVICES (CAR-ANS) PART 6 INCORPORATING AMENDMENT 86 TO ICAO ANNEX 10 VOLUME 1**

REFERENCE:

1. Philippine Civil Aviation Regulations- Air Navigation Services Part 6
2. ICAO Annex 10 Volume 1; Amendment 86
3. Regulations Amendment Procedures
4. Board Resolution No. 2012-054 dated 28 September 2012

Pursuant to the powers vested in me under the Republic Act 9497, otherwise known as the Civil Aviation Authority Act of 2008 and in accordance with the Board Resolution No.: 2012-054 dated 28 September 2012, I hereby approve the incorporation of ICAO Annex 10 Volume 1 Amendment No. 86 to the Philippine Civil Aviation Regulations – Air Navigation Services (CAR-ANS) Part 6.

ORIGINAL REGULATION SUBJECT FOR REVIEW AND REVISION:

CAR-ANS Part 6

...

APPENDIX B. TECHNICAL SPECIFICATIONS FOR THE GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

...

3.6.4 DATA CONTENT

...

3.6.4.1 *Message types.* The message types that can be transmitted by GBAS shall be as in Table B-63.

~~*Note. — Currently only 9 of the 256 available message types have been defined, with the intent that future needs can be addressed in the remaining message types.*~~

...

Table B-63. GBAS VHF data broadcast messages

Message type identifier	Message name
0	Spare
1	Pseudo-range corrections
2	GBAS-related data
3	Null message ~~Reserved for ground based ranging source~~
4	Final approach segment FAS) data
5	Predicted ranging source availability
6	Reserved
7	Reserved for national applications
8	Reserved for test applications
9 to 100	Spare
101	GRAS pseudo-range corrections
102 to 255	Spare

Note.— See 3.6.6 for message formats.

...

3.6.4.2.4 The measurement block parameters shall be as follows:

...

3.6.4.3.2 *Additional data blocks*. For additional data blocks other than additional data block 1, the parameters for each data block shall be as follows:

...

Coding: 1000 0000 = Reference receiver was not used to compute the pseudo-range correction.

Note.— Some airborne receivers may expect a static correspondence of the reference receivers tom the indices for short-service interruptions. However, the B value indices may be reassigned after the ground subsystem has been out of service for an extended period of time, such as for maintenance.

...

ADDITIONAL DATA BLOCK NUMBER: the numerical identifier of the type of additional data block.

Coding: 0 to 1 = reserved

2 = additional data block 2, GRAS broadcast stations

3 = reserved for future services supporting Category II/III operations

4 = additional data block 4, VDB authentication Parameters

~~35~~ to 255 = spare

...

3.6.4.3.2.2 *VDB authentication parameters*

Additional data block 4 includes information needed to support VDB authentication protocols

Slot group definition: This 8-bit field indicates which of the 8 slots (A-H) are assigned for use by the ground station. The field is transmitted LSB first. The LSB corresponds to slot A, the next bit to slot B, and so on. A "1" in the bit position indicates the slot is assigned to the ground station. A "0" indicates the slot is not assigned to the ground station.

...

Table B-65C. VDB authentication parameters

Data	Bits used	Range of values
Resolution		
Content Slot group definition	8	-

...

3.6.4.4 *TYPE 3 MESSAGE—NULL MESSAGE*

~~*Note.— Type 3 message is intended to provide the information required to use ground based ranging sources and is reserved for future applications.*~~

...

Insert new Table B-71B after Table B-71 and *renumber* Table B-71 as B-71A

Table B-71B. Type 3 null message

Data content	Bits used	Range of values	Resolution
Filler	Variable (Note)	N/A N	N/A

...

3.6.7.2.1.3 *VDB authentication*

Note.— This section is reserved for forward compatibility with future authentication functions.

3.6.7.2.2.9 *Linked pair of Type 1 or Type 101 messages.* If a linked pair of Type 1 or Type 101 messages is transmitted then,

a) the two messages shall have the same modified Z-count;

b) the minimum number of pseudo-range corrections in each message shall be one;

c) the measurement block for a given satellite shall not be broadcast more than once in a linked pair of messages; ~~and~~

d) the two messages shall be broadcast in different time slots~~.~~ ; and

e) the order of the B values in the two messages shall be the same

...

~~3.6.7.4 *GROUND-BASED RANGING SOURCES*~~

~~*Note. – Ground-based ranging systems are expected to use a portion of the 1 559-1 610 MHz band, which will be classified by the ITU as providing RNSS-ARNS service, and are expected to require up to ±10 MHz around their centre frequency. As augmentations to GPS and/or GLONASS, they will constitute components of GNSS and will have associated avionics receivers. Their interference protection level must be consistent with the interference environment of GNSS receivers.*~~

...

Insert new text as follows:

3.6.7.4 *Functional requirements for authentication protocols*

3.6.7.4.1 *Functional requirements for ground subsystems that support authentication*

3.6.7.4.1.1 The ground system shall broadcast the additional data block 4 with the Type 2 message with the slot group definition field coded to indicate which slots are assigned to the ground station.

3.6.7.4.1.2 The ground subsystem shall broadcast every Type 2 message in the slot that corresponds to the SSID coding for the ground subsystem. Slot A is represented by SSID=0, B by 1, C by 2, and H by 7.

3.6.7.4.1.3 *Assigned slot occupancy*. The ground subsystem shall transmit messages such that 87 percent or more of every assigned slot is occupied. If necessary, Type 3 messages will be used to fill unused space in any assigned time slot.

3.6.7.4.1.4 *Reference path identifier coding*. Every reference path identifier included in every final approach segment data block broadcast by the ground station via the Type 4 messages shall have the first letter selected to indicate the SSID of the ground station in accordance with the following coding.

Coding: A = SSID of 0
X = SSID of 1
Z = SSID of 2
J = SSID of 3
C = SSID of 4
V = SSID of 5

P = SSID of 6
T = SSID of 7

3.6.7.4.2 *Functional requirements for ground subsystems that do not support authentication*

3.6.7.4.2.1 *Reference path indicator coding.* Characters in this set: {A X Z J C V P T} shall not be used as the first character of the reference path identifier included in any FAS block broadcast by the ground station via the Type 4 messages.

3.6.8 AIRCRAFT ELEMENTS

3.6.8.1 *GNSS receiver.* The GBAS-capable GNSS receiver shall process signals of GBAS in accordance with the requirements specified in this section as well as with requirements in 3.1.3.1 and/or 3.2.3.1 and/or 3.5.8.1.

~~*Note.— A GBAS-capable GNSS receiver may be implemented without the capability to process the Type 101 message, the Type 2 message additional data block 2, or data specific to an approach performance designator value of 0.*~~

...

3.6.8.3 *AIRCRAFT FUNCTIONAL REQUIREMENTS*

...

3.6.8.3.1.2 The receiver shall use message data only if the message block identifier is set to the bit pattern "1010 1010".

Insert new text as follows:

3.6.8.3.1.2.1 *GBAS message processing capability.* The GBAS receiver shall at a minimum process GBAS message types in accordance with Table B-82.

3.6.8.3.1.2.2 *Airborne processing for forward compatibility*

Note.— Provisions have been made to enable future expansion of the GBAS Standards to support new capabilities. New message types may be defined, new additional data blocks for message Type 2 may be defined and new data blocks defining reference paths for inclusion within message Type 4 may be defined. To facilitate these future expansions, all equipment should be designed to properly ignore all data types that are not recognized.

3.6.8.3.1.2.2.1 *Processing of unknown message types.* The existence of messages unknown to the airborne receiver shall not prevent correct processing of the required messages.

3.6.8.3.1.2.2.2 *Processing of unknown Type 2 extended data blocks.* The existence of message Type 2 additional data blocks unknown to the airborne receiver shall not prevent correct processing of the required messages.

3.6.8.3.1.2.2.3 *Processing of unknown Type 4 data blocks.* The existence of message Type 4 data blocks unknown to the airborne receiver shall not prevent correct processing of the required messages.

Note.— While the current SARPs include only one definition of a data block for inclusion within a Type 4 message, future GBAS Standards may include other reference path definitions.

...

Insert new Table B-82 as follows and *renumber* existing Tables B-82 to B-87 including their corresponding references:

Table B-82. Airborne equipment message type processing

Airborne equipment designed performance	Minimum message types processed
APV-I	MT 1 or 101, MT 2 (including ADB 1 and 2 if provided)
APV-II	MT 1, MT 2 (including ADB 1 and 2 if provided), MT 4
Category I	MT 1, MT 2 (including ADB 1 if provided), MT 4

...

3.6.8.3.5 *Airborne pseudo-range measurements.* ~~Pseudo-range measurement for each satellite shall be smoothed using the carrier measurement and a smoothing filter which deviates less than 0.1 metre within 200 seconds after initialization, relative to the steady-state response of the filter defined in 3.6.5.1 in the presence of drift between the code phase and integrated carrier phase of up to 0.01 metre per second.~~

3.6.8.3.5.1 *Carrier smoothing for airborne equipment.* Airborne equipment shall utilize the standard 100 second carrier smoothing of code phase measurements defined in 3.6.5.1. During the first 100 seconds after filter start up, the value of α shall be either:

1) a constant equal to the sample interval divided by 100 seconds or,

2) a variable quantity defined by the sample interval divided by the time in seconds since filter start-up.

...

Insert, after Figure B-18, the following new figure:

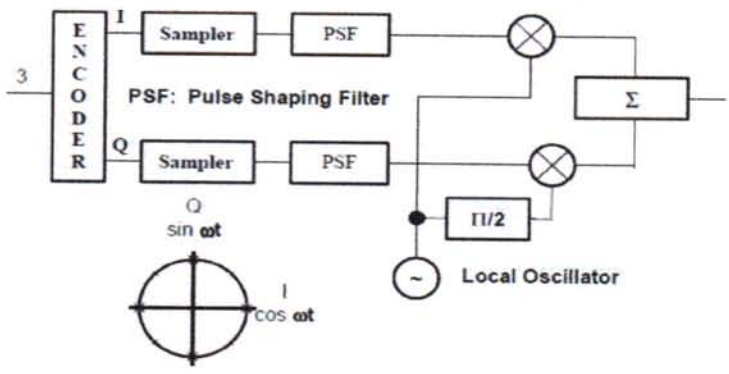

Figure B-19. Example data modulation

...

7.2 RF characteristics

7.2.1 ~~*Frequency*~~ *Coordination*

7.2.1.1 *Performance factors*

7.2.1.1.1 The geographical separation between a candidate GBAS station, a candidate VOR station and existing VOR or GBAS installations must consider the following factors:

a) the coverage volume, minimum field strength and effective radiated power (ERP) of the candidate GBAS including the GBAS positioning service, if provided. The minimum requirements for coverage and field strength are found in CAR-ANS 6.3, 6.3.7.3.5.3 and 6.3.7.3.5.4.4, respectively. The ERP is determined from these requirements;

b) the coverage volume, minimum field strength and ERP of the surrounding VOR and GBAS stations including the GBAS positioning service, if provided. Specifications for coverage and field strength for VOR are found in CAR-ANS 6.3, 6.3.3, and respective guidance material is provided in Attachment C;

c) the performance of VDB receivers, including co-channel and adjacent channel rejection, and immunity to desensitization and intermodulation products from FM broadcast signals. These requirements are found in Appendix B, 3.6.8.2.2;

d) the performance of VOR receivers, including co-channel and adjacent channel rejection of VDB signals. Since existing VOR receivers were not specifically designed to reject VDB transmissions, desired-to-undesired (D/U) signal ratios for co-channel and adjacent channel rejection of the VDB were determined empirically. Table D-2 summarizes the assumed signal ratios based upon empirical performance of numerous VOR receivers designed for 50 kHz channel spacing;

~~d~~ e) for areas/regions of frequency congestion, a precise

~~e~~ f) that between GBAS installations RPDS and RSDS numbers are assigned only once on a given frequency within radio range of a particular GBAS ground subsystem. The requirement is found in Appendix B, 3.6.4.3.1;

~~f~~ g) that between GBAS installations within radio range of a particular GBAS ground subsystem the reference path identifier is assigned to be unique. The requirement is found in Appendix B, 3.6.4.5.1; and

~~g~~ h) the four-character GBAS ID to differentiate between GBAS ground subsystems. The GBAS ID is normally identical to the location indicator at the nearest aerodrome. The requirement is found in Appendix B, 3.6.3.4.1.

...

Table D-3. Nominal VDB link budget

VDB link elements	Vertical component link budget at coverage edge	Horizontal component link budget at coverage edge
Required receiver sensitivity (dBm)	–87	–87
Maximum aircraft implementation loss (dB)	11	15
Power level after aircraft antenna (dBm)	–76	–72
Operating margin (dB)	3	3
Fade margin (dB)	10	10
Free space path loss (dB) at 43 km (23 NM)	106	106
Nominal effective radiated power (ERP) (dBm)	43	47

...

Insert new Table D-8B following Table D-8A:

Table D-8B. Example of Type 2 Message Containing Data Blocks 1 and 4

DATA CONTENT	BITS USED	RANGE OF VALUES	RESOLUTION	VALUES	BINARY REPRESENTATION (NOTE 1)
BURST DATA CONTENT					
Power ramp-up and settling	15	-	-	-	000 0000 0000 0000
Synchronization and ambiguity resolution	48	-	-	-	0100 0111 1101 1111 1000 1100 0111 0110 0000 0111 1001 0000
SCRAMBLED DATA					
Station Slot Identifier	3	-	-	E	100
Transmission Length	17	0 – 1824 bits	1 bit	1704	0 0000 0110 1010 1000
Training Sequence FEC	5	-	-	-	01000
APPLICATION DATA					
Message Block 1(Type 2 Message)					
Message Block Header					
Message Block Identifier	8	-	-	Normal	1010 1010
GBAS ID	24	-	-	BELL	000010 000101 001100 001100
Message Type Identifier	8	1 – 101	1	2	0000 0010
Message Length	8	10 – 222 bytes	1 byte	37	0010 0101
Message (Type 2 Example)					
GBAS reference receivers	2	2 – 4	1	3	01
Ground accuracy designator letter	2	-	-	B	01
Spare	1	-	-	-	0
GBAS continuity/integrity Designator	3	0 – 7	1	2	010
Local magnetic variation	11	± 180°	0.25°	E58.0°	000 1110 1000
Spare	5	-	-	-	0000 0
σvert_iono_gradient	8	0 - 25.5 x 10-6 m/m	0.1 x 4x 10-6 m/m	4x10-6	0010 1000
Refractivity index	8	16 to 781	3	379	1111 1001
Scale height	8	0 – 25,500 m	100 m	100 m	0000 0001
Refractivity uncertainty	8	0 – 255	1	20	0001 0100
Latitude	32	± 90.0°	0.0005 arcsec	N45° 40' 32" (+164432")	0001 0011 10011010 0001 0001 0000 0000
Longitude	32	± 180.0°	0.0005 arcsec	W93° 25' 13" (-336313")	1101 0111 11101000 1000 10101011 0000
Ellipsoid height	24	± 83,886.07 m	0.01 m	892.55 m	0000 0001 01011100 1010 0111

Additional Data Block 1					
Reference Station Data Selector	8	0 – 48	1	5	0000 0101
Maximum Use Distance (Dmax)	8	2 – 510 km	2 km	50 km	0001 1001
Kmd_e_POS,GPS	8	0 – 12.75	0.05	6	0111 1000
Kmd_e C,GPS	8	0 – 12.75	0.05	5	0110 0100
Kmd_e_POS,GLONASS	8	0 – 12.75	0.05	0	0000 0000
Kmd_e C,GLONASS	8	0 – 12.75	0.0 5	0	0000 0000
Additional Data Block 4					
Additional Data Block Length	8	3	1 byte	3	0000 0011
Additional Data Block Number	8	4	1	4	0000 0100
Slot Group Definition	8	-	-	E	0011 0000
Message Block 1 CRC	32	-	-		1100 0101 11100000 0010 0110 1100 1011
Message Block 2 (Type 3 Message)					
Message Block Header					
Message block identifier	8	-	-	Normal	1010 1010
GBAS ID	24	-	-	BELL	000010 000101001100 001100
Message type identifier	8	1-101	-	3	101 1 3 0000 0011
Message length	8	N/A	1 byte	170	1010 1010
Message (Type 3 example)					
Filler	1280	-	-	-	1010 1010 ......1010 1010
Message Block 2 CRC	32	-	-	-	1001 0000 11101100 1101 10011011 1010
Application FEC	48	-	-	-	0000 1000 00100011 1100 10111101 0000 11010110 1011 0101
Input to Bit Scrambling (note 2)	0 45 58 02 55 30 CA 10 40 A4 A2 17 00 14 9F 80 28 00 88 59 88 59 C8 0D 5117 EB E5 3A 80 A0 98 1E 26 00 00 C0 20 0C D3 64 07 A3 55 30 CA 10 C055 5D 9B 37 09 AD 6B 0B D3 C4 10				
Output from the bit scrambling (Note 3)	0 63 6F 8A 1F 2F D2 3B 9F 3E 77 CE 32 C8 D9 50 DE C 1 C11 C1 5A D4 09 7E E7 81 5A 5C D4 28 56 00 CE 29 60 A3 5F 77 87 C0 C9 D2 42 73 01 15 DB A6 8F EF 8C F3 88 DC 78 B6 C7 D0 93 58 5D 46 B5 6F D5 0C AA 77 FE D3 30 A2 27 E1 EC E4 F7 17 2D AD F4 0B 29 82 04 61 96 E4 50 E9 58 FA B8 C0 38 99 C7 BB 6C 3D 09 CA 7B 7E C2 CF 60 8D 18 75 B9 2B C5 FC 94 C8 57 79 52 C5 5F 6A B2 FF DF 33 4D DD 74 B5 28 2A 06 01 91 9B A4 43 E9 63 05 1D 95 B4 54 29 56 05 51 95 5B AA BC 00 36 66 2E EE 0F 0E 72 71 21 25 E5 EB 14 FD A8 CB F8 83 38 62 39 1E 3A 4E 3E 8E 30 71 D9 24 BA 17 C1 AC 9B F7 BC D3 C8 A3 78 1D 39 B5 C4 2B 69 FD 04 CA 68 81 07 9A 64 8F6B 39 7D 2A 34 D0 6F EA				
Fill Bits	0 to 2	-	-	2	00
Power ramp-down	9	-	-	-	000 000 000
D8PSK Symbols (Note 4)	00000035 11204546 31650102 46331130 13067746 52605627 35467122 62533573 77100603 75554273 0166646 41203311 42111340 14733657 27302663 77076361 44301001 17175104 35263707 43007132 40135774 07012022 52546153 57425454 25413051 54022547 01622754 12302141 24615265 50476225 56622615 23311312 51275055 11132570 45242065 63665236 04052447 35155017 73303745 61650521 06765616 04756006 16264736 30530735 02426407 53610061 12111501 04147002 72512117 74672621 4225425112533720 37475054 44460104 57516674 46523401 22503075 25125742 03431633 22607072 37230050 35463673 43300570 12353363 77140357 42715724 03470633 30354042 67720645 27225703 50111005 40736127 14021742 36572477 13042222 2				

...

Table D-13A. GPS tracking constraints for GRAS and SBAS airborne receivers with double-delta Correlators

Region	3 dB precorrelation bandwidth, BW	Average correlator spacing (X) (chips)	Instantaneous correlator spacing (chips)	Differential group delay
1	(-50 × X)+12 < BW ≤ 7 MHz	0.1 – 0.2	0.09 – 0.22	≤ 600 ns
	2 < BW ≤ 7 MHz	0.2 – 0.6	0.18 – 0.65	
2	(-50 × X)+12 < BW ≤ ≤(40 × X)+11.2 MHz	0.045 – 0.07	0.04 – 0.077	
	(-50 × X)+12 < BW ≤ 14 MHz	0.07 – 0.1	0.062 – 0.11	≤ 150 ns
	7 < BW ≤ 14 MHz	0.1 – 0.24	0.09 – 0.26	
3	14 < BW ≤ 16 MHz	0.7 – 0.24	0.06 – 0.26	≤ 150 ns

Table D-13B. GPS tracking constraints for GBAS airborne receivers with double-delta Correlators

Region	3 dB precorrelation bandwidth, BW	Average correlator spacing (X) (chips)	Instantaneous correlator spacing (chips)	Differential group delay
1	$(-50 \times X)+12 < BW \leq 7$ MHz	0.1 – 0.16	0.09 – 0.18	≤ 600 ns
	$2 < BW \leq 7$ MHz	0.16 – 0.6	0.14 – 0.65	
2	$(-50 \times X)+12 < BW \leq (133.33 \times X)+2.667$ MHz	0.07 – 0.085	0.063 – 0.094	
	$(-50 \times X)+12 < BW \leq 14$ MHz	0.085 – 0.1	0.077 – 0.11	≤ 150 ns
	$7 < BW \leq 14$ MHz	0.1 – 0.24	0.09 – 0.26	
3	$14 < BW \leq 16$ MHz	0.1 – 0.24	0.09 – 0.26	
	$14 < BW \leq (133.33 \times X) + 2.667$ MHz	0.085 – 0.1	0.077 – 0.11	≤ 150 ns

AMENDED REGULATION AFTER REVISION:

CAR-ANS PART 6:

...

APPENDIX B. TECHNICAL SPECIFICATIONS FOR THE GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

...

3.6.4 DATA CONTENT

...

3.6.4.1 *Message types.* The message types that can be transmitted by GBAS shall be as in Table B-63.

...

Table B-63. GBAS VHF data broadcast messages

Message type identifier	Message name
0	Spare
1	Pseudo-range corrections
2	GBAS-related data
3	Null message
4	Final approach segment (FAS) data
5	Predicted ranging source availability
6	Reserved
7	Reserved for national applications
8	Reserved for test applications
9 to 100	Spare
101	GRAS pseudo-range corrections
102 to 255	Spare

...

3.6.4.2.4 The measurement block parameters shall be as follows:

...

Coding: 1000 0000 = Reference receiver was not used to compute the pseudo-range correction.

Note.— Some airborne receivers may expect a static correspondence of the reference receivers tom the indices for short-service interruptions. However, the B value indices may be reassigned after the ground subsystem has been out of service for an extended period of time, such as for maintenance.

. . .

3.6.4.3.2 *Additional data blocks.* For additional data blocks other than additional data block 1, the parameters for each data block shall be as follows:

...

ADDITIONAL DATA BLOCK NUMBER: the numerical identifier of the type of additional data block.

Coding:	0 to 1	=	reserved
	2	=	additional data block 2, GRAS broadcast stations
	3	=	reserved for future services supporting Category II/III operations
	4	=	additional data block 4, VDB authentication Parameters
	5 to 255	=	spare

...

3.6.4.3.2.2 *VDB authentication parameters*

Additional data block 4 includes information needed to support VDB authentication protocols

Slot group definition: This 8-bit field indicates which of the 8 slots (A-H) are assigned for use by the ground station. The field is transmitted LSB first. The LSB corresponds to slot A, the next bit to slot B, and so on. A "1" in the bit position indicates the slot is assigned to the ground station. A "0" indicates the slot is not assigned to the ground station.

...

Table B-65C. VDB authentication parameters

Data Content	Bits used	Range of values	Resolution
Slot group definition	8	-	-

...

3.6.4.4 *TYPE 3 MESSAGE—NULL MESSAGE*

...

Table B-71B. Type 3 null message

Data content	Bits used	Range of values	Resolution
Filler	Variable (Note)	N/A	N/A

...

3.6.7.2.1.3 *VDB authentication*

Note.— This section is reserved for forward compatibility with future authentication functions.

...

3.6.7.2.2.9 *Linked pair of Type 1 or Type 101 messages.* If a linked pair of Type 1 or Type 101 messages is transmitted then,

a) the two messages shall have the same modified Z-count;

b) the minimum number of pseudo-range corrections in each message shall be one;

c) the measurement block for a given satellite shall not be broadcast more than once in a linked pair of messages;

d) the two messages shall be broadcast in different time slots.; and

e) the order of the B values in the two messages shall be the same.

...

3.6.7.4 *Functional requirements for authentication protocols*

3.6.7.4.1 *Functional requirements for ground subsystems that support authentication*

3.6.7.4.1.1 The ground system shall broadcast the additional data block 4 with the Type 2 message with the slot group definition field coded to indicate which slots are assigned to the ground station.

3.6.7.4.1.2 The ground subsystem shall broadcast every Type 2 message in the slot that corresponds to the SSID coding for the ground subsystem. Slot A is represented by SSID=0, B by 1, C by 2, and H by 7.

3.6.7.4.1.3 *Assigned slot occupancy.* The ground subsystem shall transmit messages such that 87 percent or more of every assigned slot is occupied. If necessary, Type 3 messages will be used to fill unused space in any assigned time slot.

3.6.7.4.1.4 *Reference path identifier coding.* Every reference path identifier included in every final approach segment data block broadcast by the ground station via the Type 4 messages shall have the first letter selected to indicate the SSID of the ground station in accordance with the following coding.

Coding: A = SSID of 0
X = SSID of 1
Z = SSID of 2
J = SSID of 3
C = SSID of 4
V = SSID of 5
P = SSID of 6
T = SSID of 7

3.6.7.4.2 *Functional requirements for ground subsystems that do not support authentication*

3.6.7.4.2.1 *Reference path indicator coding.* Characters in this set: {A X Z J C V P T} shall not be used as the first character of the reference path identifier included in any FAS block broadcast by the ground station via the Type 4 messages.

...

3.6.8 AIRCRAFT ELEMENTS

3.6.8.1 *GNSS receiver.* The GBAS-capable GNSS receiver shall process signals of GBAS in accordance with the requirements specified in this section as well as with requirements in 3.1.3.1 and/or 3.2.3.1 and/or 3.5.8.1.

...

3.6.8.3 *AIRCRAFT FUNCTIONAL REQUIREMENTS*

...

3.6.8.3.1.2 The receiver shall use message data only if the message block identifier is set to the bit pattern "1010 1010".

3.6.8.3.1.2.1 *GBAS message processing capability.* The GBAS receiver shall at a minimum process GBAS message types in accordance with Table B-82.

3.6.8.3.1.2.2 *Airborne processing for forward compatibility*

Note.— Provisions have been made to enable future expansion of the GBAS Standards to support new capabilities. New message types may be defined, new additional data blocks for message Type 2 may be defined and new data blocks defining reference paths for inclusion within message Type 4 may be defined. To facilitate these future expansions, all equipment should be designed to properly ignore all data types that are not recognized.

3.6.8.3.1.2.2.1 *Processing of unknown message types.* The existence of messages unknown to the airborne receiver shall not prevent correct processing of the required messages.

3.6.8.3.1.2.2.2 *Processing of unknown Type 2 extended data blocks.* The existence of message Type 2 additional data blocks unknown to the airborne receiver shall not prevent correct processing of the required messages.

3.6.8.3.1.2.2.3 *Processing of unknown Type 4 data blocks.* The existence of message Type 4 data blocks unknown to the airborne receiver shall not prevent correct processing of the required messages.

Note.— While the current SARPs include only one definition of a data block for inclusion within a Type 4 message, future GBAS Standards may include other reference path definitions.

Table B-82. Airborne equipment message type processing

Airborne equipment designed performance	Minimum message types processed
APV-I	MT 1 or 101, MT 2 (including ADB 1 and 2 if provided)
APV-II	MT 1, MT 2 (including ADB 1 and 2 if provided), MT 4
Category I	MT 1, MT 2 (including ADB 1 if provided), MT 4

. . .

3.6.8.3.5 *Airborne pseudo-range measurements.*

3.6.8.3.5.1 *Carrier smoothing for airborne equipment.* Airborne equipment shall utilize the standard 100 second carrier smoothing of code phase measurements defined in 3.6.5.1. During the first 100 seconds after filter start up, the value of α shall be either:

1) a constant equal to the sample interval divided by 100 seconds or,

2) a variable quantity defined by the sample interval divided by the time in seconds since filter start-up.

. . .

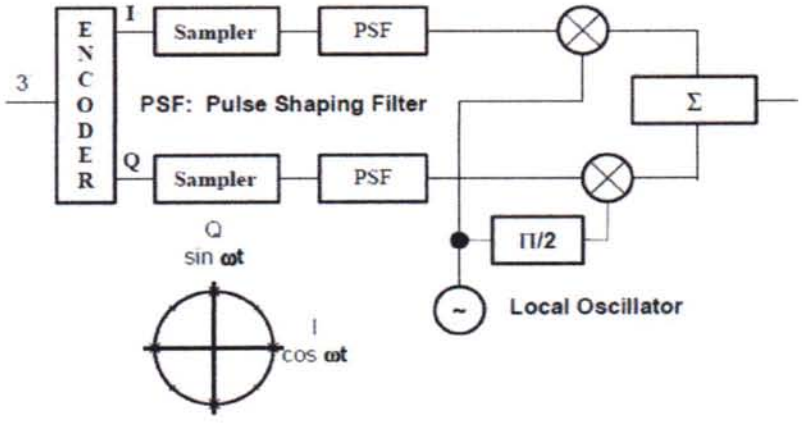

Figure B-19. Example data modulation

. . .

ATTACHMENT D. INFORMATION AND MATERIAL FOR GUIDANCE IN THE APPLICATION OF THE GNSS STANDARDS AND RECOMMENDED PRACTICES

. . .

7.2 RF characteristics

7.2.1 *Coordination*

7.2.1.1 *Performance factors*

7.2.1.1.1 The geographical separation between a candidate GBAS station, a candidate VOR station and existing VOR or GBAS installations must consider the following factors:

a) the coverage volume, minimum field strength and effective radiated power (ERP) of the candidate GBAS including the GBAS positioning service, if provided. The minimum requirements for coverage and field strength are found in CAR-ANS 6.3, 6.3.7.3.5.3 and 6.3.7.3.5.4.4, respectively. The ERP is determined from these requirements;

b) the coverage volume, minimum field strength and ERP of the surrounding VOR and GBAS stations including the GBAS positioning service, if provided. Specifications for coverage and field strength for VOR are found in CAR-ANS 6.3, 6.3.3, and respective guidance material is provided in Attachment C;

c) the performance of VDB receivers, including co-channel and adjacent channel rejection, and immunity to desensitization and intermodulation products from FM broadcast signals. These requirements are found in Appendix B, 3.6.8.2.2;

d) the performance of VOR receivers, including co-channel and adjacent channel rejection of VDB signals. Since existing VOR receivers were not specifically designed to reject VDB transmissions, desired-to-undesired (D/U) signal ratios for co-channel and adjacent channel rejection of the VDB were determined empirically. Table D-2 summarizes the assumed signal ratios based upon empirical performance of numerous VOR receivers designed for 50 kHz channel spacing;

e) for areas/regions of frequency congestion, a precise

f) that between GBAS installations RPDS and RSDS numbers are assigned only once on a given frequency within radio range of a particular GBAS ground subsystem. The requirement is found in Appendix B, 3.6.4.3.1;

g) that between GBAS installations within radio range of a particular GBAS ground subsystem the reference path identifier is assigned to be unique. The requirement is found in Appendix B, 3.6.4.5.1; and

h) the four-character GBAS ID to differentiate between GBAS ground subsystems. The GBAS ID is normally identical to the location indicator at the nearest aerodrome. The requirement is found in Appendix B, 3.6.3.4.1.

...

Table D-3. Nominal VDB link budget

VDB link elements		
For approach service	Vertical component at coverage edge	Horizontal component at coverage edge

Required receiver sensitivity (dBm)	–87	–87
Maximum aircraft implementation loss (dB)	11	15
Power level after aircraft antenna (dBm)	–76	–72
Operating margin (dB)	3	3
Fade margin (dB)	10	10
Free space path loss (dB) at 43 km (23 NM)	106	106
Nominal effective radiated power (ERP) (dBm)	43	47

For longer range and low radiation angle associated with positioning service	Vertical component		Horizontal component	
Required receiver sensitivity (dBm)	–87		–87	
Maximum aircraft implementation loss (dB)	11		15	
Power level after aircraft antenna (dBm)	–76		–72	
Operating margin (dB)	3		3	
Fade margin (dB)	0		0	
Nominal ERP (dBm)				
Range (km (NM))	Free space loss (dB)	ERP (dBm)	ERP (W)	ERP (dBm)	ERP (W)
93 (50)	113	39.9	10	43.9	25
185 (100)	119	45.9	39	49.9	98
278 (150)	122	49.4	87	53.4	219
390 (200)	125	51.9	155	55.9	389

...

Table D-8B. Example of Type 2 Message Containing Data Blocks 1 and 4

DATA CONTENT	BITS USED	RANGE OF VALUES	RESOLUTION	VALUES	BINARY REPRESENTATION (NOTE 1)
BURST DATA CONTENT					
Power ramp-up and settling	15	-	-	-	000 0000 0000 0000
Synchronization and ambiguity resolution	48	-	-	-	0100 0111 1101 1111 1000 1100 0111 0110 0000 0111 1001 0000
SCRAMBLED DATA					
Station Slot Identifier	3	-	-	E	100
Transmission Length	17	0 – 1824 bits	1 bit	1704	0 0000 0110 1010 1000
Training Sequence FEC	5	-	-	-	01000
APPLICATION DATA					
Message Block 1(Type 2 Message)					
Message Block Header					
Message Block Identifier	8	-	-	Normal	1010 1010
GBAS ID	24	-	-	BELL	000010 000101 001100 001100
Message Type Identifier	8	1 – 101	1	2	0000 0010
Message Length	8	10 – 222 bytes	1 byte	37	0010 0101
Message (Type 2 Example)					
GBAS reference receivers	2	2 – 4	1	3	01
Ground accuracy designator letter	2	-	-	B	01
Spare	1	-	-	-	0
GBAS continuity/integrity Designator	3	0 – 7	1	2	010

Local magnetic variation	11	± 180°	0.25°	E58.0°	000 1110 1000
Spare	5	-	-	-	0000 0
σvert_iono_gradient	8	0 - 25.5 x 10-6 m/m	0.1 x 4x 10-6 m/m	4x10-6	0010 1000
Refractivity index	8	16 to 781	3	379	1111 1001
Scale height	8	0 – 25,500 m	100 m	100 m	0000 0001
Refractivity uncertainty	8	0 – 255	1	20	0001 0100
Latitude	32	± 90.0°	0.0005 arcsec	N45° 40' 32" (+164432")	0001 0011 10011010 0001 0001 0000 0000
Longitude	32	± 180.0°	0.0005 arcsec	W93° 25' 13" (-336313")	1101 0111 11101000 1000 10101011 0000
Ellipsoid height	24	± 83,886.07 m	0.01 m	892.55 m	0000 0001 01011100 1010 0111
Additional Data Block 1					
Reference Station Data Selector	8	0 – 48	1	5	0000 0101
Maximum Use Distance (Dmax)	8	2 – 510 km	2 km	50 km	0001 1001
Kmd_e_POS,GPS	8	0 – 12.75	0.05	6	0111 1000
Kmd_e C,GPS	8	0 – 12.75	0.05	5	0110 0100
Kmd_e_POS,GLONASS	8	0 – 12.75	0.05	0	0000 0000
Kmd_e C,GLONASS	8	0 – 12.75	0.0 5	0	0000 0000
Additional Data Block 4					
Additional Data Block Length	8	3	1 byte	3	0000 0011
Additional Data Block Number	8	4	1	4	0000 0100
Slot Group Definition	8	-	-	E	0011 0000
Message Block 1 CRC	32	-	-		1100 0101 11100000 0010 0110 1100 1011
Message Block 2 (Type 3 Message)					
Message Block Header					
Message block identifier	8	-	-	Normal	1010 1010
GBAS ID	24	-	-	BELL	000010 000101001100 001100
Message type identifier	8	1-101	-	3	101 1 3 0000 0011
Message length	8	N/A	1 byte	170	1010 1010
Message (Type 3 example)					
Filler	1280	-	-	-	1010 1010 ......1010 1010
Message Block 2 CRC	32	-	-	-	1001 0000 11101100 1101 10011011 1010
Application FEC	48	-	-	-	0000 1000 00100011 1100 10111101 0000 11010110 1011 0101
Input to Bit Scrambling (note 2)	0 45 58 02 55 30 CA 10 40 A4 A2 17 00 14 9F 80 28 00 88 59 88 59 C8 0D 5117 EB E5 3A 80 A0 98 1E 26 00 00 C0 20 0C D3 64 07 A3 55 30 CA 10 C055 5D 9B 37 09 AD 6B 0B D3 C4 10				
Output from the bit scrambling (Note 3)	0 63 6F 8A 1F 2F D2 3B 9F 3E 77 CE 32 C8 D9 50 DE C 1 C11 C1 5A D4 09 7E E7 81 5A 5C D4 28 56 00 CE 29 60 A3 5F 77 87 C0 C9 D2 42 73 01 15 DB A6 8F EF 8C F3 88 DC 78 B6 C7 D0 93 58 5D 46 B5 6F D5 0C AA 77 FE D3 30 A2 27 E1 EC E4 F7 17 2D AD F4 0B 29 82 04 61 96 E4 50 E9 58 FA B8 C0 38 99 C7 BB 6C 3D 09 CA 7B 7E C2 CF 60 8D 18 75 B9 2B C5 FC 94 C8 57 79 52 C5 5F 6A B2 FF DF 33 4D DD 74 B5 28 2A 06 01 91 9B A4 43 E9 63 05 1D 95 B4 54 29 56 05 51 95 5B AA BC 00 36 66 2E EE 0F 0E 72 71 21 25 E5 EB 14 FD A8 CB F8 83 38 62 39 1E 3A 4E 3E 8E 30 71 D9 24 BA 17 C1 AC 9B F7 BC D3 C8 A3 78 1D 39 B5 C4 2B 69 FD 04 CA 68 81 07 9A 64 8F6B 39 7D 2A 34 D0 6F EA				
Fill Bits	0 to 2	-	-	2	00
Power ramp-down	9	-	-	-	000 000 000
D8PSK Symbols (Note 4)	00000035 11204546 31650102 46331130 13067746 52605627 35467122 62533573 77100603 75554273 0166646 41203311 42111340 14733657 27302663 77076361 44301001 17175104 35263707 43007132 40135774 07012022 52546153 57425454 25413051 54022547 01622754 12302141 24615265 50476225 56622615 23311312 51275055 11132570 45242065 63665236 04052447 35155017 73303745 61650521 06765616 04756006 16264736 30530735 02426407 53610061 12111501 04147002 72512117 74672621 4225425112533720 37475054 44460104 57516674 46523401 22503075 25125742 03431633 22607072 37230050 35463673 43300570 12353363 77140357 42715724 03470633 30354042 67720645 27225703 50111005 40736127 14021742 36572477 13042222 2				

…

Table D-13A. GPS tracking constraints for GRAS and SBAS airborne receivers with double-delta Correlators

Region	3 dB precorrelation bandwidth, BW	Average correlator spacing (X) (chips)	Instantaneous correlator spacing (chips)	Differential group delay
1	$(-50 \times X)+12 < BW \leq 7$ MHz	0.1 – 0.2	0.09 – 0.22	≤ 600 ns
	$2 < BW \leq 7$ MHz	0.2 – 0.6	0.18 – 0.65	
2	$(-50 \times X)+12 < BW \leq\leq (40 \times X)+11.2$ MHz	0.045 – 0.07	0.04 – 0.077	
	$(-50 \times X)+12 < BW \leq 14$ MHz	0.07 – 0.1	0.062 – 0.11	≤ 150 ns
	$7 < BW \leq 14$ MHz	0.1 – 0.24	0.09 – 0.26	
3	$14 < BW \leq 16$ MHz	0.7 – 0.24	0.06 – 0.26	≤ 150 ns

Table D-13B. GPS tracking constraints for GBAS airborne receivers with double-delta Correlators

Region	3 dB precorrelation bandwidth, BW	Average correlator spacing (X) (chips)	Instantaneous correlator spacing (chips)	Differential group delay
1	$(-50 \times X)+12 < BW \leq 7$ MHz	0.1 – 0.16	0.09 – 0.18	≤ 600 ns
	$2 < BW \leq 7$ MHz	0.16 – 0.6	0.14 – 0.65	
2	$(-50 \times X)+12 < BW \leq (133.33 \times X)+2.667$ MHz	0.07 – 0.085	0.063 – 0.094	
	$(-50 \times X)+12 < BW \leq 14$ MHz	0.085 – 0.1	0.077 – 0.11	≤ 150 ns
	$7 < BW \leq 14$ MHz	0.1 – 0.24	0.09 – 0.26	
3	$14 < BW \leq 16$ MHz	0.1 – 0.24	0.09 – 0.26	
	$14 < BW \leq (133.33 \times X) + 2.667$ MHz	0.085 – 0.1	0.077 – 0.11	≤ 150 ns

— END—

---

i. ***Separability Clause.*** - If, for any reason, any provision of this Memorandum Circular is declared invalid or unconstitutional, the other part or parts thereof which are not affected thereby shall continue to be in full force and effect.

ii. ***Repealing Clause.*** - All orders, rules, regulations and issuances, or parts thereof which are inconsistent with this Memorandum Circular are hereby repealed, superseded or modified accordingly.

iii. ***Determination of changes.*** – To highlight the amendments and/or revisions in the Memorandum Circular, the deleted text shall be shown with strikethrough and the new inserted text shall be highlighted with grey shading, as illustrated below:

1. Text deleted: ~~Text to be deleted is shown with a line through it.~~
2. New text inserted: New text is highlighted with grey shading.
3. New text replacing existing text: ~~Text to be deleted is shown with a line through it~~ followed by the replacement text which is highlighted with grey shading.

iv. ***Effectivity Clause.*** - This Memorandum Circular shall take effect fifteen (15) days after publication in a requisite single newspaper of general circulation or the Official Gazette and a copy filed with the U.P. Law Center - Office of the National Administrative Register.

So Ordered. Signed this 17 day of JUL 2017, at the Civil Aviation Authority of the Philippines, MIA Road, Pasay City, Metro Manila, 1301.

CAPTAIN JIM C. SYDIONGCO