GAMA PUBLICATION NO. 11

ARINC 429, GENERAL AVIATION SUBSET

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Version: 6.0
Date: May 6, 2016

List of Effective Pages	*The asterisk indicates pages changed, added, or deleted by the current change.

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| Record of Revisions | | | RETAIN THIS RECORD IN THE FRONT OF MANUAL. ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS. | | | | |

REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	16 Jun 1986						
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5.1th Ed	19 May 2009	REF					
6th Ed	6 May 2016	REF					

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1.0   UNDERLINE GENERAL

1.1   SCOPE

    THIS DOCUMENT IS THE RESULT OF EFFORTS BY THE GENERAL AVIATION MANUFACTURERS ASSOCIATION (GAMA) DATA BUS AD HOC COMMITTEE TO ESTABLISH AND DEFINE A SET OF STANDARD LABEL CODES FOR USE IN AVIONICS EQUIPMENT. THESE LABEL CODES ARE BASED ON ARINC SPECIFICATION 429-12, "MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS)", PUBLISHED JULY 1, 1990. THESE LABEL CODES ARE A SUPPLEMENT TO AND NOT A REPLACEMENT FOR THE LABEL CODES LISTED IN THE ABOVE MENTIONED, AND SUBSEQUENT, ARINC SPECIFICATIONS.

1.2   CHANGES

    COMMENTS ON GAMA PUBLICATION NO. 11 SHOULD BE SUBMITTED TO:
GAMA PUBLICATION 11 – ARINC 429, GENERAL AVIATION SUBSET COMMENTS
GENERAL AVIATION MANUFACTURERS ASSOCIATION
MAIL - 1400 K ST. NW SUITE 801, WASHINGTON DC 20005
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1.2.1   CHANGE MARKINGS

    CHANGES ASSIGNED TO THIS REVISION WILL BE MARKED LINE-BY-LINE IN THE LEFT MARGIN.

1.2.2   HIGHLIGHTS, THIS REVISION

    THE MAY 6, 2016 REVISION OF THE GAMA 429 DATA BUS STANDARD INCORPORATES THE FOLLOWING ADDITIONS AND CHANGES:

- ADDITION OF GENESYS AEROSYSTEMS TO LABEL 371G, GENERAL AVIATION EQUIPMENT IDENTIFICATION CODES (#31)
- ADDITION OF LABEL 040 – UHF COM

2.0   STANDARDS

2.1   LABEL CODE STANDARDS

    THE LABEL CODES LISTED IN THIS DOCUMENT COMPLY WITH THE ARINC SPECIFICATION 429-12 THE "MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM" (DITS) AND ITS SUPPLEMENTS. THE LABEL CODES LISTED ARE SPECIALLY DEFINED FOR USE BY GENERAL AVIATION MANUFACTURERS TO SUPPLY MORE DESIGN AND OPERATION VERSATILITY THAN WAS AVAILABLE WITH THE STANDARD ARINC LABEL CODE SELECTION.

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3.0   DOCUMENT DESCRIPTION

3.1   LRN AND CNI BIT DEFINITIONS

LRN AND CNI BIT DEFINITIONS LIST THE LABEL CODES OUTPUT PRIMARILY BY LONG RANGE NAVIGATION EQUIPMENTS AND COMMUNICATION / NAVIGATION / INTERROGATION (CNI) EQUIPMENTS. THE LONG RANGE NAVIGATION EQUIPMENT (LRN) LABELS ARE INFORMATION TRANSMITTED BY LRN'S FOR USE BY ELECTRONIC FLIGHT INSTRUMENT SYSTEMS (EFIS) FOR PURPOSES OF MAPPING, AND REMOTE WAYPOINT ENTRY. THE CNI LABELS ARE USED TO TUNE VARIOUS RADIOS AND TO TRANSMIT THEIR TRADITIONAL INFORMATION AROUND THE AIRCRAFT.

LRN AND CNI BIT DEFINITIONS

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
001	02	DISTANCE TO GO (BCD)			
001	09	DISTANCE TO GO (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-14	TENTHS OF NAUT MI		
		15-18	UNITS OF NAUT MI		
		19-22	TENS OF NAUT MI		
		23-26	HUNDREDS OF NAUT MI		
		27-29	THOUSANDS OF NAUT MI		
		30-31	SSM		
		32	PARITY (ODD)		
002	02	TIME TO GO (BCD)			
002	09	TIME TO GO (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-14	SPARES		PAD ZERO
		15-18	TENTHS OF MINUTES		
		19-22	UNITS OF MINUTES		
		23-26	TENS OF MINUTES		
		27-29	HUNDREDS OF MINUTES		
		30-31	SSM		
		32	PARITY (ODD)		
012	02	GROUND SPEED (BCD)			
012	09	GROUND SPEED (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-14	TENTHS OF KNOTS		
		15-18	UNITS OF KNOTS		
		19-22	TENS OF KNOTS		
		23-26	HUNDREDS OF KNOTS		
		27-29	THOUSANDS OF KNOTS		
		30-31	SSM		
		32	PARITY (ODD)		

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
017	10	SELECTED RUNWAY HDG (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-14	SPARES		PAD ZERO
		15-18	TENTHS OF DEGREES		
		19-22	UNITS OF DEGREES		
		23-26	TENS OF DEGREES		
		27-29	HUNDREDS OF DEGREES		
		30-31	SSM		
		32	PARITY (ODD)		
024G	11	SELECTED COURSE 1 (BCD)			
		01-08	LABEL		
		09-10	SDI		
		# 11	HSI CRS SEL MASTER CONTROL	LRN CTRL	NOT LRN
		12-18	SPARES		PAD ZERO
		19-22	UNITS OF DEGREES		
		23-26	TENS OF DEGREES		
		27-29	HUNDREDS OF DEGREES		
		30-31	SSM		
		32	PARITY (ODD)		
027	11	SELECTED COURSE 2 (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-18	SPARES		PAD ZERO
		19-22	UNITS OF DEGREES		
		23-26	TENS OF DEGREES		
		27-29	HUNDREDS OF DEGREES		
		30-31	SSM		
		32	PARITY (ODD)		
030G	02	VHF COM FREQUENCY (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-14	THOUSANDTHS OF MHZ		
		15-18	HUNDREDTHS OF MHZ		
		19-22	TENTHS OF MHZ		
		23-26	UNITS OF MHZ		
		27-29	TENS OF MHZ		
		30-31	SSM AND DISCRETE		

31(0) & 30(0) - NORMAL OPERATION
31(0) & 30(1) - NO COMPUTED DATA
31(1) & 30(0) - FUNCTIONAL TEST (NOT USED)
* 31(1) & 30(1) - SQUELCH DISABLE

| | | 32 | PARITY (ODD) | | |

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
030G	16	VHF COM FREQUENCY (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-14	THOUSANDTHS OF MHZ		
		15-18	HUNDREDTHS OF MHZ		
		19-22	TENTHS OF MHZ		
		23-26	UNITS OF MHZ		
		27-29	TENS OF MHZ		
		30-31	SSM AND DISCRETE		
			31(0) & 30(0) - NORMAL OPERATION		
			31(0) & 30(1) - NO COMPUTED DATA		
			31(1) & 30(0) - FUNCTIONAL TEST (NOT USED)		
			* 31(1) & 30(1) - TRANSMIT ON		
		32	PARITY (ODD)		
031G	02	BEACON TRANSPONDER CODE (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11	ALTITUDE REPORTING	OFF	ON
		12	CONTROL FUNCTION (SEE 15-17 BELOW)		
		13	IDENT	ON	OFF
		14	ALTITUDE DATA SOURCE SELECT	SOURCE#2	SOURCE#1
		15-17	CONTROL FUNCTION		
			17(0) & 16(0) & 15(0) & 12(1) - DABS ON / ASAS OFF		
			17(0) & 16(0) & 15(1) & 12(0) - RESET AURAL WARNING		
			* 17(0) & 16(1) & 15(0) & 12(0) - TRANSPONDER IN USE		
		18	D1	TRANSMIT	NOT XMIT
		19	D2	TRANSMIT	NOT XMIT
		20	D4	TRANSMIT	NOT XMIT
		21	C1	TRANSMIT	NOT XMIT
		22	C2	TRANSMIT	NOT XMIT
		23	C4	TRANSMIT	NOT XMIT
		24	B1	TRANSMIT	NOT XMIT
		25	B2	TRANSMIT	NOT XMIT
		26	B4	TRANSMIT	NOT XMIT
		27	A1	TRANSMIT	NOT XMIT
		28	A2	TRANSMIT	NOT XMIT
		29	A4	TRANSMIT	NOT XMIT
		30-31	SSM		
		32	PARITY (ODD)		

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LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
031G	18	BEACON TRANSPONDER CODE (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11	ALTITUDE REPORTING	OFF	ON
		12	CONTROL FUNCTION (SEE 15-17 BELOW)		
		13	IDENT	OFF	ON
		14	ALTITUDE DATA SOURCE SELECT	SOURCE#2	SOURCE#1
		15-17	CONTROL FUNCTION		
			17(0) & 16(0) & 15(0) & 12(1) - DABS ON / ASAS OFF		
			17(0) & 16(0) & 15(1) & 12(0) - RESET AURAL WARNING		
			* 17(0) & 16(1) & 15(0) & 12(0) - TRANSPONDER IN USE		
		18	D1	TRANSMIT	NOT XMIT
		19	D2	TRANSMIT	NOT XMIT
		20	D4	TRANSMIT	NOT XMIT
		21	C1	TRANSMIT	NOT XMIT
		22	C2	TRANSMIT	NOT XMIT
		23	C4	TRANSMIT	NOT XMIT
		24	B1	TRANSMIT	NOT XMIT
		25	B2	TRANSMIT	NOT XMIT
		26	B4	TRANSMIT	NOT XMIT
		27	A1	TRANSMIT	NOT XMIT
		28	A2	TRANSMIT	NOT XMIT
		29	A4	TRANSMIT	NOT XMIT
		30-31	SSM AND DISCRETE		
			31(0) & 30(0) - NORMAL OPERATION		
			31(0) & 30(1) - NO COMPUTED DATA		
			31(1) & 30(0) - FUNCTIONAL TEST (NOT USED)		
			* 31(1) & 30(1) - REPLY		
		32	PARITY (ODD)		
032	02	ADF FREQUENCY (BCD)			
032	12	ADF FREQUENCY (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11	BFO	ON	OFF
		12	MODE	ADF	ANTENNA
		13	SPARE		PAD ZERO
		14	0.5KHZ	0.5KHz	0.0KHz
		15-18	UNITS OF KHZ		
		19-22	TENS OF KHZ		
		23-26	HUNDREDS OF KHZ		
		27-29	THOUSANDS OF KHZ		
		30-31	SSM		
		32	PARITY (ODD)		

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
033	02	ILS FREQUENCY (BCD)			
033	10	ILS FREQUENCY (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-12	ILS CATEGORY		
			12(0) & 11(0) - CATEGORY NOT ENCODED		
			12(0) & 11(1) - ILS CAT I		
			12(1) & 11(0) - ILS CAT II		
			12(1) & 11(1) - ILS CAT III		
		13-14	SPARES		PAD ZERO
		15-18	0.01 MHZ		
		19-22	0.1 MHZ		
		23-26	1 MHZ		
		27-29	10 MHZ		
		30-31	SSM		
		32	PARITY (ODD)		
034G	02	VOR/ILS FREQUENCY (BCD)			
034G	10	VOR/ILS FREQUENCY (BCD)			
034G	11	VOR/ILS FREQUENCY (BCD) (NOTE 1)			
		01-08	LABEL		
		09-10	SDI		
		* 11	MARKER SENSITIVITY	HIGH	LOW
		* 12	LAST TUNE SOURCE (NOTE 1)	CTL HEAD	OTHER
		# 13	VOR DIG BEARING FILTER (NOTE 2)	NO FILT	FILT IN
		14	ILS MODE	ILS	VOR
		15-18	HUNDREDTHS OF MHZ		
		19-22	TENTHS OF MHZ		
		23-26	UNITS OF MHZ		
		27-29	TENS OF MHZ		
		30-31	SSM		
		32	PARITY (ODD)		

NOTE 1: SEE APPENDIX 6 FOR ALTERNATE USAGE OF BIT 12.
NOTE 2: (APPLIES TO BOTH DIGITAL AND ANALOG OUTPUTS.): THIS BIT SHOULD BE SET TO 1, EXCEPT WITH KING RADIOS WHERE FILTER IS DESIRED.

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION / BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
035G	02	DME FREQUENCY (BCD)			
035G	09	DME FREQUENCY (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-13	DME MODE		
			13(0) & 12(0) & 11(0) - STANDBY		
			13(0) & 12(0) & 11(1) - DIRECTED FREQ 1		
			13(0) & 12(1) & 11(0) - DIRECTED FREQ 2		
			13(0) & 12(1) & 11(1) - DIRECTED FREQ 3		
			* 13(1) & 12(0) & 11(0) - HOLD FREQ 1		
			* 13(1) & 12(0) & 11(1) - HOLD FREQ 2		
			* 13(1) & 12(1) & 11(0) - FREE SCAN (NOT USED)		
			13(1) & 12(1) & 11(1) - SPARE		
		14-15	NAV MODE		
			15(0) & 14(0) - VOR		
			15(0) & 14(1) - ILS		
			15(1) & 14(0) - MLS		
			15(1) & 14(1) - SPARE		
		16	DISPLAY	ENABLE	DISABLE
		17	IDENT	AUDIO ON	AUDIO OFF
		18	0.05 MHz	0.05 MHz	0.00 MHz
		19-22	TENTHS OF MHZ		
		23-26	UNITS OF MHZ		
		27-29	TENS OF MHZ		
		30-31	SSM		
		32	PARITY (ODD)		

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
040	02	UHF COM FREQUENCY (BCD)			
	17	UHF COM FREQUENCY (BCD)			
		01-08	LABEL		
		09-10	SDI		
			10(0) & 9(0) – ALL CALL		
			10(0) & 9(1) – COM 1		
			10(1) & 9(0) – COM 2		
			10(1) & 9(1) – COM 3		
		11-12	MODULATION		
			12(0) & 11(0) – AM MODULATION		
			12(0) & 11(1) – FM, WIDEBAND MODULATION		
			12(1) & 11(0) – FM, NARROWBAND MODULATION		
			12(1) & 11(1) – TX FREQUENCY ENCODED		
		13	OPERATIONAL MODE	SIMPLEX	SEMI-DUPLEX
		14-16	NUMBER OF 12.5 KHz INCREMENTS		
		17-20	TENTHS OF MHz		
		21-24	UNITS OF MHz		
		25-28	TENS OF MHz		
		29	100 MHz FREQ INCREMENTS	300MHz	200 MHz?
		30-31	SIGN STATUS MATRIX		
			31(0) & 30(0) – SQUELCH NORMAL		
			31(0) & 30(1) – NO COMPUTED DATA		
			31(1) & 30(0) – FUNCTIONAL TEST		
			31(1) & 30(1) – RECEIVER SQUELCH OPEN		
		32	PARITY (ODD)		
041	02	SET POSITION LATITUDE (BCD)			
		01-08	LABEL		
		09-12	TENTHS OF MINUTES		
		13-16	UNITS OF MINUTES		
		17-20	TENS OF MINUTES		
		21-24	UNITS OF DEGREES		
		25-28	TENS OF DEGREES		
		29	HUNDREDS OF DEGREES		
		30-31	SSM		
		32	PARITY (ODD)		
042	02	SET POSITION LONGITUDE (BCD)			
		01-08	LABEL		
		09-12	TENTHS OF MINUTES		
		13-16	UNITS OF MINUTES		
		17-20	TENS OF MINUTES		
		21-24	UNITS OF DEGREES		
		25-28	TENS OF DEGREES		
		29	HUNDREDS OF DEGREES		
		30-31	SSM		
		32	PARITY (ODD)		

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
043	02	SET MAGNETIC HEADING (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-18	SPARES		PAD ZERO
		19-22	UNITS OF DEGREES		
		23-26	TENS OF DEGREES		
		27-29	HUNDREDS OF DEGREES		
		30-31	SSM		
		32	PARITY (ODD)		
060P	02	OMEGA DATA SELECT (BNR) (AlliedSignal)			
		01-08	LABEL		
		# 09-24	BINARY ADDRESS (BIT 24 MSB)		
		# 25-26	RELANE BITS		
			26(0) & 25(0) - NO ACTION		
			26(0) & 25(1) - RELANE		
			26(1) & 25(0) - DO NOT RELANE		
			26(1) & 25(1) - NOT ALLOWED		
		# 27	RHO RHO UPDATING	INHIBIT	ALLOW
		# 28	FULL RESTART BIT	RESTART	NO RESTART
		29	SPARE		PAD ZERO
		30-31	SSM		
		32	PARITY (ODD)		
061P	02	COVARIANCE DATA (BNR) (AlliedSignal)			
		01-08	LABEL		
		# 09-18	MANTISSA (IEEE FLT. PNT.)		
		# 19-26	EXPONENT (IEEE FLT. PNT.)		
		# 27	SIGN	NEGATIVE	POSITIVE
		# 28-29	TERM IDENT		
			29(0) & 28(0) - TERM 1		
			29(0) & 28(1) - TERM 2		
			29(1) & 28(0) - TERM 3		
			29(1) & 28(1) - NOT DEFINED		
		30-31	SSM		
		32	PARITY (ODD)		
074G	02	DATA RECORD HEADER (BNR)			
		01-08	LABEL		
		* 09-15	TOTAL BNR NUMBER OF RECORDS (127)		
		16-20	SPARES		PAD ZERO
		* 21	PRIOR RECORD CHANGE (NOTE)	CHANGED	UNCHANGED
		22-29	SPARES		PAD ZERO
		30-31	SSM		
		32	PARITY (ODD)		
		NOTE:	PRIOR RECORD CHANGE INDICATES THAT DATA IN AT LEAST ONE RECORD OF THE PRIOR BLOCK OF RECORDS HAS BEEN CHANGED.		

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
075G	02	ACTIVE WAYPOINT FROM/TO DATA (DSC)			
		01-08	LABEL		
		# 09	AUTO/LEG / MAN/OBS	MAN/OBS	AUTO/LEG
		# 10	MAG/TRUE REFERENCE	TRUE	MAG
		# 11	RADAR WPT DISPLAYED	NOT DISP	DISPLAYED
		# 12	LAT/LON / ILS MODE	ILS	LAT/LON
		* 13-16	TO WPT BCD MS BYTE		
		* 17-20	FROM WPT BCD MS BYTE		
		* 21-24	TO WPT BCD LS BYTE		
		* 25-28	FROM WPT BCD LS BYTE		
		29	SPARE		PAD ZERO
		30-31	SSM		
		32	PARITY (ODD)		
100G	02	SELECTED COURSE 1 (BNR)			
		01-08	LABEL		
		09-10	SDI		
		# 11	HSI CRS SEL MASTER CONTROL	LRN CTRL	NOT CTRL
		12-16	SPARES		PAD ZERO
		17-28	BINARY ANGLE (180 / 4,096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		
100	11	SELECTED COURSE 1 (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-16	SPARES		PAD ZERO
		17-28	BINARY ANGLE (180 / 4,096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		
101G	02	SELECTED HEADING (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11	DATA CHANGE BIT (NOTE)	CHANGE	NO CHANGE
		12-16	SPARES		PAD ZERO
		17-28	BINARY ANGLE (180 / 4,096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		

NOTE: BIT 11 WILL REMAIN HIGH FOR 3 SECONDS WHEN THE DATA FROM THE FMS HAS BEEN CHANGED BY THE PILOT/COPILOT. ALWAYS SET TO ZERO WHEN SENT BY EFIS. THE FMS OUTPUT IS VALID ONLY WHEN IT IS IN HEADING MODE.

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
101G	25	SELECTED HEADING (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11	DATA CHANGE BIT (NOTE)	CHANGE	NO CHANGE
		12-16	SPARES		PAD ZERO
		17-28	BINARY ANGLE (180 /4 ,096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		

NOTE: BIT 11 WILL REMAIN HIGH FOR 3 SECONDS WHEN THE DATA FROM THE FMS HAS BEEN CHANGED BY THE PILOT/COPILOT. ALWAYS SET TO ZERO WHEN SENT BY EFIS. THE FMS OUTPUT IS VALID ONLY WHEN IT IS IN HEADING MODE.

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
102G	02	SELECTED ALTITUDE (BNR)			
		01-08	LABEL		
		09-10	SDI		
		# 11	ALTITUDE SELECT KNOB	NO MOTION	IN MOTION
		# 12	ALTITUDE ALERT	ON	OFF
		13-28	BINARY FEET (65,536 / 65,536)		
		29	SIGN		ALWAYS ZERO
		30-31	SSM		
		32	PARITY (ODD)		

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
105	10	SELECTED RUNWAY HEADING (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-17	SPARES		PAD ZEROS
		18-28	BINARY ANGLE (180 / 4,096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
110	11	SELECTED COURSE 2 (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-16	SPARES		PAD ZEROS
		17-28	BINARY ANGLE (180 / 4,096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
113G	02	MESSAGE CHECKSUM (BNR)			
		01-08	LABEL		
		* 09-29	BINARY MESSAGE CHECKSUM (NOTE)		
		30-31	SSM		
		32	PARITY (ODD)		

NOTE: THE MESSAGE CHECKSUM IS THE TWO'S COMPLEMENT 21 BIT SUMOF ALL THE OTHER WORDS TRANSMITTED IN THE GROUP DISCARDING THE INTERMEDIATE CARRY AND REPLACING BIT 32 WITH ODD PARITY BIT.

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LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
114	02	DESIRED TRACK (TRUE) (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-16	SPARES		PAD ZEROS
		17-28	BINARY ANGLE (180 / 4,096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		
115	02	WAYPOINT BEARING (TRUE) (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-16	SPARES		PAD ZERO
		17-28	BINARY ANGLE (180 / 4,096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		
116G	02	CROSS TRACK DISTANCE (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-13	RESERVED NAUT MI (128 / 262,144) (NOTE)		
		14-28	BINARY NAUT MI (128 / 32,768)		
		29	SIGN	FLY RIGHT	FLY LEFT
		30-31	SSM		
		32	PARITY (ODD)		

NOTE: BITS 11-13 ARE TO BE USED AS OPTIONAL RESOLUTION EXTENSION TO SUPPORT EXPANDED DEVIATION SCALE APPLICATIONS. FILL WITH ZERO WHEN NOT USED.

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
117G	02	VERTICAL DEVIATION (BNR)			
		01-08	LABEL		
		09-10	SDI		
		# 11	ALTITUDE GREATER THAN 1000 FT	GREATER	LESS THAN
		# 12	VNAV BENDOVER DIRECT'N (NOTE 1)	FLY UP	FLY DOWN
		# 13	VNAV BENDOVER	CAPTURE	TRACK
		* 14	VNAV ARM ENABLE/ALERT (NOTE 2)	ENABLE	NOT ENABLE
		15-28	BINARY FEET (*16,384 / 16,384)		
		29	SIGN	FLY UP	FLY DOWN
		30-31	SSM		
		32	PARITY (ODD)		

NOTE 1: BENDOVER DIRECTION WILL BE DEFINED ONLY DURING CAPTURE.
NOTE 2: SEE APPENDIX 6 FOR ALTERNATE USAGE OF BIT 14.

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
121	02	HORIZONTAL COMMAND (TO AUTOPILOT) (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-14	SPARES		PAD ZERO
		15-28	BINARY ANGLE (180 / 16,384)		
		29	SIGN	FLY LEFT	FLY RIGHT
		30-31	SSM		
		32	PARITY (ODD)		
122G	02	VERTICAL COMMAND (TO AUTOPILOT) (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11	ALT SEL LVL OFF INTERVENT'N	FMS LEVEL	AP LEVEL
		12	VERTICAL TRACK ALERT HORN	HORN	NO HORN
		13	VERT TRK ALRT ANN. (NOTE)	ANN	NO ANN
		14	FMS VNAV CAPTURE / TRACK	CAPTURE	TRACK
		15-16	SPARES		PAD ZERO
		17-28	BINARY ANGLE (180 / 4,096)		
		29	SIGN	FLY DOWN	FLY UP
		30-31	SSM		
		32	PARITY (ODD)		
		NOTE:	SEE APPENDIX 6 FOR ALTERNATE USAGE OF BIT 13.		
123	02	THROTTLE COMMAND (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-28	BINARY DEG/SEC (256 / 262,144)		
		29	SIGN	DECREASE	INC. POWER
		30-31	SSM		
		32	PARITY (ODD)		
125	02	GREENWICH MEAN TIME (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-14	TENTHS OF MINUTES		
		15-18	UNITS OF MINUTES		
		19-22	TENS OF MINUTES		
		23-26	UNITS OF HOURS		
		27-29	TENS OF HOURS		
		30-31	SSM		
		32	PARITY (ODD)		

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LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
147G	02	MAGNETIC VARIATION (BNR)			
		01-08	LABEL		
		09-10	SDI		
		* 11	SOURCE OF DATA	PILOT ENT	COMPUTED
		12-16	SPARES		PAD ZERO
		* 17-28	BINARY ANGLE (*180 / 4,096) (NOTE)		
		29	SIGN	WEST	EAST
		30-31	SSM		
		32	PARITY (ODD)		
		NOTE:	MAGVAR IS 2'S COMPLEMENT BINARY - POSITIVE EAST. RANGE = +/- 180 DEG		
150	02	GREENWICH MEAN TIME (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11	SPARE		PAD ZERO
		12-17	BINARY SECONDS (0-59)		
		18-23	BINARY MINUTES (0-59)		
		24-28	BINARY HOURS (0-23)		
		29	SIGN		ALWAYS ZERO
		30-31	SSM		
		32	PARITY (ODD)		
157P	06	NORMALIZED ANGLE OF ATTACK (BNR) (AlliedSignal)			
		01-08	LABEL		
		09-10	SDI		
		11-16	SPARE		PAD ZERO
		17-28	NORMALIZED AOA (2.0 / 4,096)		
		29	SIGN	NEG AOA	POS AOA
		30-31	SSM		
		32	PARITY (ODD)		
162G	12	ADF BEARING (BNR)			
		01-08	LABEL		
		09-10	SDI		
		# 11	DISPLAY ADF DEVIATION	ON	OFF
		12-16	SPARES		PAD ZERO
		17-28	BINARY ANGLE (180 / 4,096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		
163G	02	WIND ON NOSE (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-19	SPARES		PAD ZERO
		* 20-28	BINARY KNOTS (*256 / 512)		
		* 29	SIGN	TAIL WIND	HEAD WIND
		30-31	SSM		
		32	PARITY (ODD)		

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LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
173	10	LOCALIZER DEVIATION (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11	TUNE INHIBIT	INHIBIT	ALLOW
		12-16	SPARES		PAD ZERO
		17-28	BINARY DDM (0.4 / 4,096) (NOTE)		
		29	SIGN	FLY LEFT	FLY RIGHT
		30-31	SSM		
		32	PARITY (ODD)		
		NOTE:	150mV(LOC) = 0.155DDM		
174	10	GLIDESLOPE DEVIATION (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11	TUNE INHIBIT	INHIBIT	ALLOW
		12-16	SPARES		PAD ZERO
		17-28	BINARY DDM (0.8 / 4,096) (NOTE)		
		29	SIGN	FLY UP	FLY DOWN
		30-31	SSM		
		32	PARITY (ODD)		
		NOTE:	150mV(GS) = 0.175DDM		
202	02	DME DISTANCE (BNR)			
202	09	DME DISTANCE (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11	MEMORY	MEM. ON	MEM. OFF
		12	FOREGROUND	FORE.	NOT FORE.
		13-28	BINARY NAUT MI (512 / 65,536)		
		29	SIGN		ALWAYS ZERO
		30-31	SSM		
		32	PARITY (ODD)		
204	02	BARO CORRECTED ALTITUDE #1 (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11	SPARE		PAD ZERO
		12-28	BINARY FEET (131,072 / 131,072)		
		29	SIGN	BELOW	ABOVE S.L.
		30-31	SSM		
		32	PARITY (ODD)		

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION / BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
210	02	TRUE AIRSPEED (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-13	SPARES		PAD ZERO
		14-28	BINARY KNOTS (2,048 / 32,768)		
		29	SIGN		ALWAYS ZERO
		30-31	SSM		
		32	PARITY (ODD)		
213	02	STATIC AIR TEMPERATURE (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-17	SPARES		PAD ZERO
		18-28	BINARY DEG C (512 / 2,048)		
		29	SIGN	BELOW	ABOVE ZERO
		30-31	SSM		
		32	PARITY (ODD)		
222P	11	VOR RADIAL (FROM STATION TO AIRCRAFT) (BNR) (AlliedSignal)			
222	02	VOR OMNIBEARING (FROM AIRCRAFT TO STATION) (BNR)			
222	10	VOR OMNIBEARING (FROM AIRCRAFT TO STATION) (BNR)			
222	11	VOR OMNIBEARING (FROM AIRCRAFT TO STATION) (BNR)			
		01-08	LABEL		
		09-10	SDI - NOTE: COMES FROM SDI OF LABEL 034G		
		11	MARKER BEACON 400 HZ	PRESENT	ABSENT
		12	MARKER BEACON 1300 HZ	PRESENT	ABSENT
		13	MARKER BEACON 3000 HZ	PRESENT	ABSENT
		14-16	SPARES		PAD ZERO
		17-28	BINARY ANGLE (*180/4096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		

NOTE: SIMULTANEOUS PRESENCE OF MORE THAN ONE MARKER BEACON BIT SHOULD BE RECOGNIZED AS MARKER SELF TEST AND NOT INITIATE FLIGHT CONTROL GAIN CHANGES.

LABEL	HEX ID	DESCRIPTION / BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
241P	*	NORMALIZED ANGLE OF ATTACK (BNR) (Rockwell Collins)			
		01-08	LABEL		
		09-10	SDI		
		11-16	SPARES		PAD ZERO
		17-28	BIN NORMALIZED AOA (2.0 / 4,096)		
		29	SIGN	NEG AOA	POS AOA
		30-31	SSM		
		32	PARITY (ODD)		

* Stall Warning / AOA System

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LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
251G	02	DISTANCE TO GO (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-13	SPARES		PAD ZERO
		14-28	BINARY NAUT MI (4,096 / 32,768)		
		29	SIGN		ALWAYS ZERO
		30-31	SSM		
		32	PARITY (ODD)		
252	02	TIME TO GO (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-19	SPARES		PAD ZERO
		20-28	BINARY MINUTES (512 / 512)		
		29	SIGN		ALWAYS ZERO
		30-31	SSM		
		32	PARITY (ODD)		
260G	02	DATE (BCD)			
		01-08	LABEL		
		09-10	SDI		
		11-14	YEAR ONES DIGIT		
		15-18	YEAR TENS DIGIT		
		19-22	MONTH ONES DIGIT		
		23	MONTH TENS DIGIT		
		24-27	DAY ONES DIGIT		
		28-29	DAY TENS DIGIT		
		30-31	SSM		
		32	PARITY (ODD)		

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LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
261G	02	GPS DISCRETE WORD 1			
		01-08	LABEL		
		09-10	SDI		
		11-12	SPARE		PAD ZERO
		13-16	RESERVED		
		17-19	WAAS APPROACH TYPE		

19(0) & 18(0) & 17(0) – No Approach Type Selected
19(0) & 18(0) & 17(1) – LNAV
19(0) & 18(1) & 17(0) – LNAV/VNAV
19(0) & 18(1) & 17(1) – Not Used
19(1) & 18(0) & 17(0) – LP
19(1) & 18(0) & 17(1) – LPV
19(1) & 18(1) & 17(0) – Not Used
19(1) & 18(1) & 17(1) – Not Used

NOTE: LNAV: LATERAL NAVIGATION
       LNAV/VNAV: LATERAL NAVIGATION/VERTICAL NAVIGATION
       LP: LOCALIZER PERFORMANCE WITHOUT VERTICAL GUIDANCE
       LPV: LOCALIZER PERFORMANCE WITH VERTICAL GUIDANCE

		BIT NO.	FUNCTION	ONE	ZERO
		20	VERT. DEV. (FINAL APPR.)	ANGULAR	LINEAR
		21	LAT. DEV SCALING IN TRANSITION	YES	NO
		22	LAT. DEV. (FINAL APPR)	ANGULAR	LINEAR
		23	APPR INTEGRITY (FINAL APPR)	VALID	INVALID
		24	GPS INTEGRITY	FAIL	VALID
		25-27	GPS ANNUNCIATION		

27(0) & 26(0) & 25(0) - ENROUTE
27(0) & 26(0) & 25(1) - TERMINAL
27(0) & 26(1) & 25(0) - APPROACH
27(1) & 26(0) & 25(0) - OCEANIC

| | | 28-29 | SPARE | | |
| | | 30-31 | SSM | | |

31(0) & 30(0) - NORMAL OPERATION
31(0) & 30(1) - NO COMPUTED DATA
31(1) & 30(0) - FUNCTIONAL TEST
31(1) & 30(1) - NOT USED

| | | 32 | PARITY (ODD) | | |

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275G   02   LRN STATUS WORD (DSC)

	Bit	Description	State 1	State 0
	01-08	LABEL		
	09-10	SDI		
*	11	WAYPOINT ALERT	ON	OFF
*	12	DEAD RECKON	DR	NOT DR
#	13	DIRECT TO	SELECT	NOT SELECT
#	14-15	MODE		

          15(0) & 14(0) - MULTIPLE SENSOR BASED
          15(0) & 14(1) - VOR/DME OFFSET (RNAV) APPROACH
          15(1) & 14(0) - VOR/TACAN (NON-OFFSET) APPROACH/ENROUTE
          15(1) & 14(1) - ILS APPROACH

	Bit	Description	State 1	State 0
*	16	VERT & LAT DEV SCALING	APPROACH	ENROUTE
#	17	FMS CONTRL'D HDG SUB-MODE	FMS/FGS	FGS ONLY
#	18	REMOTE FGS ARM FOR NAV CAPT.	ARM	NO CHANGE
#	19	FMS PLAN MODE	SELECT	NOT SELECT
#	20	DISPLAY FINAL APPR COURSE	DISPLAY	NO CHANGE
#	21	ANGULAR SCALING	ACTIVE	NOT ACTIVE
#	22	INTEGRITY WARN	WARN	NOT WARN
*	23	TO	TO	NOT TO
*	24	FROM	FROM	NOT FROM
*	25	PARALLEL XTK OFFSET	SELECTED	NOT SELECT
#	26	AIRPORT DISPLAY SELECTED	SELECT	NOT SELECT
*	27	MESSAGE ALERT	ON	OFF
*	28	TRUE/MAG	TRUE	MAGNETIC
*	29	HSI VALID (NAV WARN)	VALID	WARN
	30-31	SSM		
	32	PARITY (ODD)		

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
277G	02	CABIN DISPLAY CONTROL DISCRETE (DSC)			
		01-08	LABEL		
		09-10	SDI (if required)		
		11	PLAY BRIEFING #1		
		12	PLAY BRIEFING #2		
		13	PLAY BRIEFING #3		
		14	PLAY BRIEFING #4		
		15	PLAY BRIEFING #5		
		16	PLAY BRIEFING #6		
		17	CANCEL BRIEFING #1		
		18	CANCEL BRIEFING #2		
		19	CANCEL BRIEFING #3		
		20	CANCEL BRIEFING #4		
		21	CANCEL BRIEFING #5		
		22	CANCEL BRIEFING #6		
		23	ANNUNCIATE CABIN MESSAGE (NOTE)		
		24-28	SPARES		PAD ZERO
		29	ALTERNATE FORMAT	ALT	STD
		30-31	SSM		
			31(0) & 30(0) - NORMAL OPERATION		
			31(0) & 30(1) - NO COMPUTED DATA		
			31(1) & 30(0) - FUNCTIONAL TEST		
			31(1) & 30(1) - FAILURE WARNING		
		32	PARITY (ODD)		

NOTE: THE **ALTERNATE FORMAT** BIT (# 29) CAUSES THE BRIEFING PLAY (BITS 11-16) AND BRIEFING CANCEL (BITS 17-22) CONTROLS TO BE INTERPRETED AS THE BRIEFING NUMBER FROM 1 TO 63 WITH THE BRIEFING #1 BIT AS THE LEAST SIGNIFICANT. IF BIT 29 IS SET TO 1, THIS DECODING WILL BE USED. IF THE BRIEFING NUMBER IS NON ZERO, THE INDICATED BRIEFING WILL BE PLAYED OR CANCELED.

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LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
300G	02	STN DECLINATION, TYPE AND CLASS (BNR)			
		01-08	LABEL		
		09-14	SPARES		PAD ZERO
		* 15	NON COLLOCATED DME (NOTE 1)	NON COLL	SAME LOCAT
		* 16	TUNED AND RECEIVED	BEING RXD	NOT RXD
		* 17-24	STATION DECLINATION (NOTE 2)		
		* 25	VOR	VOR	NOT VOR
		* 26	DME	DME	NOT DME
		* 27	TACAN	TACAN	NOT TACAN
		* 28-29	CLASS		
			29(0) & 28(0) - LOW		
			29(0) & 28(1) - HIGH		
			29(1) & 28(0) - TERMINAL		
			29(1) & 28(1) - UNDEFINED		
		30-31	SSM		
		32	PARITY (ODD)		

NOTE 1:   BITS 15-29 ARE USED TO INDICATE STATUS OF STATION:
BIT 15 = 1, IF THIS IS A NON-COLLOCATED DME,
BIT 25 = 1, IF THERE IS A VOR AT THIS LOCATION,
BIT 26 = 1, IF THERE IS A DME AT THIS LOCATION AND,
BIT 27 = 1, IF THERE IS A TACAN AT THIS LOCATION

NOTE 2:   BINARY NUMBER WITH SIGN BIT 24. EAST IS POSITIVE BINARY
NUMBER AND WEST IS 2'S COMPLEMENT OF THE POSITIVE VALUE.
RANGE IS E-127 DEG TO W\127 DEG. RESOLUTION IS 1 DEG AT BIT 17.

LABEL	HEX ID	BIT NO.	FUNCTION		
301G	02	MESSAGE CHARACTERS 7-9 (BNR)			
		01-08	LABEL		
		* 09-15	CHARACTER 7		
		* 16-22	CHARACTER 8		
		* 23-29	CHARACTER 9		
		30-31	SSM		
		32	PARITY (ODD)		
302G	02	MESSAGE CHARACTERS 10-12 (BNR)			
		01-08	LABEL		
		* 09-15	CHARACTER 10		
		* 16-22	CHARACTER 11		
		* 23-29	CHARACTER 12		
		30-31	SSM		
		32	PARITY (ODD)		

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LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
303G	02	MESSAGE LENGTH/TYPE/NUMBER (BNR)			
		01-08	LABEL		
		* 09-12	WORDS IN MESSAGE		
		* 13-15	WAYPOINT/STATION TYPE		
			15(0) & 14(0) & 13(0) - WAYPOINT		
			15(0) & 14(0) & 13(1) - NAV AID		
			15(0) & 14(1) & 13(0) - AIRPORT		
			15(0) & 14(1) & 13(1) - NDB		
			15(1) & 14(0) & 13(0) - ALTITUDE PROFILE		
			15(1) & 14(0) & 13(1) - NO SYMBOL		
			15(1) & 14(1) & 13(0) - VOR		
			15(1) & 14(1) & 13(1) - INTERSECTION		
		* 16	DATA RECORD	OFF ROUTE	ON ROUTE
		* 17-23	BINARY WAYPOINT NUMBER		
		24	FMS PLAN MODE	SELECT	NOT SELECT
		25	WAYPOINT AT PLAN CENTER	CENTER	NOT CENTER
		26	FLIGHT PLAN GAP FOLLOWS	GAP	NO GAP
		27-29	SPARES		PAD ZERO
		30-31	SSM		
		32	PARITY (ODD)		
304G	02	MESSAGE CHARACTERS 1-3 (BNR)			
		01-08	LABEL		
		* 09-15	CHARACTER 1		
		* 16-22	CHARACTER 2		
		* 23-29	CHARACTER 3		
		30-31	SSM		
		32	PARITY (ODD)		
305G	02	MESSAGE CHARACTERS 4-6 (BNR)			
		01-08	LABEL		
		* 09-15	CHARACTER 4		
		* 16-22	CHARACTER 5		
		* 23-29	CHARACTER 6		
		30-31	SSM		
		32	PARITY (ODD)		
306G	02	NAV/WPT/AP LATITUDE (BNR)			
		01-08	LABEL		
		* 09-28	BINARY ANGLE (*180/1048576)		
		29	SIGN	SOUTH	NORTH
		30-31	SSM		
		32	PARITY (ODD)		
307G	02	NAV/WPT/AP LONGITUDE (BNR)			
		01-08	LABEL		
		* 09-28	BINARY ANGLE (*180/1048576)		
		29	SIGN	WEST	EAST
		30-31	SSM		
		32	PARITY (ODD)		

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
310	02	PRESENT POSITION LATITUDE (BNR)			
		01-08	LABEL		
		09-28	BINARY ANGLE (*180/1048576)		
		29	SIGN	SOUTH	NORTH
		30-31	SSM		
		32	PARITY (ODD)		
311	02	PRESENT POSITION LONGITUDE (BNR)			
		01-08	LABEL		
		09-28	BINARY ANGLE (*180/1048576)		
		29	SIGN	WEST	EAST
		30-31	SSM		
		32	PARITY (ODD)		
312	02	GROUND SPEED (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-13	SPARES		PAD ZERO
		14-28	BINARY KNOTS (*4096/32768)		
		29	SIGN		ALWAYS ZERO
		30-31	SSM		
		32	PARITY (ODD)		
313	02	TRACK ANGLE (TRUE) (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-16	SPARES		PAD ZERO
		17-28	BINARY ANGLE (*180/4096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		
314	02	TRUE HEADING (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-13	SPARES		PAD ZERO
		14-28	BINARY ANGLE (*180/32768)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		
315	02	WIND SPEED (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-20	SPARES		PAD ZERO
		21-28	BINARY KNOTS (*256/256)		
		29	SIGN		ALWAYS ZERO
		30-31	SSM		
		32	PARITY (ODD)		

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
316	02	WIND ANGLE (TRUE) (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-20	SPARES		PAD ZERO
		21-28	BINARY ANGLE (*180/256)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		
320	02	MAGNETIC HEADING (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-13	SPARES		PAD ZERO
		14-28	BINARY ANGLE (*180/32768)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		
321	02	DRIFT ANGLE (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-16	SPARES		PAD ZERO
		17-28	BINARY ANGLE (*180/4096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		
326G	02	LATERAL SCALE FACTOR (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-13	RESERVED NAUT MI (128 / 262,144) (NOTE)		
		14-28	BINARY FULL SCALE DISTANCE NM (*128/32,768) (SECOND DOT ON +/- 2 DOT SCALE)		
		29	SIGN		
		30-31	SSM		
		32	PARITY (ODD)		

NOTE: BITS 11-13 ARE TO BE USED AS OPTIONAL RESOLUTION EXTENSION TO SUPPORT EXPANDED DEVIATION SCALE APPLICATIONS. FILL WITH ZERO WHEN NOT USED.

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
327G	02	VERTICAL SCALE FACTOR (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-13	RESERVED		
		14-28	BINARY FULL SCALE DISTANCE FT (*2048/32,768) (SECOND DOT ON +/- 2 DOT SCALE)		
		29	SIGN		
		30-31	SSM		
		32	PARITY (ODD)		

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
351G	02	DISTANCE TO DESTINATION (VIA FLIGHT PLAN) (BNR)			
		01-08	LABEL		
		09-10	SDI		
		* 11-28	BINARY NM (*32768/262144)		
		29	SIGN		ALWAYS ZERO
		30-31	SSM		
		32	PARITY (ODD)		
352G	02	ESTIMATED TIME TO DESTINATION (VIA FLIGHT PLAN) (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11-16	SPARES		PAD ZERO
		* 17-28	BINARY MINUTES (*4096/4096)		
		29	SIGN		ALWAYS ZERO
		30-31	SSM		
		32	PARITY (ODD)		
353P	02	DESTINATION LOCAL TIME OFFSET (BCD) (mec)			
		01-08	LABEL		
		09-10	SDI		
		11-14	TENTHS OF MINUTES		
		15-18	UNITS OF MINUTES		
		19-22	TENS OF MINUTES		
		23-26	UNITS OF HOURS		
		27-29	TENS OF HOURS		
		30-31	SSM		
			31(0) & 30(0) - POSITIVE (Local time greater than UTC, East)		
			31(0) & 30(1) - NO COMPUTED DATA		
			31(1) & 30(0) - FUNCTIONAL TEST		
			31(1) & 30(1) - NEGATIVE (Local time less than UTC, West)		
		32	PARITY		
371G	02	GEN AV EQUIPMENT IDENT. CODE (DSC)			
371G	09	GEN AV EQUIPMENT IDENT. CODE (DSC)			
371G	10	GEN AV EQUIPMENT IDENT. CODE (DSC)			
371G	11	GEN AV EQUIPMENT IDENT. CODE (DSC)			
371G	12	GEN AV EQUIPMENT IDENT. CODE (DSC)			
371G	16	GEN AV EQUIPMENT IDENT. CODE (DSC)			

LRN AND CNI BIT DEFINITIONS (CONT)

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
371G	18	GEN AV	EQUIPMENT IDENT. CODE (DSC)		
		01-08	LABEL		
		09-10	SDI		
		* 11-14	ARINC HEXADECIMAL EQUIP ID CODE LSD		
		* 15-18	ARINC HEXADECIMAL EQUIP ID CODE MSD		
		* 19-24	BINARY COMPANY ID CODE (BIT 19 = LSB)		
			1 B&D INSTRUMENTS		
			2 BEECH AIRCRAFT		
			3 BENDIX AVIONICS		
			4 CANADIAN MARCONI		
			5 CESSNA AIRCRAFT		
			6 COLLINS AVIONICS		
			7 DELCO ELECTRONICS		
			8 FOSTER RNAV		
			9 GABLE CONTROLS		
			10 GLOBAL SYSTEMS		
			11 GULFSTREAM AEROSPACE		
			12 HONEYWELL		
			13 KING RADIO		
			14 LEARJET		
			15 LITTON AERO PRODUCTS		
			16 OFFSHORE NAVIGATION		
			17 RACAL AVIONICS		
			18 SPERRY		
			19 UNIVERSAL NAVIGATION SYSTEMS		
			20 3M AVIATION SAFETY SYSTEMS		
			21 ALLIEDSIGNAL GENERAL AVIATION AVIONICS		
			22 ALLIEDSIGNAL GLOBAL WULFSBERG		
			23 BF GOODRICH AVIONICS		
			24 GARMIN		
			25 ARNAV		
			26 COMPUTER INSTRUMENTS CORPORATION		
			27 RYAN INTERNATIONAL CORP		
			28 CHELTON AVIONICS, INC.		
			29 INNOVATIVE SOLUTIONS & SUPPORT, INC. (IS&S)		
			30 FREEFLIGHT SYSTEMS		
			31 GENESYS AEROSYSTEMS		
			32-63 SPARES		
		* 25-29	COMPANY PRIVATE USE		
		30-31	SSM		
		32	PARITY (ODD)		

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3.2   GENERAL INFORMATION

Sign/Status Matrix (NOTE 1):

31	30		BCD Numeric
0	0		Plus, North, East, Right, To, Above
0	1		No Computed Data
1	0		Functional Test
1	1		Minus, South, West, Left, From, Below

31	30		Discrete Data Words (NOTE 2)
0	0		Verified Data, Normal Operation
0	1		No Computed Data
1	0		Functional Test
1	1		Failure Warning

31	30		AIM Data
0	0		Intermediate Word
0	1		Initial Word
1	0		Final Word
1	1		Control Word

31	30		File Transfer
0	0		Intermediate Word, Plus, North, etc.
0	1		Initial Word
1	0		Final Word
1	1		Intermediate Word, Minus, South, etc.

31	30	29	BNR Numeric Data
0	0	X	Failure Warning
0	1	X	No Computed Data
1	0	X	Functional Test
1	1	X	Normal Operation
X	X	0	Plus, North, East, Right, To, Above
X	X	1	Minus, South, West, Left, From, Below

Note 1: From ARINC Spec 429-14, 1 JAN 93

Note 2: Exercise caution when using the Discrete Data Word SSM protocol since many older designs used the BCD or BNR Numeric Data protocol for discrete data, ie. identifying NORMAL OPERATION with [1   1].

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GENERAL INFORMATION (CONT)

Definitions:

    AIM - Acknowledge, ISO Alphabet No.5 and Maintenance data
    BCD - Binary Coded Decimal
    BNR - Binary
    DSC - Discrete
    SDI - Source/Destination Identifier
    SSM - Sign/Status Matrix (also occurs as SM)
Label Suffix Codes:

    No Suffix - selected ARINC 429 words
    "G" - GAMA 429 words
    "P" - Private 429 words

Bit Prefix Codes:

    "*" - Non-ARINC bit assignment, GAMA standard.
    "#" - Indicates private use by one or more manufacturers; not to be re-assigned for other functions.

Equipment Hex ID (GAMA current use):

    01 - Flight Control Computer
    02 - Flight Management Computer
    04 - Inertial Reference System
    05 - Attitude and Heading Ref. System 06 - Air Data System
    09 - Airborne DME
    0B - Global Positioning System
    10 - Airborne ILS Receiver
    11 - Airborne VOR Receiver
    12 - Airborne ADF System
    16 - Airborne VHF Comm. Receiver
    17 - Airborne UHF Comm. Receiver
    18 - ATC Transponder
    25 - Electronic Flight Instruments
    27 - Microwave Landing System
    36 - Radio Management System
    5A - Loran
    5B - Omega
    A9 - Airborne DME Controller
    B0 - Airborne ILS Controller
    B2 - Airborne ADF Controller
    B6 - VHF Comm. Controller
    B8 - ATC Transponder Controller
    C7 - Microwave Landing System Controller FA - Loran Controller
    FB - Omega Controller

ADDENDA

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ADDENDUM 1

ARINC 429 Label Attributes

GENERAL AVIATION MANUFACTURERS ASSOCIATION
ARINC 429 LABEL ATTRIBUTES
("N" LABEL SUFFIX INDICATES NON-ARINC STANDARD)

LBL OCT NUM NAME	EQP HEX NUM TYPE	PARAMETER UNITS	DATA RANGE	B/D	SENSE	NO. SIG RESOLUT	POSITIVE MSEC	APPROX MSEC	MIN TRANS MSEC	MAX TRANS MSEC	MAX UPDATE NOTES
001	02	DISTANCE TO GO	BCD	Naut Mi	+/-3999.9	5	Always Pos	0.1	100	200	
001	09	DISTANCE TO GO	BCD	Naut Mi	+/-3999.9	5	Always Pos	0.1	100	200	
002	02	TIME TO GO	BCD	Minutes	0-399.9	4	Always Pos	0.1	100	200	
002	09	TIME TO GO	BCD	Minutes	0-399.9	4	Always Pos	0.1	100	200	
012	02	GROUND SPEED	BCD	Knots	0-7999.9	5	Always Pos	0.1	250	500	
012	09	GROUND SPEED	BCD	Knots	0-7999.9	5	Always Pos	0.1	250	500	
017	10	SELECTED RUNWAY HDG	BCD	Degrees	0-359.9	4	Always Pos	0.1	167	333	
024G	11	SELECTED COURSE 1	BCD	Degrees	0-359	3	Always Pos	1.0	167	333	Bit 11 Discr
027	11	SELECTED COURSE 2	BCD	Degrees	0-359	3	Always Pos	1.0	167	333	
030G	02	VHF COM FREQUENCY	BCD	MHz	118-135.975	5		0.025	100	200	SSM Squelch
030G	16	VHF COM FREQUENCY	BCD	MHz	118-135.975	5		0.025	100	200	SSM XMIT On
031G	02	BEACON TRANSPONDER CODE	BCD	Discrete					100	200	XPDR in use

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031G	18	BEACON TRANSPONDER							
CODE	BCD	Discrete					100	200	SSM Reply
032	02	ADF FREQUENCY	BCD	KHz	190-				
1750	5		0.5	100	200	429 Fig 3-1			

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LBL OCT NUM NAME	EQP HEX NUM TYPE	PARAMETER UNITS	DATA RANGE	B/D	SENSE	NO. SIG RESOLUT	POSITIVE MSEC	APPROX MSEC	MIN TRANS MSEC	MAX TRANS NOTES	MAX UPDATE
032	12	ADF FREQUENCY	BCD	KHz	190-						
1750	5		0.5	100	200		429 Fig 3-1				
033	02	ILS FREQUENCY	BCD	MHz	108-						
111.95	4		0.05	167	333		429 Fig 3-1				
033	10	ILS FREQUENCY	BCD	MHz	108-						
111.95	4		0.05	167	333		429 Fig 3-1				
034G	02	VOR/ILS FREQUENCY	BCD	MHz	108-						
117.95	4		0.05	167	333		429 Fig 3-1				
034G	10	VOR/ILS FREQUENCY	BCD	MHz	108-						
117.95	4		0.05	167	333		429 Fig 3-1				
034G	11	VOR/ILS FREQUENCY	BCD	MHz	108-						
117.95	4		0.05	167	333		429 Fig 3-1				
035G	02	DME FREQUENCY	BCD	MHz	108-						
135.95	4		0.05	100	200		429 Fig 3-1				
035G	09	DME FREQUENCY	BCD	MHz	108-						
135.95	4		0.05	100	200		429 Fig 3-1				
040		UHF COM FREQUENCY	BCD	MHz	225-399.975						

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Label	Eqp ID	Parameter	Type	Units	Range	Bits	Resolution	Min	Max	Notes
041	02	SET POSITION LATITUDE	BCD	Deg:Min	180N-180S	6	0.1	250	500	429 Tab 6-1b
		North								
042	02	SET POSITION LONGITUDE	BCD	Deg:Min	180E-180W	6	0.1	250	500	429 Tab 6-1b
		East								
043	02	SET MAGNETIC HEADING	BCD	Deg	0-359	3	1.0	250	500	
060P	02	OMEGA DATA SELECT	BNR	Discrete				100	200	
061P	02	COVARIANCE DATA	BNR					100	200	
074G	02	DATA RECORD HEADER	DSC	Discrete						See Note 1
075G	02	ACTIVE WPT FROM/TO DATA	DSC	Discrete						See Note 1
100G	02	SELECTED COURSE 1	BNR	Deg/180	+/-180 Deg	12	0.05			
				Deg	167	333				Bit 11 Discr

LBL OCT NUM NAME	EQP HEX NUM TYPE	PARAMETER UNITS	DATA RANGE	B/D	SENSE	NO. SIG RESOLUT	POSITIVE MSEC	APPROX MSEC	MIN TRANS MSEC	MAX TRANS NOTES	MAX UPDATE
100	11	SELECTED COURSE 1	BNR	Deg/180	+/-180 Deg	12		0.05 Deg	167	333	
101G	02	SELECTED HEADING	BNR	Deg/180	+/-180 Deg	12		0.05 Deg	31.3	62.5	
101G	25	SELECTED HEADING	BNR	Deg/180	+/-180 Deg	12		0.05 Deg	31.3	62.5	
102G	02	SELECTED ALTITUDE	BNR	Feet	65536	16	Above				
S.L.	1	100	200		Bit 11,12 Disc						
105	10	SELECTED RUNWAY HEADING	BNR	Deg/180	+/-180 Deg	11		0.1 Deg	167	333	
110	11	SELECTED COURSE 2	BNR	Deg/180	+/-180 Deg	12		0.05 Deg	167	333	
113G	02	MESSAGE CHECKSUM	BNR						See Note 2		
114	02	DESIRED TRACK (TRUE)	BNR	Deg/180	+/-180 Deg	12		0.05 Deg	31.3	62.5	
115	02	WAYPOINT BEARING (TRUE)	BNR	Deg/180	+/-180 Deg	12	A/C to Wpt	0.05 Deg	31.3	62.5	
116G	02	CROSS TRACK DISTANCE	BNR	Naut Mi	128	15	Fly Left	0.004	31.3	62.5	
117G	02	VERTICAL DEVIATION	BNR	Feet	16384	14	Fly				
Down	1.0	31.3	62.5		>1K' Bit 11=1						
121	02	HORIZ.CMD.(TO AUTOPILOT)	BNR	Deg/180	+/-180 Deg	14	Fly Right	0.01 Deg	50	100	
122G	02	VERT. CMD. (TO AUTOPILOT)	BNR	Deg/180	+/-180 Deg	12	Fly Up	0.05 Deg	50	100	
123	02	THROTTLE COMMAND	BNR	Deg/sec	2.56	18	Inc. Power	0.001 Deg	50	100	
125	02	GREENWICH MEAN TIME	BCD	Hr:Min	0-23.59.9	5		0.1			
Min	100	200		429 Tab 6-1a							

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147G	02	MAGNETIC VARIATION	BNR	Deg/180	+/-180 Deg	12	East	0.05
Deg	500	1000		Bit 11 Discr				
150	02	GREENWICH MEAN TIME	BNR	Hr:Min:Sec	23:59:59	5:6:6		1.0
Sec	50	100		429 Attach 6				

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LBL OCT NUM NAME	EQP HEX NUM TYPE	PARAMETER UNITS	DATA RANGE	B/D	SENSE	NO. SIG RESOLUT	POSITIVE MSEC	APPROX MSEC	MIN TRANS MSEC	MAX TRANS NOTES	MAX UPDATE
157P	06	NORMALIZED AOA	BNR	1=Stall	+/-2	12	Upward	0.0005	125	125	125
162G	12	ADF BEARING	BNR	Deg/180	+/-180 Deg	12		0.05			
Deg	31.3	62.5		Bit 11 Discr							
163G	02	WIND ON NOSE	BNR	Knots	256	9	Head Wind	0.5	50	100	
173	10	LOCALIZER DEVIATION	BNR	DDM	0.4	12	Fly				
Right	0.0001	33.3	66.6		429 Attach 6						
174	10	GLIDESLOPE DEVIATION	BNR	DDM	0.8	12	Fly				
Down	0.0002	33.3	66.6		429 Attach 6						
202	02	DME DISTANCE	BNR	Naut Mi	512	16	Always				
Pos	0.008	83.3	167		429 Attach 6						
202	09	DME DISTANCE	BNR	Naut Mi	512	16	Always				
Pos	0.008	83.3	167		429 Attach 6						
204	02	BARO CORRECTED ALT.#1	BNR	Feet	131,072	17	Above S.L.	1.0	31.3	62.5	
210	02	TRUE AIRSPEED	BNR	Knots	2047.93	15	Always Pos	0.0625	62.5	125	
213	02	STATIC AIR TEMPERATURE	BNR	Deg C	512	11	Above Zero	0.25	250	500	
222P	02	VOR RADIAL	BNR	Deg/180	+/-180 Deg	12	To Station	0.044			
Deg	50	100		429 Attach 6							

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222	02	VOR OMNIBEARING	BNR	Deg/180	+/-180 Deg	12	From Station	0.044			
Deg	50	100		429 Attach 6							
222	10	VOR OMNIBEARING	BNR	Deg/180	+/-180 Deg	12	From Station	0.044			
Deg	31.3	62.5		429 Attach 6							
222	11	VOR OMNIBEARING	BNR	Deg/180	+/-180 Deg	12	From Station	0.044			
Deg	31.3	62.5		429 Attach 6							
241P	*	NORMALIZED AOA	BNR	1=Stall	+/-2	12	Upward	0.0005	125	125	125
251G	02	DISTANCE TO GO	BNR	Naut Mi	4096	15	Always Pos	0.125	100	200	
252	02	TIME-TO-GO	BNR	Minutes	512	9	Always Pos	1.0	100	200	
260G	02	DATE	BCD	Discrete		6		1			
Day	500	1000		Year Added							

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LBL OCT NUM NAME	EQP HEX NUM TYPE	PARAMETER UNITS	DATA RANGE	B/D	SENSE	NO. SIG RESOLUT	POSITIVE MSEC	APPROX MSEC	MIN TRANS MSEC	MAX TRANS NOTES	MAX UPDATE
261G	02	GPS DISCRETE WORD 1	DSC	Discrete					1000	1000	1000
275G	02	LRN STATUS WORD	DSC	Discrete					200	400	
277G	02	CABIN DSPY CONT DSC	DSC	Discrete					200	200	
300G	02	STN MAG DEC, TYPE & CLASS	BNR	Discrete					See Note 2		
301G	02	MESSAGE CHARACTERS 7-9	BNR	Discrete					See Note 2		
302G	02	MESSAGE CHARACTERS 10-12	BNR	Discrete					See Note 2		
303G	02	MESS. LENGTH/TYPE/NUMBER	BNR	Discrete					See Note 2		
304G	02	MESSAGE CHARACTERS 1-3	BNR	Discrete					See Note 2		
305G	02	MESSAGE CHARACTERS 4-6	BNR	Discrete					See Note 2		
306G	02	NAV/WPT/AP LATITUDE	BNR	Deg/180	180N-180S	20	North	.000172Deg	See Note 2		
307G	02	NAV/WPT/AP LONGITUDE	BNR	Deg/180	180E-180W	20	East	.000172Deg	See Note 2		
310	02	PRESENT POSITION LATITUDE	BNR	Deg/180	180N-180S	20	North	.000172Deg	100	200	
311	02	PRESENT POSITION LONGITUD	BNR	Deg/180	180E-180W	20	East	.000172Deg	100	200	
312	02	GROUND SPEED	BNR	Knots	4096	15	Always Pos	0.125	25	50	
313	02	TRACK ANGLE (TRUE)	BNR	Deg/180	+/-180 Deg	12		0.05 Deg	25	50	
314	02	TRUE HEADING	BNR	Deg/180	+/-180 Deg	15		0.0055 Deg	25	50	
315	02	WIND SPEED	BNR	Knots	256	8	Always Pos	1.0	50	100	
316	02	WIND ANGLE (TRUE)	BNR	Deg/180	+/-180 Deg	8		0.7	50	100	

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LBL OCT NUM NAME	EQP HEX NUM TYPE	PARAMETER UNITS	DATA RANGE	B/D	SENSE	NO. SIG RESOLUT	POSITIVE MSEC	APPROX MSEC	MIN TRANS MSEC	MAX TRANS NOTES	MAX UPDATE
320	02	MAGNETIC HEADING	BNR	Deg/180	+/-180 Deg	15		0.0055 Deg	25	50	
321	02	DRIFT ANGLE	BNR	Deg/180	+/-180 Deg	12		0.05 Deg	25	50	
326G	02	LATERAL SCALE FACTOR	BNR	Naut Mi	+/-128	15		0.0039 NM	80	1200	
327G	02	VERTICAL SCALE FACTOR	BNR	Feet	+/- 2048	15		0.0625 Ft	80	1200	
351G	02	DISTANCE TO DESTINATION	BNR	Naut Mi	32,768	18	Always Pos	0.125	500	1000	
352G	02	EST. TIME TO DESTINATION	BNR	Minutes	4096	12	Always Pos	1.0	500	1000	
353P	02	DEST. LOCAL TIME OFFSET	BCD	Hour/Min	23:59	5	Always pos	0.1 Min	1000	1000	1000
371G	02	SPECIFIC EQUIPMENT IDENT.	DSC						500	1000	
371G	09	SPECIFIC EQUIPMENT IDENT.	DSC						500	1000	
371G	10	SPECIFIC EQUIPMENT IDENT.	DSC						500	1000	
371G	11	SPECIFIC EQUIPMENT IDENT.	DSC						500	1000	
371G	12	SPECIFIC EQUIPMENT IDENT.	DSC						500	1000	
371G	16	SPECIFIC EQUIPMENT IDENT.	DSC						500	1000	
371G	18	SPECIFIC EQUIPMENT IDENT.	DSC						500	1000	

NOTE 1: These labels are transmitted once at the beginning of each flight plan / graphics map data transfer. Refer to the GAMA FMS Output Bus Standard for further information.

NOTE 2: These labels are used to make up the individual records that comprise a flight plan / graphics map data transfer. Not all labels are transmitted with each record. Ten records

are transmitted in one second. Refer to the "FMS Waypoint/Navaid/Airport Data Transfer Protocol", addendum 3.

ADDENDUM 2

Alpha Label Index

LABEL INDEX BY NUMBER

LABEL   DESCRIPTION

LABEL	DESCRIPTION
001	DISTANCE TO GO (BCD)
002	TIME TO GO (BCD)
012	GROUND SPEED (BCD)
017	SELECTED RUNWAY HDG (BCD)
024G	SELECTED COURSE 1 (BCD)
027	SELECTED COURSE 2 (BCD)
030G	VHF COM FREQUENCY (BCD)
031G	BEACON TRANSPONDER CODE (BCD)
032	ADF FREQUENCY (BCD)
033	ILS FREQUENCY (BCD)
034G	VOR/ILS FREQUENCY (BCD)
035G	DME FREQUENCY (BCD)
040	UHF FREQUENCY (BCD)
041	SET POSITION LATITUDE (BCD)
042	SET POSITION LONGITUDE (BCD)
043	SET MAGNETIC HEADING (BCD)
060P	OMEGA DATA SELECT (BNR)
061P	COVARIANCE DATA (BNR)
074G	DATA RECORD HEADER (DSC)
075G	ACTIVE WAYPOINT FROM/TO DATA (DSC)
100G	SELECTED COURSE 1 (BNR)
100	SELECTED COURSE 1 (BNR)
101G	SELECTED HEADING (BNR)
102G	SELECTED ALTITUDE (BNR)
105	SELECTED RUNWAY HEADING (BNR)
110	SELECTED COURSE 2 (BNR)
113G	MESSAGE CHECKSUM (BNR)
114	DESIRED TRACK (TRUE) (BNR)
115	WAYPOINT BEARING (TRUE) (BNR)
116G	CROSS TRACK DISTANCE (BNR)
117G	VERTICAL DEVIATION (BNR)
121	HORIZONTAL COMMAND (TO AUTOPILOT) (BNR)
122G	VERTICAL COMMAND (TO AUTOPILOT) (BNR)
123	THROTTLE COMMAND (BNR)
125	GREENWICH MEAN TIME (BCD)
147G	MAGNETIC VARIATION (BNR)
150	GREENWICH MEAN TIME (BNR)
157P	NORMALIZED ANGLE OF ATTACK (BNR)
162G	ADF BEARING (BNR)
163G	WIND ON NOSE (BNR)
173	LOCALIZER DEVIATION (BNR)
174	GLIDESLOPE DEVIATION (BNR)
202	DME DISTANCE (BNR)
204	BARO CORRECTED ALTITUDE #1 (BNR)
210	TRUE AIRSPEED (BNR)
213	STATIC AIR TEMPERATURE (BNR)
222P	VOR RADIAL (FROM STATION TO AIRCRAFT) (BNR)
222	VOR OMNIBEARING (FROM AIRCRAFT TO STATION) (BNR)
241P	NORMALIZED ANGLE OF ATTACK (BNR)
251G	DISTANCE TO GO (BNR)

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LABEL	DESCRIPTION
252	TIME TO GO (BNR)
260G	DATE (BCD)
261G	GPS DISCRETE WORD 1
275G	LRN STATUS WORD (DSC)
277G	CABIN DISPLAY CONTROL DISCRETE (DSC)
300G	STN DECLINATION, TYPE AND CLASS (BNR)
301G	MESSAGE CHARACTERS 7-9 (BNR)
302G	MESSAGE CHARACTERS 10-12 (BNR)
303G	MESSAGE LENGTH/TYPE/NUMBER (BNR)
304G	MESSAGE CHARACTERS 1-3 (BNR)
305G	MESSAGE CHARACTERS 4-6 (BNR)
306G	NAV/WPT/AP LATITUDE (BNR)
307G	NAV/WPT/AP LONGITUDE (BNR)
310	PRESENT POSITION LATITUDE (BNR)
311	PRESENT POSITION LONGITUDE (BNR)
312	GROUND SPEED (BNR)
313	TRACK ANGLE (TRUE) (BNR)
314	TRUE HEADING (BNR)
315	WIND SPEED (BNR)
316	WIND ANGLE (TRUE) (BNR)
320	MAGNETIC HEADING (BNR)
321	DRIFT ANGLE (BNR)
326G	LATERAL SCALE FACTOR
327G	VERTICAL SCALE FACTOR
351G	DISTANCE TO DESTINATION (VIA FLIGHT PLAN) (BNR)
352G	ESTIMATED TIME TO DESTINATION (VIA FLIGHT PLAN) (BNR)
353P	DESTINATION LOCAL TIME OFFSET (BCD)
371G	GEN AV EQUIPMENT IDENT. CODE (DSC)

LABEL	DESCRIPTION
075G	ACTIVE WAYPOINT FROM/TO DATA (DSC)
162G	ADF BEARING (BNR)
032	ADF FREQUENCY (BCD)
204	BARO CORRECTED ALTITUDE #1 (BNR)
031G	BEACON TRANSPONDER CODE (BCD)
277G	CABIN DISPLAY CONTROL DISCRETE (DSC)
061P	COVARIANCE DATA (BNR)
116G	CROSS TRACK DISTANCE (BNR)
074G	DATA RECORD HEADER (DSC)
260G	DATE (BCD)
114	DESIRED TRACK (TRUE) (BNR)
353P	DESTINATION LOCAL TIME OFFSET (BCD)
351G	DISTANCE TO DESTINATION (VIA FLIGHT PLAN) (BNR)
001	DISTANCE TO GO (BCD)
251G	DISTANCE TO GO (BNR)
202	DME DISTANCE (BNR)
035G	DME FREQUENCY (BCD)
321	DRIFT ANGLE (BNR)
352G	ESTIMATED TIME TO DESTINATION (VIA FLIGHT PLAN) (BNR)
371G	GEN AV EQUIPMENT IDENT. CODE (DSC)
174	GLIDESLOPE DEVIATION (BNR)
261G	GPS DISCRETE WORD 1
125	GREENWICH MEAN TIME (BCD)
150	GREENWICH MEAN TIME (BNR)
012	GROUND SPEED (BCD)
312	GROUND SPEED (BNR)
121	HORIZONTAL COMMAND (TO AUTOPILOT) (BNR)
033	ILS FREQUENCY (BCD)
326G	LATERAL SCALE FACTOR
173	LOCALIZER DEVIATION (BNR)
275G	LRN STATUS WORD (DSC)
320	MAGNETIC HEADING (BNR)
147G	MAGNETIC VARIATION (BNR)
304G	MESSAGE CHARACTERS 1-3 (BNR)
302G	MESSAGE CHARACTERS 10-12 (BNR)
305G	MESSAGE CHARACTERS 4-6 (BNR)
301G	MESSAGE CHARACTERS 7-9 (BNR)
113G	MESSAGE CHECKSUM (BNR)
303G	MESSAGE LENGTH/TYPE/NUMBER (BNR)
306G	NAV/WPT/AP LATITUDE (BNR)
307G	NAV/WPT/AP LONGITUDE (BNR)
157P	NORMALIZED ANGLE OF ATTACK (BNR)
241P	NORMALIZED ANGLE OF ATTACK (BNR)
060P	OMEGA DATA SELECT (BNR)
310	PRESENT POSITION LATITUDE (BNR)
311	PRESENT POSITION LONGITUDE (BNR)
102G	SELECTED ALTITUDE (BNR)
024G	SELECTED COURSE 1 (BCD)
100G	SELECTED COURSE 1 (BNR)

LABEL	DESCRIPTION
100	SELECTED COURSE 1 (BNR)
027	SELECTED COURSE 2 (BCD)
110	SELECTED COURSE 2 (BNR)
101G	SELECTED HEADING (BNR)
017	SELECTED RUNWAY HDG (BCD)
105	SELECTED RUNWAY HEADING (BNR)
043	SET MAGNETIC HEADING (BCD)
041	SET POSITION LATITUDE (BCD)
042	SET POSITION LONGITUDE (BCD)
213	STATIC AIR TEMPERATURE (BNR)
300G	STN DECLINATION, TYPE AND CLASS (BNR)
123	THROTTLE COMMAND (BNR)
002	TIME TO GO (BCD)
252	TIME TO GO (BNR)
313	TRACK ANGLE (TRUE) (BNR)
210	TRUE AIRSPEED (BNR)
314	TRUE HEADING (BNR)
122G	VERTICAL COMMAND (TO AUTOPILOT) (BNR)
117G	VERTICAL DEVIATION (BNR)
327G	VERTICAL SCALE FACTOR
030G	VHF COM FREQUENCY (BCD)
222	VOR OMNIBEARING (FROM AIRCRAFT TO STATION) (BNR)
222P	VOR RADIAL (FROM STATION TO AIRCRAFT) (BNR)
034G	VOR/ILS FREQUENCY (BCD)
040	UHF COM FREQUENCY (BCD)
115	WAYPOINT BEARING (TRUE) (BNR)
316	WIND ANGLE (TRUE) (BNR)
163G	WIND ON NOSE (BNR)
315	WIND SPEED (BNR)

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ADDENDUM 3

FMC Waypoint/Navaid/Airport Data Transfer Protocol

Version: 6.0
Date: May 6, 2016

FMC WAYPOINT/NAVAID/AIRPORT

DATA TRANSFER PROTOCOL

TABLE OF CONTENTS

Version: 6.0
Date: May 6, 2016

1.0   PURPOSE

This addendum describes a protocol implementation for data transfer of waypoints, navaids, and airports from a Flight Management Computer (FMC) on the ARINC 429 Bus.

The primary purpose of this data transfer is for presentation on an EFIS, MFD, or weather radar display. Receiving NAV systems may also use the data and its associated protocol for alphanumeric flight plan transfer from the FMC with the stipulation that waypoints prior to the current FROM waypoint will not be transmitted.

It is recognized that other FMC systems may adhere to the data formats prescribed in the GAMA standard but implement unique protocols. For illustration purposes, this addendum describes a specific protocol implementation. The discussion assumes a high speed ARINC 429 bus, but a low speed bus is not precluded by this protocol.

2.0   DATA FORMATS

Data formats are as defined in the GAMA standard. Only the following words are applicable to this data transfer protocol.

OCTAL LABEL	PARAMETER NAME
074	FLIGHT PLAN HEADER
075	ACTIVE WAYPOINT FROM/TO DATA
113	MESSAGE CHECKSUM
300	STATION TYPE, CLASS
301	MESSAGE CHARACTERS 7 - 9
302	MESSAGE CHARACTERS 10 - 12
303	MESSAGE LENGTH, TYPE, NUMBER
304	MESSAGE CHARACTERS 1 - 3
305	MESSAGE CHARACTERS 4 - 6
306	NAV/WPT/AP LATITUDE
307	NAV/WPT/AP LONGITUDE

3.0   DATA RECORDS

A data record may be comprised of up to nine ARINC words. The record is used to describe flight plan waypoints, the closest navaids, the closest airports, or other data base records applicable to creation of displays. Prior to transmission of any records, a header record, consisting of Labels 074 and 075 will be transmitted to prescribe the number of data records to follow and the current FROM/TO legs. The header will not be transmitted again until all the records have been transmitted or if there has been a flight plan modification such as a waypoint insertion, deletion, modification of data in any record, initiation of a DIRECT TO, or a re initiation of a DIRECT TO. If there has been a flight plan modification, 074 will be transmitted, followed by 075 and followed immediately by records specifying the current FROM/TO and subsequent waypoint records. (Other systems may transmit label 075 on a periodic basis and not initiate a re transmission of the records.) A change in the closest navaid or airport data will not re initiate a transmission of label 074 followed by data records.

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3.1 WAYPOINT RECORDS

An active flight plan waypoint record (or message) is comprised of the following words:

Label 303: Record (Message) Length/Type/Number
Label 304: IDENT Characters 1 - 3
Label 305: IDENT Characters 4 - 6
Label 306: Waypoint Latitude
Label 307: Waypoint Longitude
Label 113: Message Checksum

(Label 300 will be sent after Label 307 when the waypoint record is also a navaid.) (Labels 301 and 302 are optional words dependent on the length of the IDENT.)

Label 113 must be the last word in the record. The sequence of all other words (including Label 303 word) in the record may not be controlled.

3.2 CLOSEST AIRPORT/NAVAID DATA RECORDS

The same transmission sequence will be used for closest airports and navaids. Bit 16 of Label 303 will be set to define that this is a closest airport or navaid data record rather than a waypoint data record. Label 300 will be sent after Label 307 when the record is a navaid.

3.3 NUMBER AND TYPES OF DATA RECORDS

The data format allows for up to 128 records of any type (100 max waypoint, 128 max closest airport, 128 max closest navaid).

3.4 DATA RECORD SEQUENCE

Record numbers will always be sequential. Record number sequence implies waypoint sequence on the flight plan. A transmission example of 10 waypoints, 4 closest navaids, 3 closest airports would have the following data records transmitted:

Example: Data Records 1 - 10: Waypoints 1 - 10
Data Records 11 - 14: Closest 4 Navaids
Data Records 15 - 17: Closest 3 Airports

Blank records will not be transmitted. Although note that the data format does not preclude transmission of blank records and a fixed number of records.

3.5 DATA RECORD TRANSMISSION RATE

A record is transmitted once every 0.1 seconds. The example of 10 waypoints, 4 navaids, and 3 airports will take 1.8 seconds. At minimum of 3 milliseconds will occur between transmission of Label 113 and Label 303 of the next transmission record.

3.6 DATA TRANSMISSION EXAMPLE

Example: Transmission of an active flight plan with 29 waypoints; 5 closest navaids, 3 closest airports. Recognize that each variable length block transmission occurs every 0.1 seconds.

Header Transmission (T = 0.0 seconds).
Sending system sends Label 74 to receiving systems

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
0	1	1	0	0	0	0	0	0	0	0	*	0	0	0	0	0
P	SSM		SPARES								prc	SPARES				

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	->bit
0	1	0	0	1	0	1	0	0	1	1	1	1	0	0	->data
NUMBER OF RECORDS (BNR)							LABEL = 074								->def'n

prc (Prior Record Change) = 1

Sending system defines the current FROM/TO waypoint (1 to 2).

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
P	SSM		*	' FROM ' LS DIGIT				' TO ' LS DIGIT				' FROM ' MS DIGIT			

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	->bit
0	0	0	0	0	0	0	0	1	0	1	1	1	1	0	0	->data
' TO ' MS DIGIT				PAD				LABEL = 075								->def'n

Transmission #1 (T = 0.1 seconds)

Label 303:	Message Length Control Word (Waypoint #1)
Label 304:	IDENT Characters 1 - 3
Label 305:	IDENT Characters 4 - 6
Label 306:	Waypoint Latitude
Label 307:	Waypoint Longitude
Label 113:	Message Checksum

NOTE: Label 300 is an optional word in the waypoint transmission 1 through 29. Label 300 is sent whenever the waypoint is also a navaid. Labels 305, 301 and 302 are optional records dependent on the number of characters in the IDENT.

DATA TRANSMISSION EXAMPLE (CONT)

Transmission #2 (T = 0.2 seconds)

Label 303:   :Message Length Control Word (Waypoint #2)
Label 304:   IDENT Characters 1 - 3
Label 305:   IDENT Characters 4 - 6
Label 306:   Waypoint Latitude
Label 307:   Waypoint Longitude
Label 113:   Message Checksum

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Transmission #29 (T   = 2.9 seconds)

Label 303:   Message Length Control Word (Waypoint #29)
Label 304:   IDENT Characters 1 - 3
Label 305:   IDENT Characters 4 - 6
Label 306:   Waypoint Latitude
Label 307:   Waypoint Longitude
Label 113:   Message Checksum

Transmission #30 (T = 3.0 seconds)

Label 303:   Message Length Control Word (Navaid #1)
Label 304:   IDENT Characters 1 - 3
Label 306:   NAVAID Latitude
Label 307:   NAVAID Longitude
Label 300:   STN Declination, Type, Class and FREQ
Label 113:   Message Checksum

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Transmission #34 (T = 3.4 seconds)

Label 303:   Message Length Control Word (Navaid #5)
Label 304:   IDENT Characters 1 - 3
Label 306:   NAVAID Latitude
Label 307:   NAVAID Longitude
Label 300:   STN Declination, Type, Class and FREQ
Label 113:   Message Checksum

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DATA TRANSMISSION EXAMPLE (CONT)

Transmission #35

Label 303:   Message Length Control Word (Airport #1)
Label 304:   Airport IDENT Characters (1 - 3)
Label 305:   Airport IDENT Characters (4 - 6)
Label 306:   Airport Latitude
Label 307:   Airport Longitude
Label 113:   Message Checksum

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Transmission #37

Label 303:   Message Length Control Word (Airport #3)
Label 304:   Airport IDENT Characters (1 - 3)
Label 305:   Airport IDENT Characters (4 - 6)
Label 306:   Airport Latitude
Label 307:   Airport Longitude
Label 113:   Message Checksum

3.7   PRIOR RECORD CHANGE BIT USAGE

The prior record change bit will be sent any time any data is changed from the data sent in the previous transmission. This bit will be set for a change in any data record either a waypoint, navaid, or airport data record. It will be set whenever any records are added or deleted. However, it will not be set when a normal leg change occurs.

3.8   DISPLAY OF WAYPOINT NUMBERS

Display systems must avoid display of record numbers. They exist to define record sequence only. Disparity will exist with systems that currently display and number ARINC 571 (419) waypoints.

3.9   GENERAL WAYPOINT NUMBERING/RECORD CHANGE

The prior record change bit (Label 074) will be set for all of the following examples (except a normal leg change) for the first transmission.

Records may be renumbered for any modification of the flight plan; i.e., insertion of waypoints, deletion of waypoints, initiation of a direct. Record numbers will always be sequential. The first record number may be any number from 0 to 99. As an example, records will not be renumbered for a normal leg change where no data beyond the current FROM is altered.

3.10   PSEUDO VORTAC SPECIAL CASE

When the pilot initiates a Pseudo VORTAC, the same protocol will occur as with a direct except that the FROM waypoint number will be identical to the current TO waypoint number.

3.11   SELECTION OF ACTIVE FLIGHT PLAN

On pilot selection of an active flight plan and subsequent leg selection, the entire flight plan will be sent on the bus. If no active flight plan has been selected or no leg selection made, no waypoints will be sent on the bus.

ADDENDUM 4

Concentrated EFIS to FMS Data Bus

CONCENTRATED EFIS TO FMS DATA BUS

BUS SPEED = 100 KHZ

LBL OCT NUM	EQP HEX NUM	PARAMETER NAME	MIN/MAX TRANS MSEC	MAX TRANSPORT DELAY MSEC	NOTES
100	25	Selected Course	132	100	All Else Per A429
101G	25	Selected Heading	132	100	All Else Per GAMA 429
102	25	Selected Altitude	132	100	All Else Per A429
203	25	Pressure Altitude	132	100	All Else Per A429
204	25	Baro Altitude	132	100	All Else Per A429
205	25	Mach	132	100	All Else Per A429
206	25	Indicated Airspeed	132	100	All Else Per A429
210	25	True Airspeed	132	100	All Else Per A429
211	25	Total Air Temp	132	100	All Else Per A429
212	25	Altitude Rate	132	100	All Else Per A429
213	25	Static Air Temp	132	100	All Else Per A429
270	25	DGC Status	132	100	User Defined Discretes

BITS	ASSIGNMENTS	
1 ----- 8	OCTAL LABEL 270	
9 ----- 10	SDI	
11	11(1) =	ONSIDE NAV1 TUNE DISABLE
	11(0) =	ONSIDE NAV1 TUNE ENABLE
12	12(1) =	ONSIDE NAV2 TUNE DISABLE
	12(0) =	ONSIDE NAV2 TUNE ENABLE
13	13(1) =	CROSS SIDE NAV1 TUNE DISABLE
	13(0) =	CROSS SIDE NAV1 TUNE ENABLE
14	14(1) =	CROSS SIDE NAV2 TUNE DISABLE
	14(0) =	CROSS SIDE NAV2 TUNE ENABLE
15	15(1) =	WEIGHT ON WHEELS
	15(0) =	NO WEIGHT ON WHEELS
16	16(1) =	LNAV CAPTURE
	16(0) =	LNAV NOT CAPTURE
17	17(1) =	LNAV ARM
	17(0) =	LNAV NOT ARM
18	SPARE	
19	19(1) =	VNAV ARM
	19(0) =	VNAV NOT ARM
20	SPEED INTERVENTION -- RESERVED	
	20(1) =	FMS CONTROL
	20(0) =	AUTOPILOT CONTROL
21---- 29	SPARE	
30---- 31	SIGN / STATUS MATRIX	
32	PARITY (ODD)	

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LBL OCT NUM	EQP HEX NUM	PARAMETER NAME	MIN/MAX TRANS MSEC	MAX TRANSPORT DELAY MSEC	NOTES
306	25	Designator Latitude	132	100	All Else Per GAMA 429
307	25	Designator Longitude	132	100	All Else Per GAMA 429
314	25	True Heading	132	100	All Else Per A429
320	25	Magnetic Heading	132	100	All Else Per A429
324	25	Pitch Attitude	132	100	All Else Per A429
325	25	Roll Attitude	132	100	All Else Per A429
333	25	Body Normal Accel	132	100	All Else Per A429
371	25	Specific Equipment ID	132	100	See Bit Assignments

BITS	ASSIGNMENTS
1 ----- 8	OCTAL LABEL 371
9 ----- 10	SDI
11---- 14	HEX EQUIPMENT ID CODE (LSD) = 05
15---- 18	HEX EQUIPMENT ID CODE (MSD) = 02
19---- 24	BINARY COMPANY ID CODE = Per GAMA 429
25---- 29	USER DEFINED OR SPARE
30---- 31	SIGN / STATUS MATRIX
32	PARITY (ODD)

ADDENDUM 5

FMS to EFIS -- Airspeed Bug Control

FMS TO EFIS -- AIRSPEED BUG CONTROL

BUS SPEED = 100 KHZ

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
071P	02		TAKE-OFF CLIMB AIRSPEED (V$_2$)		
		01-08	LABEL		
		09-10	SDI		
			10(0) & 09(0) - NOT USED		
			10(0) & 09(1) - FMS #1		
			10(1) & 09(0) - FMS #2		
			10(1) & 09(1) - FMS #3		
		11-13	COLOR CONTROL		
			13(0) & 12(0) & 11(0) - BLACK		
			13(0) & 12(0) & 11(1) - BLUE		
			13(0) & 12(1) & 11(0) - GREEN		
			13(0) & 12(1) & 11(1) - CYAN		
			13(1) & 12(0) & 11(0) - RED		
			13(1) & 12(0) & 11(1) - MAGENTA		
			13(1) & 12(1) & 11(0) - YELLOW		
			13(1) & 12(1) & 11(1) - WHITE		
		14	REFERENCE DISPLAY (NOTE)		
		15-17	SPARES		PAD ZERO
		18	0.25 KNOTS		
		19	0.5		
		20	1.0		
		21	2.0		
		22	4.0		
		23	8.0		
		24	16		
		25	32		
		26	64		
		27	128		
		28	256 KNOTS		
		29	SPARE		PAD ZERO
		30-31	SSM		
			31(0) & 30(0) - FAIL		
			31(0) & 30(1) - NO COMPUTED DATA		
			31(1) & 30(0) - FUNCTIONAL TEST		
			31(1) & 30(1) - NORMAL OPERATION		
		32	PARITY (ODD)		

NOTE: BIT 14, REFERENCE DISPLAY BIT: 1 = REFERENCE AIRSPEED BUG DISPLAYED ON AIRSPEED SCALE.

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LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
072P	02		ROTATION AIRSPEED (V_R)		
		01-08	LABEL		
		09-10	SDI		
			10(0) & 09(0) - NOT USED		
			10(0) & 09(1) - FMS #1		
			10(1) & 09(0) - FMS #2		
			10(1) & 09(1) - FMS #3		
		11-13	COLOR CONTROL		
			13(0) & 12(0) & 11(0) - BLACK		
			13(0) & 12(0) & 11(1) - BLUE		
			13(0) & 12(1) & 11(0) - GREEN		
			13(0) & 12(1) & 11(1) - CYAN		
			13(1) & 12(0) & 11(0) - RED		
			13(1) & 12(0) & 11(1) - MAGENTA		
			13(1) & 12(1) & 11(0) - YELLOW		
			13(1) & 12(1) & 11(1) - WHITE		
		14	REFERENCE DISPLAY (NOTE)		
		15-17	SPARES		PAD ZERO
		18	0.25 KNOTS		
		19	0.5		
		20	1.0		
		21	2.0		
		22	4.0		
		23	8.0		
		24	16		
		25	32		
		26	64		
		27	128		
		28	256 KNOTS		
		29	SPARE		PAD ZERO
		30-31	SSM		
			31(0) & 30(0) - FAIL		
			31(0) & 30(1) - NO COMPUTED DATA		
			31(1) & 30(0) - FUNCTIONAL TEST		
			31(1) & 30(1) - NORMAL OPERATION		
		32	PARITY (ODD)		

NOTE: BIT 14, REFERENCE DISPLAY BIT: 1 = REFERENCE AIRSPEED BUG DISPLAYED ON AIRSPEED SCALE.

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
073P	02		CRITICAL ENGINE FAILURE AIRSPEED (V_1)		
		01-08	LABEL		
		09-10	SDI		
			10(0) & 09(0) - NOT USED		
			10(0) & 09(1) - FMS #1		
			10(1) & 09(0) - FMS #2		
			10(1) & 09(1) - FMS #3		
		11-13	COLOR CONTROL		
			13(0) & 12(0) & 11(0) - BLACK		
			13(0) & 12(0) & 11(1) - BLUE		
			13(0) & 12(1) & 11(0) - GREEN		
			13(0) & 12(1) & 11(1) - CYAN		
			13(1) & 12(0) & 11(0) - RED		
			13(1) & 12(0) & 11(1) - MAGENTA		
			13(1) & 12(1) & 11(0) - YELLOW		
			13(1) & 12(1) & 11(1) - WHITE		
		14	REFERENCE DISPLAY (NOTE)		
		15-17	SPARES		PAD ZERO
		18	0.25 KNOTS		
		19	0.5		
		20	1.0		
		21	2.0		
		22	4.0		
		23	8.0		
		24	16		
		25	32		
		26	64		
		27	128		
		28	256 KNOTS		
		29	SPARE		PAD ZERO
		30-31	SSM		
			31(0) & 30(0) - FAIL		
			31(0) & 30(1) - NO COMPUTED DATA		
			31(1) & 30(0) - FUNCTIONAL TEST		
			31(1) & 30(1) - NORMAL OPERATION		
		32	PARITY (ODD)		

NOTE: BIT 14, REFERENCE DISPLAY BIT: 1 = REFERENCE AIRSPEED BUG
DISPLAYED ON AIRSPEED SCALE.

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
077P	02	TARGET AIRSPEED (V_T)			
		01-08	LABEL		
		09-10	SDI		
			10(0) & 09(0) - NOT USED		
			10(0) & 09(1) - FMS #1		
			10(1) & 09(0) - FMS #2		
			10(1) & 09(1) - FMS #3		
		11-13	COLOR CONTROL		
			13(0) & 12(0) & 11(0) - BLACK		
			13(0) & 12(0) & 11(1) - BLUE		
			13(0) & 12(1) & 11(0) - GREEN		
			13(0) & 12(1) & 11(1) - CYAN		
			13(1) & 12(0) & 11(0) - RED		
			13(1) & 12(0) & 11(1) - MAGENTA		
			13(1) & 12(1) & 11(0) - YELLOW		
			13(1) & 12(1) & 11(1) - WHITE		
		14	REFERENCE DISPLAY (NOTE)		
		15-17	SPARES		PAD ZERO
		18	0.25 KNOTS		
		19	0.5		
		20	1.0		
		21	2.0		
		22	4.0		
		23	8.0		
		24	16		
		25	32		
		26	64		
		27	128		
		28	256 KNOTS		
		29	SPARE		PAD ZERO
		30-31	SSM		
			31(0) & 30(0) - FAIL		
			31(0) & 30(1) - NO COMPUTED DATA		
			31(1) & 30(0) - FUNCTIONAL TEST		
			31(1) & 30(1) - NORMAL OPERATION		
		32	PARITY (ODD)		

NOTE: BIT 14, REFERENCE DISPLAY BIT: 1 = REFERENCE AIRSPEED BUG DISPLAYED ON AIRSPEED SCALE.

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LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
240P	02		FLAP EXTENSION AIRSPEED (V_F)		
		01-08	LABEL		
		09-10	SDI		
			10(0) & 09(0) - NOT USED		
			10(0) & 09(1) - FMS #1		
			10(1) & 09(0) - FMS #2		
			10(1) & 09(1) - FMS #3		
		11-13	COLOR CONTROL		
			13(0) & 12(0) & 11(0) - BLACK		
			13(0) & 12(0) & 11(1) - BLUE		
			13(0) & 12(1) & 11(0) - GREEN		
			13(0) & 12(1) & 11(1) - CYAN		
			13(1) & 12(0) & 11(0) - RED		
			13(1) & 12(0) & 11(1) - MAGENTA		
			13(1) & 12(1) & 11(0) - YELLOW		
			13(1) & 12(1) & 11(1) - WHITE		
		14	REFERENCE DISPLAY (NOTE)		
		15-17	SPARES		PAD ZERO
		18	0.25 KNOTS		
		19	0.5		
		20	1.0		
		21	2.0		
		22	4.0		
		23	8.0		
		24	16		
		25	32		
		26	64		
		27	128		
		28	256 KNOTS		
		29	SPARE		PAD ZERO
		30-31	SSM		
			31(0) & 30(0) - FAIL		
			31(0) & 30(1) - NO COMPUTED DATA		
			31(1) & 30(0) - FUNCTIONAL TEST		
			31(1) & 30(1) - NORMAL OPERATION		
		32	PARITY (ODD)		

NOTE: BIT 14, REFERENCE DISPLAY BIT: 1 = REFERENCE AIRSPEED BUG DISPLAYED ON AIRSPEED SCALE.

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LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
243P	02		USER DEFINED AIRSPEED MARKER - A		
		01-08	LABEL		
		09-10	SDI		
			10(0) & 09(0) - NOT USED		
			10(0) & 09(1) - FMS #1		
			10(1) & 09(0) - FMS #2		
			10(1) & 09(1) - FMS #3		
		11-13	COLOR CONTROL		
			13(0) & 12(0) & 11(0) - BLACK		
			13(0) & 12(0) & 11(1) - BLUE		
			13(0) & 12(1) & 11(0) - GREEN		
			13(0) & 12(1) & 11(1) - CYAN		
			13(1) & 12(0) & 11(0) - RED		
			13(1) & 12(0) & 11(1) - MAGENTA		
			13(1) & 12(1) & 11(0) - YELLOW		
			13(1) & 12(1) & 11(1) - WHITE		
		14	REFERENCE DISPLAY (NOTE)		
		15-17	SPARES		PAD ZERO
		18	0.25 KNOTS		
		19	0.5		
		20	1.0		
		21	2.0		
		22	4.0		
		23	8.0		
		24	16		
		25	32		
		26	64		
		27	128		
		28	256 KNOTS		
		29	SPARE		PAD ZERO
		30-31	SSM		
			31(0) & 30(0) - FAIL		
			31(0) & 30(1) - NO COMPUTED DATA		
			31(1) & 30(0) - FUNCTIONAL TEST		
			31(1) & 30(1) - NORMAL OPERATION		
		32	PARITY (ODD)		

NOTE: BIT 14, REFERENCE DISPLAY BIT: 1 = REFERENCE AIRSPEED BUG DISPLAYED ON AIRSPEED SCALE.

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
244P	02		USER DEFINED AIRSPEED MARKER - B		
		01-08	LABEL		
		09-10	SDI		
			10(0) & 09(0) - NOT USED		
			10(0) & 09(1) - FMS #1		
			10(1) & 09(0) - FMS #2		
			10(1) & 09(1) - FMS #3		
		11-13	COLOR CONTROL		
			13(0) & 12(0) & 11(0) - BLACK		
			13(0) & 12(0) & 11(1) - BLUE		
			13(0) & 12(1) & 11(0) - GREEN		
			13(0) & 12(1) & 11(1) - CYAN		
			13(1) & 12(0) & 11(0) - RED		
			13(1) & 12(0) & 11(1) - MAGENTA		
			13(1) & 12(1) & 11(0) - YELLOW		
			13(1) & 12(1) & 11(1) - WHITE		
		14	REFERENCE DISPLAY (NOTE)		
		15-17	SPARES		PAD ZERO
		18	0.25 KNOTS		
		19	0.5		
		20	1.0		
		21	2.0		
		22	4.0		
		23	8.0		
		24	16		
		25	32		
		26	64		
		27	128		
		28	256 KNOTS		
		29	SPARE		PAD ZERO
		30-31	SSM		
			31(0) & 30(0) - FAIL		
			31(0) & 30(1) - NO COMPUTED DATA		
			31(1) & 30(0) - FUNCTIONAL TEST		
			31(1) & 30(1) - NORMAL OPERATION		
		32	PARITY (ODD)		

NOTE: BIT 14, REFERENCE DISPLAY BIT: 1 = REFERENCE AIRSPEED BUG DISPLAYED ON AIRSPEED SCALE.

ADDENDUM 6

GAMA 429 -- Present Usage

Version: 6.0
Date: May 6, 2016

GAMA 429 -- PRESENT USAGE

The following labels and bit formats are currently being used by various GA companies. These applications may differ from the GAMA standard, but are provided here for information only.

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
034P	11	VOR/ILS FREQUENCY (BCD) (Collins, Global, Universal)			
		01-08	LABEL		
		09-10	SDI		
		* 11	MARKER SENSITIVITY	HIGH	LOW
		* 12	FMS AUTOTUNE MODE (NOTE 1)	AUTOTUNE	MANUAL
		# 13	VOR DIG BEARING FILTER (NOTE 2)	NO FILT	FILT IN
		14	ILS MODE	ILS	VOR
		15-18	HUNDREDTHS OF MHZ		
		19-22	TENTHS OF MHZ		
		23-26	UNITS OF MHZ		
		27-29	TENS OF MHZ		
		30-31	SSM		
		32	PARITY (ODD)		

NOTE 1:   BIT 12 HAS DUAL DEFINITIONS. FOR FMS TUNING, THIS BIT IS USED TO DESIGNATE AUTO / MANUAL TUNING FROM THE FMS. SEE SECTION 3.1 ABOVE FOR THE STANDARD GAMA DEFINITION.

NOTE 2:   (APPLIES TO BOTH DIGITAL AND ANALOG OUTPUTS.): THIS BIT SHOULD BE SET TO 1, EXCEPT WITH KING RADIOS WHERE FILTER IS DESIRED.

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
100P	02	SELECTED COURSE 1 (BNR) - (GARMIN)			
		01-08	LABEL		
		09-10	SDI		
		11	HSI COURSE SELECT Master Control	LRN CTRL	Not LRN CTRL
		12-13	SELECTED NAVIGATION SOURCE		
			13(0) & 12(0) – NOT USED		
			13(0) & 12(1) - GPS		
			13(1) & 12(0) – VOR/ILS/RNAV		
			13(1) & 12(1) - RESERVED		
		14-16	SPARES		PAD ZEROS
		17-28	BINARY ANGLE (180/4096)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		
100P	0B	SELECTED COURSE (BNR) - (HONEYWELL/Olathe)			
		01-08	LABEL		
		09-10	SDI		
		11	HSI COURSE SELECT Master Control	LRN CTRL	Not LRN CTRL
		12-28	BINARY ANGLE (180/131072)		
		29	SIGN	180 < 360	0 < 180 DEG
		30-31	SSM		
		32	PARITY (ODD)		

117P   02   VERTICAL DEVIATION (BNR) (Honeywell, Global, Universal)

	01-08	LABEL		
	09-10	SDI		
#	11	ALTITUDE GREATER THAN 1000 FT	GREATER	LESS THAN
#	12	VNAV BENDOVER DIRECT'N (NOTE 1)	FLY UP	FLY DOWN
#	13	VNAV BENDOVER	CAPTURE	TRACK
*	14	VERT TRK ALRT ANN (NOTE 2)	ANN	NO ANN
	15-28	BINARY FEET (*16,384 / 16,384)		
	29	SIGN	FLY UP	FLY DOWN
	30-31	SSM		
	32	PARITY (ODD)		

NOTE 1:   BENDOVER DIRECTION WILL BE DEFINED ONLY DURING CAPTURE.
NOTE 2:   LABEL 117 BIT 14 SWAPPED WITH LABEL 122 BIT 13. SEE GAMA STD
                    DEF'N IN SECTION 3.1 ABOVE.

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LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
122P	02	VERTICAL COMMAND (TO AUTOPILOT) (BNR) (Honeywell, Global, Universal)			
		01-08	LABEL		
		09-10	SDI		
		11	ALT SEL LVL OFF INTERVENT'N	FMS LEVEL	AP LEVEL
		12	VERTICAL TRACK ALERT HORN	HORN	NO HORN
		13	VNAV ARM ENABLE/ALERT (NOTE)	ENABLE	NOT ENABLE
		14	FMS VNAV CAPTURE / TRACK	CAPTURE	TRACK
		15	MAX SPEED	AT VMO	NORMAL
		16	SPARE		PAD ZERO
		17-28	BINARY ANGLE (180 / 4,096)		
		29	SIGN	FLY DOWN	FLY UP
		30-31	SSM		
		32	PARITY (ODD)		

NOTE: LABEL 117 BIT 14 SWAPPED WITH LABEL 122 BIT 13. SEE GAMA STD DEF'N IN SECTION 3.1 ABOVE.

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
351P	02	DISTANCE TO DESTINATION VIA FLIGHT PLAN (BNR) OLD BUS FORMAT (NOTE 8)	(ASINC)		
		01-08	LABEL		
		09-10	SDI		
		11-12	SPARES		PAD
		13-28	BINARY NM (4096 / 65536)		
		29	SIGN		ZERO
		30-31	SSM		
		32	PARITY (ODD)		
351P	02	DISTANCE TO DESTINATION VIA FLIGHT PLAN (BNR) NEW BUS FORMAT (NOTE 8)	(ASINC)		
		01-08	LABEL		
		09-10	SDI		
		11-28	BINARY NM (32768 / 262144)		
		29	SIGN		ZERO
		30-31	SSM		
		32	PARITY (ODD)		
352P	02	EST. TIME TO DESTINATION VIA FLIGHT PLAN (BNR) OLD BUS FORMAT (NOTE 8)	(ASINC)		
		01-08	LABEL		
		09-10	SDI		
		11-15	SPARES		PAD
		16-28	BINARY MINUTES (512 / 8192)		
		29	SIGN		ZERO
		30-31	SSM		
		32	PARITY (ODD)		

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Version: 6.0
Date: May 6, 2016

LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
352P	02	EST. TIME TO DESTINATION VIA FLIGHT PLAN (BNR)		(ASINC)	
		NEW BUS FORMAT (NOTE 8)			
		01-08	LABEL		
		09-10	SDI		
		11-16	SPARES		PAD
		17-28	BINARY MINUTES (4096 / 4096)		
		29	SIGN		ZERO
		30-31	SSM		
		32	PARITY (ODD)		
371P	18	GEN AV EQUIPMENT IDENT. CODE (DSC)		(ASINC)	
		01-08	LABEL		
		09-10	SDI		
		11-14	ARINC HEXADECIMAL EQUIP ID CODE LSD		
		15-18	ARINC HEXADECIMAL EQUIP ID CODE MSD		
		19-24	BINARY COMPANY ID CODE (BIT 19 = LSB)		

1	B&D INSTRUMENTS
2	BEECH AIRCRAFT
3	BENDIX AVIONICS
4	CANADIAN MARCONI
5	CESSNA AIRCRAFT
6	COLLINS AVIONICS
7	DELCO ELECTRONICS
8	FOSTER RNAV
9	GABLE CONTROLS
10	GLOBAL SYSTEMS
11	GULFSTREAM AEROSPACE
12	HONEYWELL
13	KING RADIO
14	LEARJET
15	LITTON AERO PRODUCTS
16	OFFSHORE NAVIGATION
17	RACAL AVIONICS
18	SPERRY
19	UNIVERSAL NAVIGATION SYSTEMS
20	3M AVIATION SAFETY SYSTEMS
21	ALLIEDSIGNAL GENERAL AVIATION AVIONICS
22	ALLIEDSIGNAL GLOBAL WULFSBERG
23	BF GOODRICH AVIONICS
24	GARMIN
25	ARNAV
26	COMPUTER INSTRUMENTS CORPORATION
27	RYAN INTERNATIONAL CORP
28	CHELTON AVIONICS, INC.
29	INNOVATIVE SOLUTIONS & SUPPORT, INC. (IS&S)
30	FREEFLIGHT SYSTEMS
31 - 63	SPARES

		25	BUS FORMAT (NOTE 8)	NEW FMT	OLD FMT

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26-29   COMPANY PRIVATE USE
30-31   SSM
32   PARITY (ODD)

NOTE 8:   If Distance to Destination (351) and Time to Destination (352) are transmitted in the OLD bus format, bit 25 of Equipment Ident. (371) will be cleared to ZERO. If Distance to Destination (351) and Time to Destination (352) are transmitted in the NEW bus format, bit 25 of Equipment Ident. (371) will be set to ONE.

Version: 6.0
Date: May 6, 2016

ADDENDUM 7

Graphics Protocol

Version: 6.0
Date: May 6, 2016

GRAPHICS PROTOCOL

The following ARINC 429 graphics protocols are being used by various GA companies. These applications do not represent the GAMA standard, but are provided here for information only.

1.0   PROTOCOL 'A'   (Honeywell)

Method for the drawing of "DME Arcs", "Procedure Turns", "Holding Patterns", and "Airport Runways"

1.1   Introduction

The following is an addition or extension to the ARINC 429 GAMA Standard for LRN data, using the existing flight plan record method (which sends packets of ARINC labels to describe waypoints, navaids, airports, etc).

The ARINC labels in this protocol are:

LABEL 330	**CONIC ARC INBOUND COURSE**	**SCALED & ROTATED SYMBOL**
LABEL 331	**CONIC ARC RADIUS**	**SCALED & ROTATED SYMBOL**
LABEL 332	**CONIC ARC COURSE CHANGE ANGLE**	**SCALED & ROTATED SYMBOL**
LABEL 333	**AIRPORT RUNWAY AZIMUTH**	**SCALED & ROTATED SYMBOL** **(OR ICON WITHOUT LBL 334)**
LABEL 334	**AIRPORT RUNWAY LENGTH**	**SCALED & ROTATED SYMBOL**
LABEL 335	**HOLDING PATTERN AZIMUTH**	**ROTATED ICON**
LABEL 340	**PROCEDURE TURN AZIMUTH**	**ROTATED ICON**

The new ARINC 429 label 303, bit 27 definition is:

LABEL 303	**FLIGHT PLAN MESSAGE LENGTH/TYPE/NUM**
** bit 27 = 1**	**FLIGHT PLAN RECORD TYPE = GRAPHIC PATTERN**

Section 1.2 details a scheme for transmitting "DME arcs", "procedure turns", and "holding patterns". Section 1.3 details a scheme for transmitting Airport Runways.

Each new parameter has the same format (but not the same label number) as ARINC 702. This should result in the economies that often result from having commonality between different specifications, without diminishing, in any way, the efficacy of this protocol.

An important part of this protocol is the assignment of different ARINC labels for different parameters. In ARINC 702, and elsewhere, "word groups" are sent that multiplex different parameters on the same ARINC label. The Honeywell family of EFISs, both old and new, do not have special ARINC steering hardware or dedicated ARINC input processors, to facilitate rapid discrimination of the same label.

1.2 DME Arcs, Procedure Turns, and Holding Patterns

There are two crucial interface problems that any proposal must solve:

(1)   If an EFIS is sent a collection of flight plan records that describe some special "graphic pattern" (i.e., procedure turn), once the EFIS begins drawing this pattern, the EFIS **MUST** know which records describe the pattern, so that it finishes drawing what it started. That is, if the EFIS is near the end of the number of records it normally processes, we do not want to stop drawing in the middle of a holding pattern, for instance. That is why this protocol contains the "graphic pattern" bit (label 303 bit 27) in each record.

(2)   When a full size, scaled and rotated, "graphic pattern" is sent to the EFIS, the EFIS must always have the option to replace that pattern (i.e., for large map ranges) with the appropriate rotated ICON. Thus, the EFIS must know (as in problem 1 above) which records compose the "graphic pattern" (in order to ignore them), and the EFIS must also be sent the ICON data (if there is one) with which to replace the full size pattern.

This protocol uses the following set of ARINC 429 tools to transmit (draw) DME Arcs, Procedure Turns, and Holding Patterns:

(1)   Flight plan records that contain Conic Arc data (three new labels in the record),
(2)   Flight plan records that contain the existing (historical) straight track lines,
(3)   Flight plan records that contain the "**GAP**" bit (label 303 bit 26),
(4)   Flight plan records that contain the "**no symbol**" station type (lbl 303 bits 13-15),
(5)   Flight plan records that contain the new "**graphic pattern**" bit (lbl 303 bit 27),
(6)   Flight plan records that contain azimuth data for fixed size rotated ICONs.

Along with this set of tools, there are some essential rules that govern their use:

1.   All of the records that describe a "graphic pattern" (i.e., holding pattern), must have the "graphic pattern" bit set (lbl 303 bit 27 = 1). This does not apply to DME Arcs. A DME Arc is described with only one record, and **MUST NOT** have the "graphic pattern" bit set. In addition, concerning DME Arcs: there is never an ICON replacement label sent for a DME Arc. This is because the Azimuth of the DME Arc, needed to draw an ICON replacement, is already one of the three conic arc parameters (label 330).

2.   Whenever a "graphic pattern" set of flight plan records have an ICON substitute, the ICON label must also be sent, in the record that immediately precedes the first "graphic pattern" record. If the EFIS chooses to draw the ICON instead of the full "graphic pattern", the ICON will be drawn at the lat/lon of the record in which the ICON data is sent.

3.   The combination of normal flight plan records and "graphic pattern" records **SHALL** be sent in such a manner that if all of the records marked "graphic pattern" (lbl 303 bit 27=1) are ignored, the records remaining still contain all of the lat/lons (waypoints) of the basic flight plan map; the existing, historical, rules of flight plan interpretation would result in the customary connected multi-waypoint map.

Corollary 1: If the last "non-graphic" record before a set of "graphic records" does not have the "gap follows" bit set (label 303 bit 26 = 0), the EFIS will draw a straight track line between this record's lat/lon and the lat/lon of the next "non-graphic" record (the first record after the set of "graphic" records). If the EFIS chooses to draw the "graphic pattern", it will also draw a straight track line between the last "non-graphic" record's lat/lon and the lat/lon of the first "graphic" (lbl 303 bit 27=1) record (which is the next record).

Corollary 2: If the last "non-graphic" record before a set of "graphic records" does have the "gap follows" bit set (label 303 bit 26 = 1), the EFIS will "put" the gap between this record's lat/lon and the lat/lon of the next "non-graphic" record (the first record after the set of "graphic" records). However, the EFIS **will** draw the straight track line between this record's lat/lon and the lat/lon of the first "graphic" record. In other words, the "gap follows" bit, in a "non-graphic" record, **never** applies to a "graphic" record, but applies only to the next "non-graphic" record.

4.   When a conic arc record is sent, the lat/lon of that record will be the **starting point of the Arc.** This saves records, in the general case, because of rule 5.

5.   Given the starting lat/lon of a conic arc, and the three conic arc parameters in the same record, the ending lat/lon of the conic arc can be determined (the arc can be drawn without processing another record). Because of this, another record does not have to be sent just to fix the arc endpoint lat/lon. The EFIS will draw a straight track line from the end of the conic arc, to the lat/lon of the very next record (conic arc record or not). If this next record also contains conic arc data, a conic arc will also be drawn, in addition to the straight line just mentioned. Of course, if the lat/lon of the next record

coincides with the end of the conic arc, no straight track line will be seen. In general, for DME Arcs, a record would probably be sent at the end of the conic arc, so that a waypoint symbol and ident may be seen there. For "graphic patterns" (i.e., holding patterns), which are probably suppressing waypoint symbols and idents, omitting records at the end of conic arcs will save records.

6. If a conic arc record is send **with the "gap follows" bit set** (label 303 bit 26 = 1), the conic arc that "follows" will still be drawn, and the only "gap" that will appear is from the end of the conic arc to the lat/lon of the next waypoint record. The rationale for this is that, if the LRN wants the conic arc to also be a gap (invisible), it should simply not sent conic arc data in the "gap follows" record.

7. Once an EFIS begins drawing a "graphic pattern", it **MUST** complete the pattern. The EFIS is free (so to speak) not to draw the pattern at all, or to draw an ICON replacement, but it must decide this beforehand, and once started, must finish drawing the "graphic" records (i.e., an EFIS cannot stop drawing half way through a holding pattern).

8. An ICON label may be sent with any (or all) record(s). There does not have to be a set of equivalent "graphic" records following an ICON record. Conversely, a set of "graphic" records does not have to have an ICON equivalent sent (in the record preceding the set).

A careful analysis will reveal that, in both **Example 1** and **Example 2** below, the same final drawing could be accomplished with one less record, if we violate rule 3 above, and use some subtle/tricky assumptions. This temptation must be resisted; there has been so much confusion and error, to this day, over implementing the existing flight plan method, that such "cleverness" and subtlety should definitely be avoided in any addition.

Rule three is not there for any kind of backwards compatibility, but only to minimize confusion in comprehension and implementation. For instance, in **Example 1**, record 2 could be omitted, and still give enough information, but then we would have a situation in which part of the normal flight plan (the location of X2,Y2) could only be found in a "graphic record". Since it is always possible that the EFIS may have to omit the graphic drawing (i.e., for large ranges), the EFIS would still have to "fish around" in the graphic records to be able to complete the normal multi-waypoint map. In addition, consider what would happen when the EFIS is asked to display a waypoint list, or to skip through waypoints. Without record 2, and rule 3 above, the EFIS would have to use some subtle "rules" to discern that the waypoint in the first graphic record was actually also a normal map waypoint. This is not good. It may be possible to come up with rules that would work, but it is too "tricky". Errors in implementation would be much more likely. If we just stick with rule 3 strictly, then generating a waypoint list, or skipping, can be easily done by just ignoring all graphic records.

This protocol is not backwards compatible. Old EFIS, ignorant of conics and of the "graphic bit" would simply connect all the graphic record lat/lons with straight lines.

It is important to note that without any further changes or assumptions, these tools/rules can be used to draw "holding pattern entries", "curved path transitions", or many other general "graphic patterns".
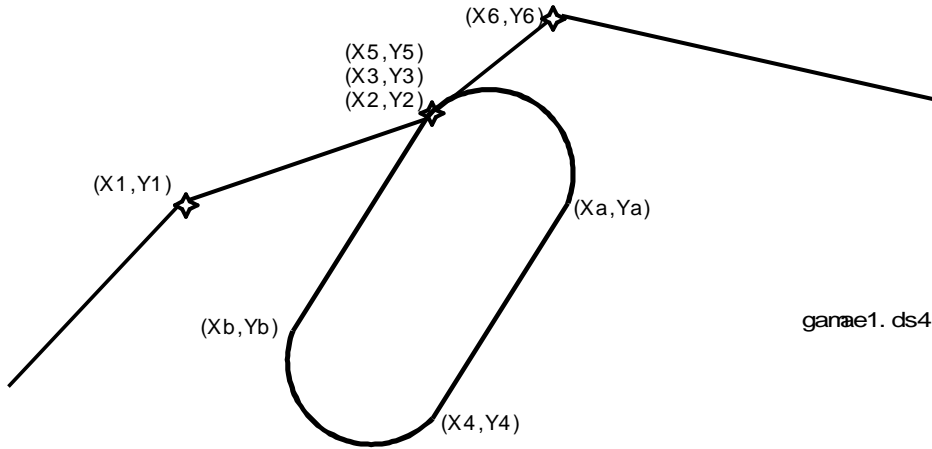
Note about records that contain Conic Arc data:

A Conic Arc is drawn by adding three new ARINC labels (330-332), to any desired flight plan record. This Conic Arc may describe a DME Arc, or may be an arc that is part of a more general "graphic pattern". **For a DME Arc, only a single (Conic Arc) record is required, and the "graphic pattern" bit should NOT be set.** This is important; if a DME Arc were implemented with a single "graphic record" instead, then when all graphic records are ignored, a waypoint on the normal multi-waypoint map would be lost (the starting waypoint of the Arc).

Note about records that contain ICON data:

In the general case, it is always possible that the EFIS may have to ignore the scaled and rotated data, and display the fixed size rotated ICON instead. This could be due to the horsepower of the particular EFIS, how many graphic symbols have already been drawn, or just that the map range is very large. If no ICON replacement is sent, and the EFIS cannot, for some reason, draw the "graphic pattern", the EFIS will simply not draw a "graphic pattern" or an ICON. ICON data may be sent, and drawn, without any accompanying "graphic pattern" records, of course.

EXAMPLE 1 (HOLDING PATTERN): six record flight plan segment, that describes three waypoints on a normal multi-waypoint map, as well as a scaled and rotated holding pattern on the second waypoint.

In the following six records, the vertical spaces do not imply a time gap, but are there simply to make it clear which labels are missing from which records. The notes under each label 303 denote:
(1) "TYPE" = bits 13-15, (2) "GRAPHIC" = bit 27, (3) "GAP" = bit 26, (4) "ROUTE" = bit 16.

```
303 REC NO 1       303 REC NO 2       303 REC NO 3       303 REC NO 4       303 REC NO 5       303 REC NO 6
... TYPE = WPT     ... TYPE = WPT     ... TYPE=NOSYM     ... TYPE=NOSYM     ... TYPE=NOSYM     ... TYPE = WPT
... GRAPHIC=OFF    ... GRAPHIC=OFF    ... GRAPHIC=ON     ... GRAPHIC=ON     ... GRAPHIC=ON     ... GRAPHIC=OFF
... GAP = OFF      ... GAP = OFF      ... GAP = OFF      ... GAP = OFF      ... GAP = OFF      ... GAP = OFF
... ON ROUTE      ... ON ROUTE      ... ON ROUTE      ... ON ROUTE      ... ON ROUTE      ... ON ROUTE
306 LAT = X1       306 LAT = X2       306 LAT = X3       306 LAT = X4       306 LAT = X5       306 LAT = X6
307 LON = Y1       307 LON = Y2       307 LON = Y3       307 LON = Y4       307 LON = Y5       307 LON = Y6
...                335 HP ICON        ...                ...                ...                ...
...                ...                330 CONIC ARC      330 CONIC ARC      ...                ...
...                ...                331 CONIC ARC      331 CONIC ARC      ...                ...
...                ...                332 CONIC ARC      332 CONIC ARC      ...                ...
304 CHR 1-3        304 CHR 1-3        304 CHR 1-3        304 CHR 1-3        304 CHR 1-3        304 CHR 1-3
305 CHR 4-6        305 CHR 4-6        305 CHR 4-6        305 CHR 4-6        305 CHR 4-6        305 CHR 4-6
301 CHR 7-9        301 CHR 7-9        301 CHR 7-9        301 CHR 7-9        301 CHR 7-9        301 CHR 7-9
302 CHR 10-12      302 CHR 10-12      302 CHR 10-12      302 CHR 10-12      302 CHR 10-12      302 CHR 10-12
113 CHECKSUM       113 CHECKSUM       113 CHECKSUM       113 CHECKSUM       113 CHECKSUM       113 CHECKSUM
```

Rec 2: Draws a straight track line from (X1,Y1) to (X2,Y2) and a waypoint symbol at (X2,Y2). Note that label 335, the ICON equivalent of records 3-5, is sent with the non-graphic record at which lat/lon the "graphic pattern" will be drawn. Since the graphic records immediately follow, the EFIS recognizes that if it cannot draw the "graphic pattern" of records 3-5, it may replace them with the ICON represented by label 335 in record 2, at location (X2,Y2).

Rec 3: Draws a straight track line from (X2,Y2) to (X3,Y3), but since they are collocated, there is no track line. Since the Type = No Symbol, there is no waypoint symbol drawn at (X3,Y3). Since there is Conic Arc data in the record, an Arc is drawn from (X2,Y2) to (Xa,Ya).

Rec 4: Draws a straight track line from (Xa,Ya), which is where the last conic arc record finished drawing, to (X4,Y4). Since there is Conic arc data in the record, an Arc is drawn from (X4,Y4) to (Xb,Yb). Since the Type = No Symbol, no waypoint symbol appears at (X4,Y4).

Rec 5: Draws a straight track line from (Xb,Yb), which is where the last conic arc record finished drawing, to (X5,Y5). Since the Type = No Symbol, no waypoint symbol appears at (X5,Y5)(remember, record 2 already drew a symbol there). This completes the scaled and rotated holding pattern, and is the last of the "graphic pattern" records.

Rec 6: Draws a straight track line from the last non-graphic record lat/lon, (X2,Y2) to (X6,Y6). Even if record number five (a "graphic pattern" record) had not ended up at (X2,Y2), record number six (a non-graphic record) would still connect (X2,Y2) to (X6,Y6).

EXAMPLE 2 (ARBITRARY GRAPHIC PATTERN): six record flight plan segment, that describes three waypoints on a normal multi-waypoint map, as well as an arbitrary (half moon) "graphical pattern", associated with the second waypoint, but which does not touch it, and which has no ICON label to replace it (If the EFIS cannot draw the object for some reason, there would simply be no ICON substitute).
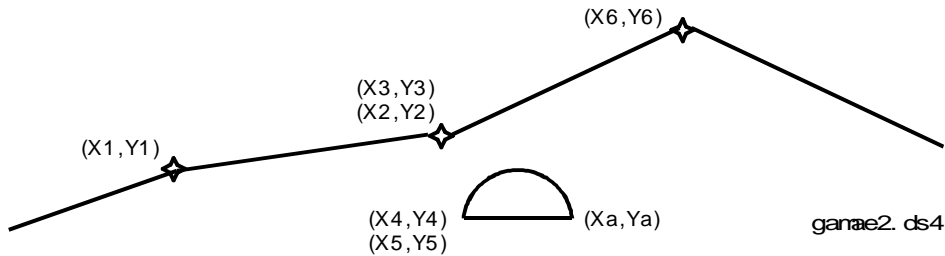
In the following six records, the vertical spaces to not imply a time gap, but are there simply to make it clear which labels are missing from which records. The notes under each label 303 denote:
(1) "TYPE" = bits 13-15, (2) "GRAPHIC" = bit 27, (3) "GAP" = bit 26, (4) "ROUTE" = bit 16.

```
303 REC NO 1      303 REC NO 2      303 REC NO 3      303 REC NO 4      303 REC NO 5      303 REC NO 6
... TYPE = WPT    ... TYPE = WPT    ... TYPE=NOSYM    ... TYPE=NOSYM    ... TYPE=NOSYM    ... TYPE = WPT
... GRAPHIC=OFF   ... GRAPHIC=OFF   ... GRAPHIC=ON    ... GRAPHIC=ON    ... GRAPHIC=ON    ... GRAPHIC=OFF
... GAP = OFF     ... GAP = OFF     ... GAP = ON      ... GAP = OFF     ... GAP = OFF     ... GAP = OFF
... ON ROUTE      ... ON ROUTE      ... ON ROUTE      ... ON ROUTE      ... ON ROUTE      ... ON ROUTE
306 LAT = X1      306 LAT = X2      306 LAT = X3      306 LAT = X4      306 LAT = X5      306 LAT = X6
307 LON = Y1      307 LON = Y2      307 LON = Y3      307 LON = Y4      307 LON = Y5      307 LON = Y6
...               ...               ...               330 CONIC ARC    ...               ...
...               ...               ...               331 CONIC ARC    ...               ...
...               ...               ...               332 CONIC ARC    ...               ...
304 CHR 1-3       304 CHR 1-3       304 CHR 1-3       304 CHR 1-3       304 CHR 1-3       304 CHR 1-3
305 CHR 4-6       305 CHR 4-6       305 CHR 4-6       305 CHR 4-6       305 CHR 4-6       305 CHR 4-6
301 CHR 7-9       301 CHR 7-9       301 CHR 7-9       301 CHR 7-9       301 CHR 7-9       301 CHR 7-9
302 CHR 10-12     302 CHR 10-12     302 CHR 10-12     302 CHR 10-12     302 CHR 10-12     302 CHR 10-12
113 CHECKSUM      113 CHECKSUM      113 CHECKSUM      113 CHECKSUM      113 CHECKSUM      113 CHECKSUM
```

Rec 2: Draws a straight track line from (X1,Y1) to (X2,Y2) and a waypoint symbol at (X2,Y2).

Rec 3: This is the first "graphic pattern" record. It draws a straight line from (X2,Y2) to (X3,Y3), but since they are collocated, there is no track line. It does not draw a symbol because the **TYPE = NO SYMBOL**. This record also has the "**GAP follows**" bit set, so there will be no track line from (X3,Y3) to (X4,Y4).

Rec 4: There is a discontinuity from (X3,Y3) to (X4,Y4), via the **GAP** bit in record 3. Since there is Conic Arc data in the record, an Arc is drawn from (X4,Y4) to (Xa,Ya). Since the **TYPE = NO SYMBOL**, no waypoint symbol appears at (X4,Y4).

Rec 5: Draws a straight track line from (Xa,Ya), which is where the last conic arc record finished drawing, to (X5,Y5). Since the **TYPE = NO SYMBOL**, no waypoint symbol appears at (X5,Y5). This completes the half moon drawing, and is the last of the "graphic pattern" records. Note: no extra record is required to "draw" our way back to (X2,Y2).

Rec 6: Draws a straight track line from (X2,Y2), which is the last non-graphic record, to (X6,Y6).

EXAMPLE 3 (DME ARC): three record flight plan segment, that illustrates the normal use of a conic arc record to describe a DME Arc. A DME Arc is a conic arc record that stands alone, and is not related to other "graphic" records. There may be two DME Arcs in a row, but the two adjacent conic arc records will not be thought of as associated to each other in any special way.

Important notes:

1. For a DME Arc, only a single (Conic Arc) record is required, and the **"graphic pattern" bit should NOT be set** (label 303 bit 27 should equal 0). The lat/lon and waypoint symbol contained in this conic arc record are part of the normal flight plan waypoint list, not part of some separate "graphic pattern".

2. When "starting with" the old fashioned multi-waypoint map, in which each waypoint is connected with a straight track line, the only alteration needed to change from a straight track line to a DME Arc, is the addition of the three conic arc labels (330,331,332), no new records.

3. There is no ICON label sent as a replacement for DME Arcs, since label 330, one of the three conic arc parameters, is already included, and would be the azimuth for an ICON.
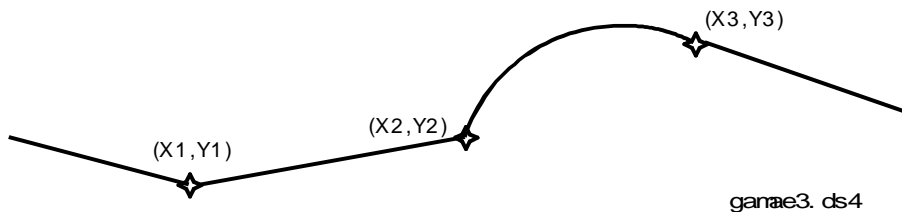
gamae3.ds4

In the following six records, the vertical spaces do not imply a time gap, but are there simply to make it clear which labels are missing from which records.
The notes under each label 303 denote:
(1) "TYPE" = bits 13-15, (2) "GRAPHIC" = bit 27, (3) "GAP" = bit 26, (4) "ROUTE" = bit 16.

```
303 REC NO 1      303 REC NO 2      303 REC NO 3
... TYPE = WPT    ... TYPE = WPT    ... TYPE=NOSYM
... GRAPHIC=OFF   ... GRAPHIC=OFF   ... GRAPHIC=OFF
... GAP = OFF     ... GAP = OFF     ... GAP = OFF
... ON ROUTE      ... ON ROUTE      ... ON ROUTE
306 LAT = X1      306 LAT = X2      306 LAT = X3
307 LON = Y1      307 LAT = Y2      307 LAT = Y3
...               330 CONIC ARC     ...
...               331 CONIC ARC     ...
...               332 CONIC ARC     ...
304 CHR 1-3       304 CHR 1-3       304 CHR 1-3
305 CHR 4-6       305 CHR 4-6       305 CHR 4-6
301 CHR 7-9       301 CHR 7-9       301 CHR 7-9
302 CHR 10-12     302 CHR 10-12     302 CHR 10-12
113 CHECKSUM      113 CHECKSUM      113 CHECKSUM
```

Rec 1: Run of the mill straight track line waypoint record.
Rec 2: Draws a straight track line from (X1,Y1) to (X2,Y2). Since there is Conic Arc data in the record, an Arc is drawn beginning at (X2,Y2).
Rec 3: Draws a straight track line from the end of the conic arc to (X3,Y3). Since (X3,Y3) has been purposely placed at the end of the DME Arc, no straight track line appears. The straight track line drawn from (X3,Y3) is due to a "Rec 4" which is not shown.
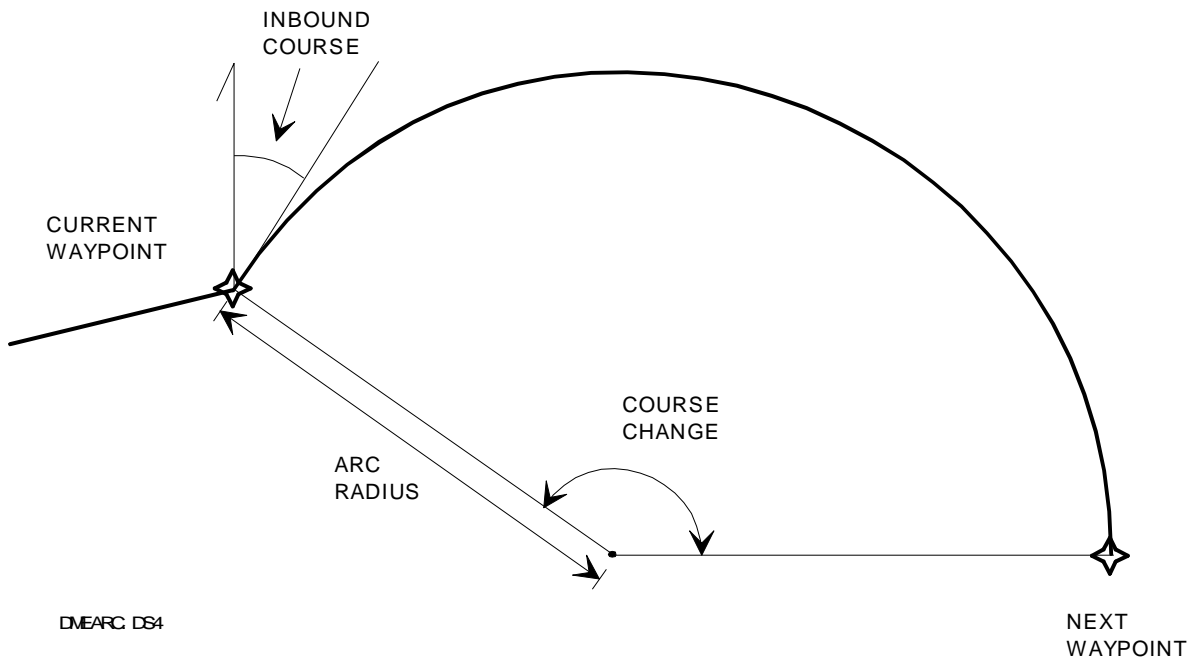
PROTOCOL ARINC LABEL BIT DEFINITIONS

303	Message Length/Type/Number	Change to Existing Label 303
01-08	LABEL	
09-12	WORDS IN MESSAGE	
13-15	WAYPOINT/STATION TYPE (INCLUDES 'NO SYMBOL')	
16	DATA RECORD	
17-23	BINARY WAYPOINT NUMBER	
24	FMS PLAN MODE	
25	WAYPOINT AT PLAN CENTER	
26	GAP FOLLOWS (DISCONTINUITY)	
27	MULTI-WAYPOINT-RECORD GRAPHIC PATTERN	NEW
28-29	SPARE	
30-31	SSM	
32	PARITY (ODD)	

NEW ARINC LABELS TO DESCRIBE ARC CONIC DATA

330   CONIC ARC INBOUND COURSE (BNR)
                        01-08   LABEL
                        09-10   SPARES
                        11   ARC DIRECTION
                                  (0) = LEFT HAND; (1) = RIGHT HAND (CLOCKWISE)
                        12-13   SPARES
                        14-28   BINARY ANGLE (*180/32768)
                        29   SIGN
                        30-31   SSM
                        32   PARITY (ODD)

331   CONIC ARC RADIUS (BNR)
                        01-08   LABEL
                        09-13   SPARES
                        14-28   BINARY NM (*256/32768)
                        29   SPARE
                        30-31   SSM
                        32   PARITY (ODD)

332   CONIC ARC COURSE CHANGE ANGLE (BNR)
                        01-08   LABEL
                        09-13   SPARES
                        14-28   BINARY ANGLE (*180/32768)
                        29   SIGN
                        30-31   SSM
                        32   PARITY (ODD)

INBOUND COURSE

CURRENT WAYPOINT

ARC RADIUS

COURSE CHANGE

NEXT WAYPOINT

DMEARC DS4

NEW ARINC LABELS TO DESCRIBE FIXED SIZE ROTATED SYMBOLS (ICONS)

335   LEFT/RIGHT HAND HOLDING PATTERN AZIMUTH (BNR)
- 01-08   LABEL
- 09-10   SPARES
- 11   0 = LEFT HAND, 1 = RIGHT HAND
- 12-13   SPARES
- 14-28   BINARY ANGLE (*180/32768)
- 29   SIGN
- 30-31   SSM
- 32   PARITY (ODD)

340   LEFT/RIGHT HAND PROCEDURE TURN AZIMUTH (BNR)
- 01-08   LABEL
- 09-10   SPARES
- 11   0 = LEFT HAND, 1 = RIGHT HAND
- 12-13   SPARES
- 14-28   BINARY ANGLE (*180/32768)
- 29   SIGN
- 30-31   SSM
- 32   PARITY (ODD)

Version: 6.0
Date: May 6, 2016

1.3   Airport Runways

This ARINC method to describe Airport Runways is not dependent upon the previously discussed implementation for drawing arcs, holding patterns, procedure turns, or other graphic patterns.

The new ARINC data to describe Airport Runways would be sent in the existing airport flight plan record (between 303 and 113). If a fixed sized, but rotated, ICON is being described, only the Airport Runway Azimuth (label 333), is sent. When a rotated and scaled Airport Runway is being described, the Airport Runway Azimuth (label 333) and Runway Length (label 334) is sent. The EFIS would use the new ARINC data if it is present in the record. No special flags would need to be included in existing labels to indicate this new data is present.

If the EFIS receives the rotated and scaled parameters (labels 333,334), but can only draw an ICON for some reason (i.e., map range to large), the EFIS will use the Azimuth data in label 333 to draw the fixed size rotated ICON.

Example of an airport record sending a rotated fixed size Airport Runway ICON:

        303   MESSAGE LENGTH/TYPE/NUM
        306   LATITUDE
        307   LONGITUDE
        333   AIRPORT RUNWAY AZIMUTH (FOR ICON SINCE LABEL 334 IS ABSENT)
        304   MESSAGE CHARACTERS 1-3
        305   MESSAGE CHARACTERS 4-6
        301   MESSAGE CHARACTERS 7-9
        302   MESSAGE CHARACTERS 10-12
        113   MESSAGE CHECKSUM

Example of an airport record sending a scaled and rotated Airport Runway:

        303   MESSAGE LENGTH/TYPE/NUM
        306   LATITUDE
        307   LONGITUDE
        333   AIRPORT RUNWAY AZIMUTH
        334   AIRPORT RUNWAY LENGTH
        304   MESSAGE CHARACTERS 1-3
        305   MESSAGE CHARACTERS 4-6
        301   MESSAGE CHARACTERS 7-9
        302   MESSAGE CHARACTERS 10-12
        113   MESSAGE CHECKSUM

Version: 6.0
Date: May 6, 2016

NEW ARINC LABELS TO DESCRIBE AIRPORT RUNWAYS

333   AIRPORT RUNWAY AZIMUTH (HEADING) (BNR)
           01-08   LABEL
           09-13   SPARES
           14-28   BINARY ANGLE (*180/32768)
           29   SIGN
           30-31   SSM
           32   PARITY (ODD)

334   AIRPORT RUNWAY LENGTH IN FEET (BNR)
           01-08   LABEL
           09-13   SPARES
           14-28   BINARY FT (*32768/32768)
           29   SIGN
           30-31   SSM
           32   PARITY (ODD)

PROTOCOL B

## Method for the drawing of "DME Arcs (AlliedSignal)

Most, if not all, approach approved GPS navigators will be flying DME arcs as part of SID's, STARS's or instrument approaches. GAMA 429 does not currently support DME arcs as part of the FMS flight plan output data. It is desirable for these arcs to be drawn on the EFIS and other map displays. This proposal defines label 325G to support this interface.

The label is the same as the Conic label used in ARINC 702 with the addition of two discrete bits. The binary numeric portion of the label contains the radius of the arc in nautical miles. One discrete bit defines the flight path as clockwise or counter clockwise - this contains the same information as the left/right flag in ARINC 424. The Arc Angle Size bit is added for the case of an arc of greater than 180 degrees.

This label is to be sent for each arc leg of the flight plan. It will be associated with the **end waypoint** of each arc leg segment. Label 325 can be placed anywhere between labels 303 and 113 in the flight plan record packet.

It is further proposed that the gap bit of label 303 (bit 26) be set to gap (one) for any point that <u>begins</u> an arc leg. This can be used to prevent the drawing of a straight line between points on the arc. This can be used on displays that do not chose to draw an arc. Some certification agencies have forbidden the drawing of a straight line between two points on the arc if they are separated by a sufficient number of degrees to create a misrepresentation of the path the aircraft will fly. These agencies have stated that not drawing anything for the arc is acceptable and the gap bit can meet this requirement.

The diagram below shows an arc with an intermediate waypoint but most arcs have only a beginning and end point:
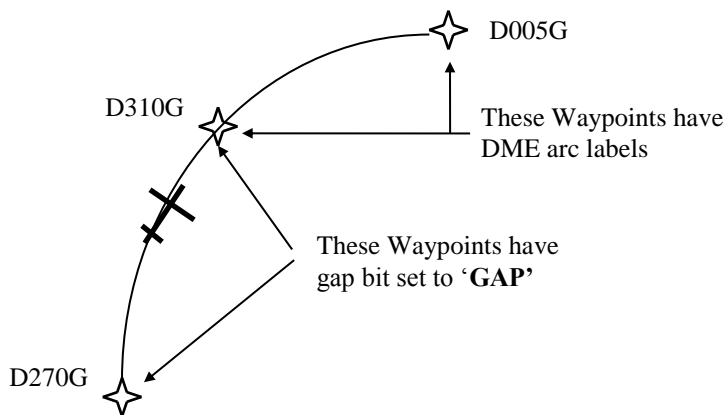
LABEL	HEX ID	DESCRIPTION BIT NO.	FUNCTION	BIT STATUS ONE	ZERO
325	02	DME ARC RADIUS (BNR)			
		01-08	LABEL		
		09-10	SDI		
		11	INBOUND DIRECTION	CCW	CLOCKWISE
		12	ARC ANGLE SIZE	180 < 360	0 < 180 DEG
		13	SPARE		PAD ZERO
		14-28	NAUTICAL MILES (*256/16,384)		
		29	SIGN		ALWAYS ZERO
		30-31	SM		
		32	PARITY (ODD)		

Version: 6.0
Date: May 6, 2016