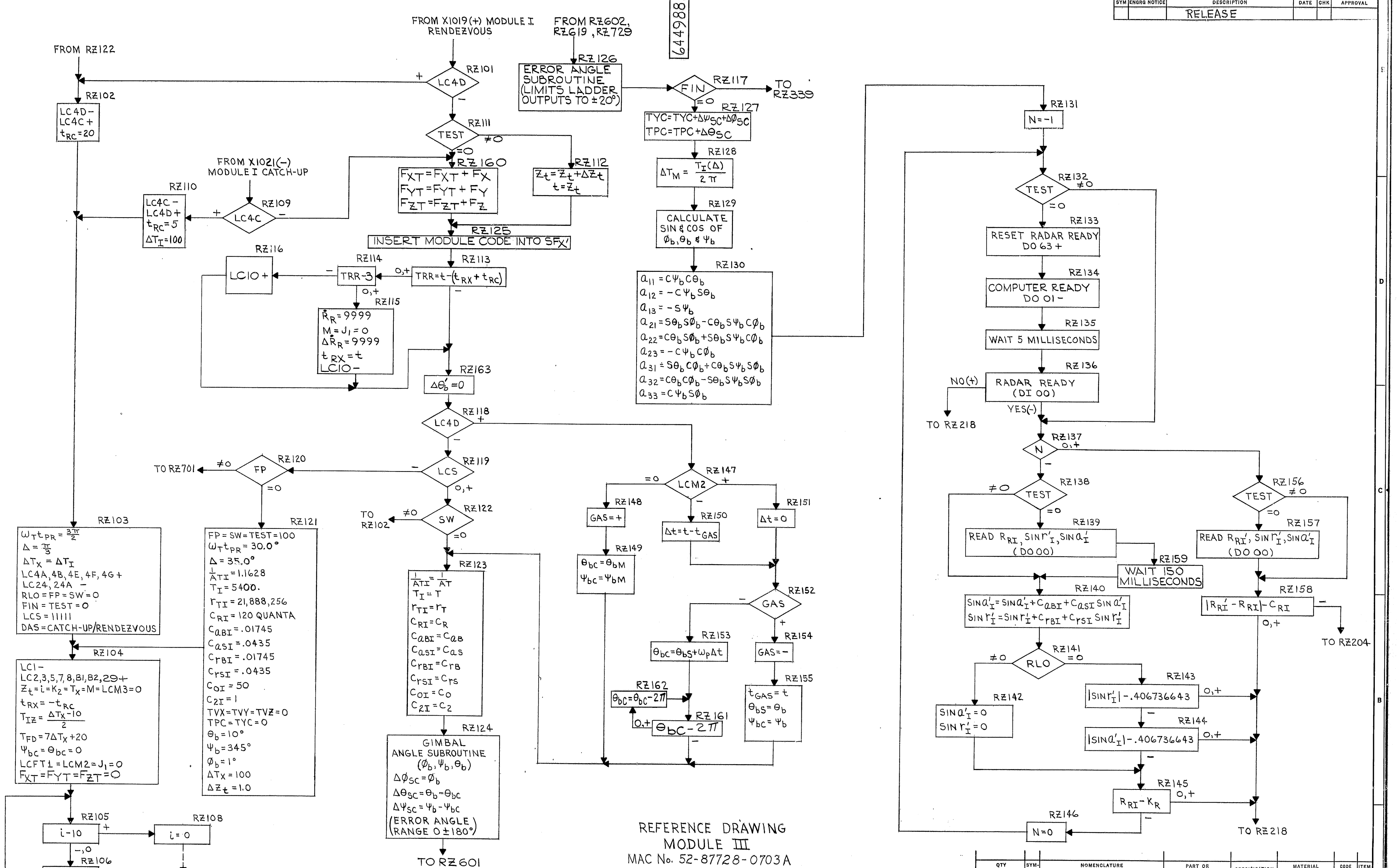
REVISIONS					
SYM	ENGRG NOTICE	DESCRIPTION	DATE	CHK	APPROVAL
		RELEASE			

6449883



REFERENCE DRAWING
MODULE III
MAC No. 52-87728-0703A

LIST OF MATERIAL OR PARTS LIST

QTY REQD	SYMBOL	NOMENCLATURE OR DESCRIPTION	PART OR IDENTIFYING NO.	SPECIFICATION	MATERIAL OR NOTES	CODE IDENT NO.	ITEM NO.

INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
590 MADISON AVE. NEW YORK 22, N.Y.

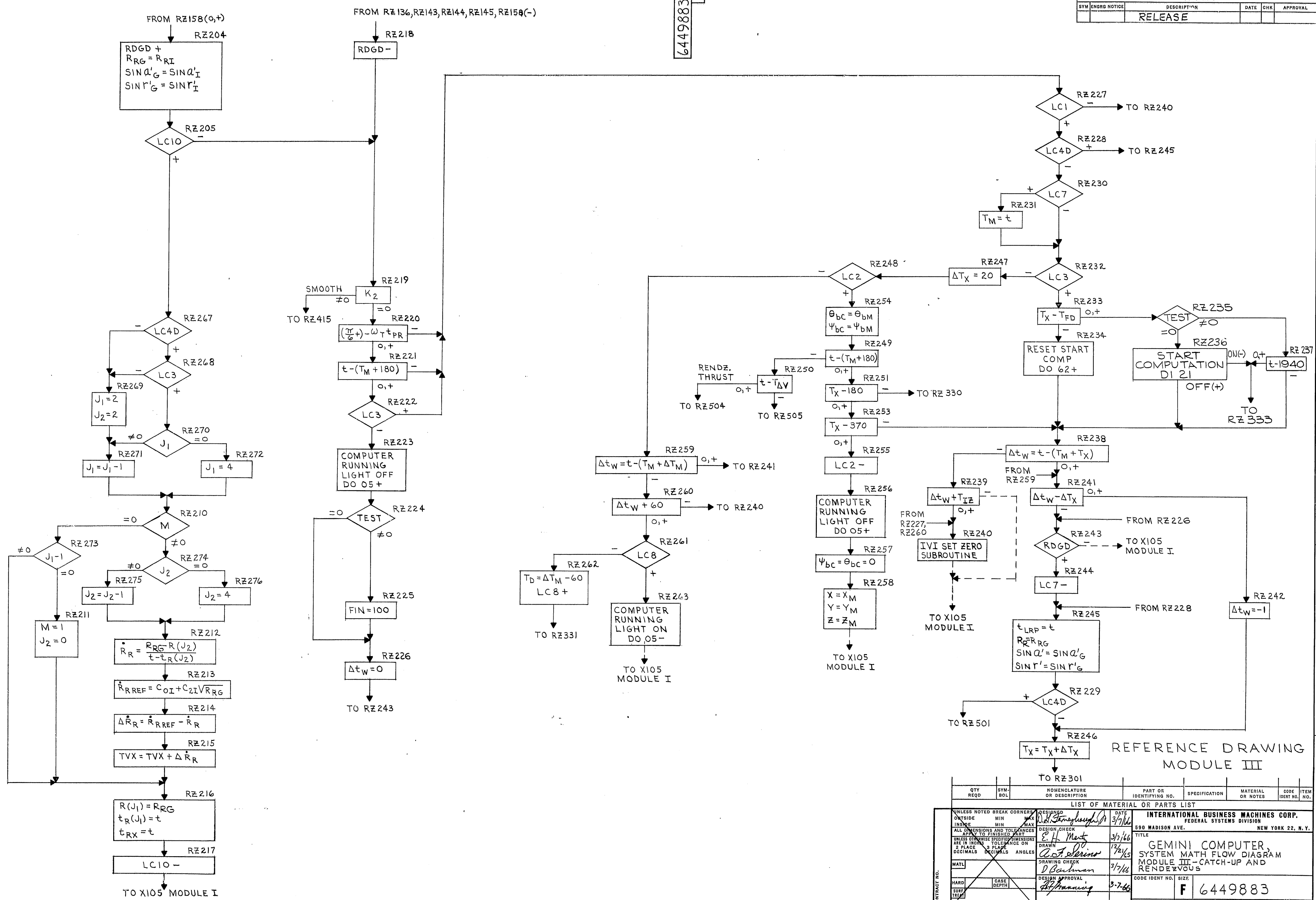
TITLE: GEMINI COMPUTER, SYSTEM MATH FLOW DIAGRAM MODULE III - CATCH-UP AND RENDEZVOUS

SIZE F — 6449883

SCALE NONE — SHEET 1 OF 12

6449883

SYM	ENGRG NOTICE	DESCRIPTION	DATE	CHK	APPROVAL
		RELEASE			



FROM RZ158(0,+)
RZ204
RDGD +
$R_{RG} = R_{RI}$
$SIN\,\alpha'_G = SIN\,\alpha'_I$
$SIN\,r'_G = SIN\,r'_I$
RZ205 LC10
RZ267 LC4D
RZ268 LC3
RZ269 $J_1 = 2$ $J_2 = 2$
RZ270 J_1
RZ271 $J_1 = J_1 - 1$
RZ272 $J_1 = 4$
RZ210 M
RZ273 $J_1 - 1$
RZ274 J_2
RZ275 $J_2 = J_2 - 1$
RZ276 $J_2 = 4$
RZ211 M = 1 $J_2 = 0$
RZ212 $\dot{R}_R = \frac{R_{RG} - R(J_2)}{t - t_R(J_2)}$
RZ213 $\dot{R}_{RREF} = C_{0I} + C_{2I}\sqrt{R_{RG}}$
RZ214 $\Delta\dot{R}_R = \dot{R}_{RREF} - \dot{R}_R$
RZ215 $TVX = TVX + \Delta\dot{R}_R$
RZ216 $R(J_1) = R_{RG}$ $t_R(J_1) = t$ $t_{RX} = t$
RZ217 LC10 −
TO X105 MODULE I
FROM RZ136, RZ143, RZ144, RZ145, RZ158(−)
RZ218 RDGD −
RZ219 K_2
SMOOTH ≠0
TO RZ415
RZ220 $(\frac{\pi}{6}+) - \omega_T t_{PR}$
RZ221 $t - (T_M + 180)$
RZ222 LC3
RZ223 COMPUTER RUNNING LIGHT OFF DO 05+
RZ224 TEST
RZ225 FIN = 100
RZ226 $\Delta t_W = 0$
TO RZ243
RZ227 LC1 TO RZ240
RZ228 LC4D TO RZ245
RZ230 LC7
RZ231 $T_M = t$
RZ232 LC3
RZ247 $\Delta T_X = 20$
RZ248 LC2
RZ254 $\theta_{bc} = \theta_{bM}$ $\psi_{bc} = \psi_{bM}$
RZ249 $t - (T_M + 180)$
RZ250 $t - T_{\Delta V}$
RENDZ. THRUST
TO RZ504
TO RZ505
RZ251 $T_X - 180$ TO RZ330
RZ253 $T_X - 370$
RZ255 LC2 −
RZ256 COMPUTER RUNNING LIGHT OFF DO 05+
RZ257 $\psi_{bc} = \theta_{bc} = 0$
RZ258 $X = X_M$ $Y = Y_M$ $Z = Z_M$
TO X105 MODULE I
RZ259 $\Delta t_W = t - (T_M + \Delta T_M)$ TO RZ241
RZ260 $\Delta t_W + 60$ TO RZ240
RZ261 LC8
RZ262 $T_D = \Delta T_M - 60$ LC8 +
TO RZ331
RZ263 COMPUTER RUNNING LIGHT ON DO 05−
TO X105 MODULE I
RZ233 $T_X - T_{FD}$
RZ234 RESET START COMP DO 62+
RZ235 TEST
RZ236 START COMPUTATION DI 21
ON(−) OFF(+)
RZ237 t − 1940
TO RZ333
RZ238 $\Delta t_W = t - (T_M + T_X)$
RZ239 $\Delta t_W + T_{IZ}$
FROM RZ259
FROM RZ227, RZ260
RZ240 IVI SET ZERO SUBROUTINE
TO X105 MODULE I
RZ241 $\Delta t_W - \Delta T_X$
FROM RZ226
RZ243 RDGD
TO X105 MODULE I
RZ244 LC7 −
FROM RZ228
RZ245 $t_{LRP} = t$ $R_R = R_{RG}$ $SIN\,\alpha' = SIN\,\alpha'_G$ $SIN\,r' = SIN\,r'_G$
RZ242 $\Delta t_W = -1$
RZ229 LC4D
TO RZ501
RZ246 $T_X = T_X + \Delta T_X$
TO RZ301

REFERENCE DRAWING
MODULE III

QTY REQD	SYMBOL	NOMENCLATURE OR DESCRIPTION	PART OR IDENTIFYING NO.	SPECIFICATION	MATERIAL OR NOTES	CODE IDENT NO.	ITEM NO.

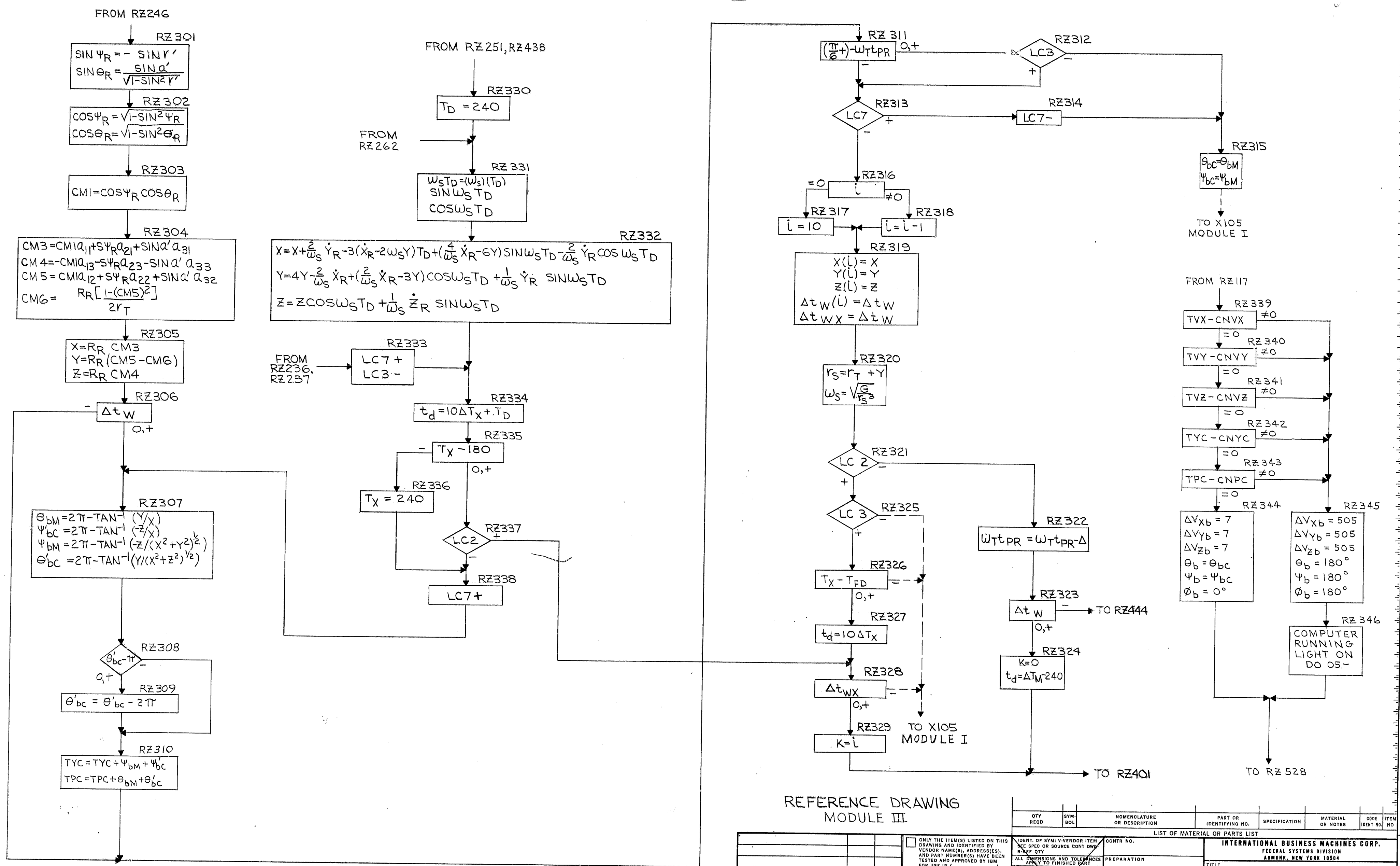
LIST OF MATERIAL OR PARTS LIST

INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
590 MADISON AVE. NEW YORK 22, N.Y.

TITLE: GEMINI COMPUTER, SYSTEM MATH FLOW DIAGRAM MODULE III - CATCH-UP AND RENDEZVOUS

DESIGNED: D. L. Stranglewayh(?) 3/7/66
DESIGN CHECK: E. H. Mertz(?) 3/7/66
DRAWN: A. F. Serino(?) 12/2/65
DRAWING CHECK: D. Bachman(?) 3/7/66
DESIGN APPROVAL: [signature] 3-7-66

SIZE F 6449883
SCALE NONE SHEET 2



FROM RZ246
RZ301
SIN ΨR = - SIN γ'
SIN ΘR = SIN α' / √(1-SIN² γ')
RZ302
COS ΨR = √(1-SIN² ΨR)
COS ΘR = √(1-SIN² ΘR)
RZ303
CM1=COS ΨR COS ΘR
RZ304
CM3=CM1a11+SΨRa21+SIN α' a31
CM4=-CM1a13-SΨRa23-SIN α' a33
CM5=CM1a12+SΨRa22+SIN α' a32
CM6= RR[1-(CM5)²] / 2rT
RZ305
X=RR CM3
Y=RR (CM5-CM6)
Z=RR CM4
RZ306
Δtw
0,+
RZ307
ΘbM=2π-TAN⁻¹ (Y/X)
Ψ'bc=2π-TAN⁻¹ (Z/X)
ΨbM=2π-TAN⁻¹ (-Z/(X²+Y²)^½)
Θ'bc=2π-TAN⁻¹ (Y/(X²+Z²)^½)
RZ308
Θ'bc-π
0,+
RZ309
Θ'bc = Θ'bc - 2π
RZ310
TYC=TYC+ΨbM+Ψ'bc
TPC=TPC+ΘbM+Θ'bc
FROM RZ251, RZ438
RZ330
TD = 240
FROM RZ262
RZ331
ωSTD=(ωS)(TD)
SIN ωSTD
COS ωSTD
RZ332
X=X+2/ωS ẎR-3(ẊR-2ωSY)TD+(4/ωS ẊR-6Y) SIN ωSTD - 2/ωS ẎR COS ωSTD
Y=4Y-2/ωS ẊR+(2/ωS ẊR-3Y) COS ωSTD + 1/ωS ẎR SIN ωSTD
Z=Z COS ωSTD + 1/ωS ŻR SIN ωSTD
FROM RZ236, RZ237
RZ333
LC7 +
LC3 -
RZ334
td=10ΔTX+TD
RZ335
TX-180
0,+
RZ336
TX = 240
RZ337
LC2
RZ338
LC7+
RZ311
(π/6+)-ωTtPR
0,+
RZ312
LC3
RZ313
LC7
RZ314
LC7-
RZ315
Θbc=ΘbM
Ψbc=ΨbM
TO X105
MODULE I
RZ316
i
=0
≠0
RZ317
i=10
RZ318
i=i-1
RZ319
X(i)=X
Y(i)=Y
Z(i)=Z
ΔtW(i)=ΔtW
ΔtWX=ΔtW
RZ320
rS=rT+Y
ωS=√(G/rS³)
RZ321
LC2
RZ325
LC3
RZ322
ωTtPR=ωTtPR-Δ
RZ326
TX-TFD
0,+
RZ327
td=10ΔTX
RZ328
ΔtWX
0,+
RZ329
K=i
TO X105
MODULE I
RZ323
ΔtW
0,+
TO RZ444
RZ324
K=0
td=ΔTM-240
TO RZ401
FROM RZ117
RZ339
TVX-CNVX
≠0
=0
RZ340
TVY-CNVY
≠0
=0
RZ341
TVZ-CNVZ
≠0
=0
RZ342
TYC-CNYC
≠0
=0
RZ343
TPC-CNPC
≠0
=0
RZ344
ΔVXb=7
ΔVYb=7
ΔVZb=7
Θb=Θbc
Ψb=Ψbc
Φb=0°
RZ345
ΔVXb=505
ΔVYb=505
ΔVZb=505
Θb=180°
Ψb=180°
Φb=180°
RZ346
COMPUTER RUNNING LIGHT ON DO 05-
TO RZ528

SOURCE OF SUPPLY

VENDOR	VENDOR ADDRESS	VENDOR CODE	VENDOR CAT. OR PN

DRAWING NO. 6449883

REVISIONS

CHK	ENGRG NOTICE	LTR	DESCRIPTION	DATE	APPROVED
			RELEASE		

REFERENCE DRAWING
MODULE III

LIST OF MATERIAL OR PARTS LIST

QTY REQD	SYMBOL	NOMENCLATURE OR DESCRIPTION	PART OR IDENTIFYING NO.	SPECIFICATION	MATERIAL OR NOTES	CODE IDENT NO	ITEM NO

SPECIFICATION NUMBER AND TYPE | NOTE | ITEM NO. APPLIES TO
APPLICABLE IBM SPECIFICATIONS

ONLY THE ITEM(S) LISTED ON THIS DRAWING AND IDENTIFIED BY VENDOR NAME(S), ADDRESS(ES), AND PART NUMBER(S) HAVE BEEN TESTED AND APPROVED BY IBM FOR USE IN ( ). A SUBSTITUTE ITEM SHALL NOT BE USED WITHOUT PRIOR TESTING AND APPROVAL BY IBM

COMMERCIAL PRODUCT MUST BE EQUAL TO AND COMPLETELY INTERCHANGEABLE WITH (SEE SOURCE OF SUPPLY)

CHECK BLOCK ☒ IF APPLICABLE

DSGN CHK: E. H. Mertz 3/1/66
DRAWING CHECK: D. Bachman 3/7/66
DESIGN APPROVAL: H. J. Drawing 3-7-66

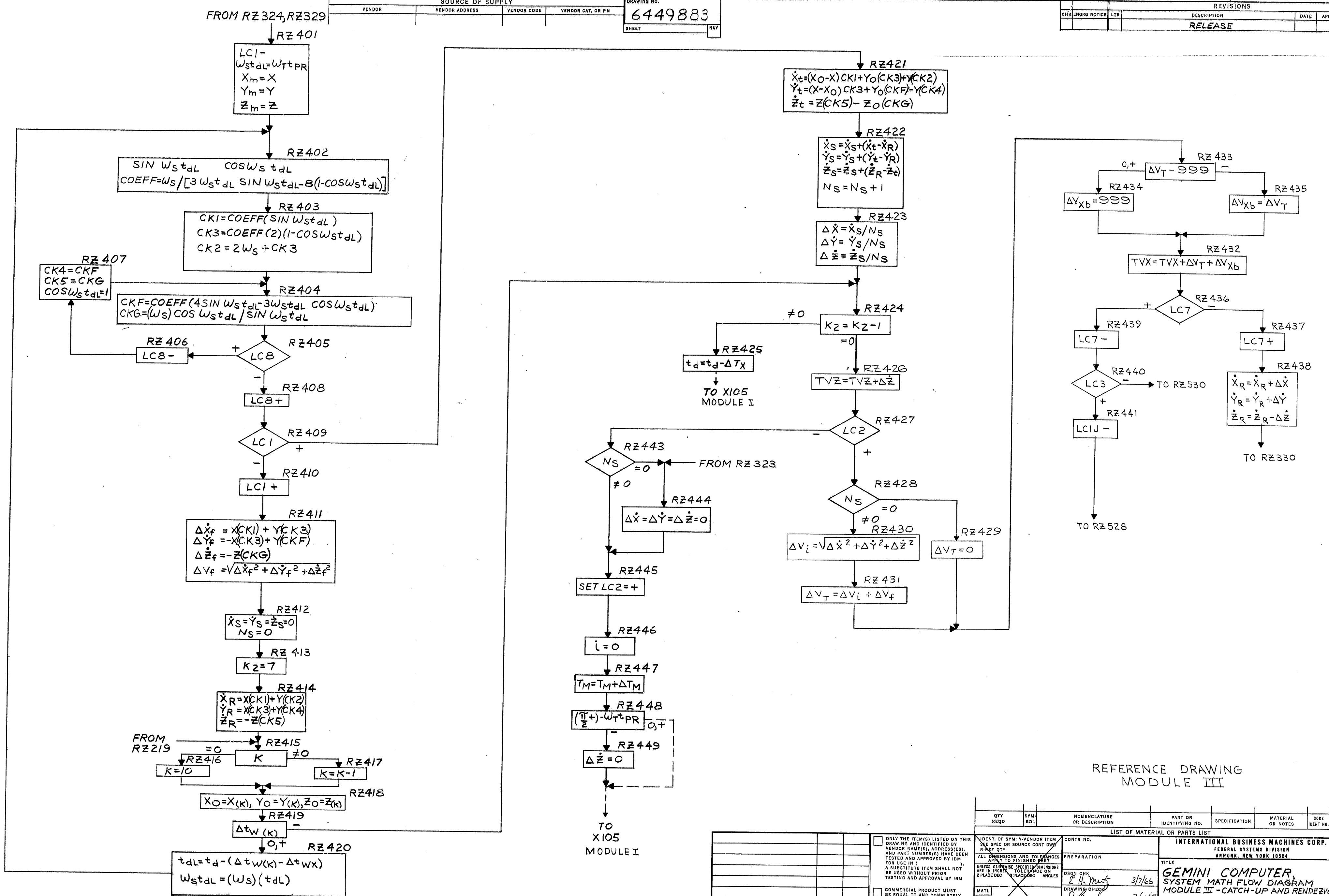
INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
ARMONK, NEW YORK 10504

TITLE
GEMINI COMPUTER,
SYSTEM MATH FLOW DIAGRAM
MODULE III - CATCH-UP AND RENDEZVOUS

SIZE F | CODE IDENT NO. 03640 | DRAWING NO. 6449883
SCALE NONE | SHEET 3

DRAWING NO. 6449883

REVISIONS: RELEASE



FROM RZ324, RZ329
RZ401
LC1 -
$\omega_{st_{dL}} = \omega_T t_{PR}$
$X_m = X$
$Y_m = Y$
$Z_m = Z$
RZ402
$SIN\ \omega_s t_{dL}$ $COS\ \omega_s t_{dL}$
$COEFF = \omega_s / [3\omega_s t_{dL}\ SIN\ \omega_s t_{dL} - 8(1 - COS\ \omega_s t_{dL})]$
RZ403
$CK1 = COEFF(SIN\ \omega_s t_{dL})$
$CK3 = COEFF(2)(1 - COS\ \omega_s t_{dL})$
$CK2 = 2\omega_s + CK3$
RZ407
$CK4 = CKF$
$CK5 = CKG$
$COS\ \omega_s t_{dL} = 1$
RZ404
$CKF = COEFF(4SIN\ \omega_s t_{dL} - 3\omega_s t_{dL}\ COS\ \omega_s t_{dL})$
$CKG = (\omega_s) COS\ \omega_s t_{dL} / SIN\ \omega_s t_{dL}$
RZ406
LC8 -
RZ405
LC8
RZ408
LC8 +
RZ409
LC1
RZ410
LC1 +
RZ411
$\Delta \dot{X}_f = X(CK1) + Y(CK3)$
$\Delta \dot{Y}_f = -X(CK3) + Y(CKF)$
$\Delta \dot{Z}_f = -Z(CKG)$
$\Delta V_f = \sqrt{\Delta \dot{X}_f^2 + \Delta \dot{Y}_f^2 + \Delta \dot{Z}_f^2}$
RZ412
$\dot{X}_S = \dot{Y}_S = \dot{Z}_S = 0$
$N_S = 0$
RZ413
$K_2 = 7$
RZ414
$\dot{X}_R = X(CK1) + Y(CK2)$
$\dot{Y}_R = X(CK3) + Y(CK4)$
$\dot{Z}_R = -Z(CK5)$
FROM RZ219
RZ415
K
=0
≠0
RZ416
K=10
RZ417
K=K-1
RZ418
$X_O = X_{(K)}, Y_O = Y_{(K)}, Z_O = Z_{(K)}$
RZ419
$\Delta t_{W(K)}$
0,+
-
RZ420
$t_{dL} = t_d - (\Delta t_{W(K)} - \Delta t_{WX})$
$\omega_{st_{dL}} = (\omega_s)(t_{dL})$
RZ421
$\dot{X}_t = (X_O - X)CK1 + Y_O(CK3) + Y(CK2)$
$\dot{Y}_t = (X - X_O)CK3 + Y_O(CKF) - Y(CK4)$
$\dot{Z}_t = Z(CK5) - Z_O(CKG)$
RZ422
$\dot{X}_S = \dot{X}_S + (\dot{X}_t - \dot{X}_R)$
$\dot{Y}_S = \dot{Y}_S + (\dot{Y}_t - \dot{Y}_R)$
$\dot{Z}_S = \dot{Z}_S + (\dot{Z}_R - \dot{Z}_t)$
$N_S = N_S + 1$
RZ423
$\Delta \dot{X} = \dot{X}_S / N_S$
$\Delta \dot{Y} = \dot{Y}_S / N_S$
$\Delta \dot{Z} = \dot{Z}_S / N_S$
RZ424
$K_2 = K_2 - 1$
≠0
=0
RZ425
$t_d = t_d - \Delta T_X$
TO X105
MODULE I
RZ426
$TVZ = TVZ + \Delta \dot{Z}$
RZ427
LC2
RZ443
N_S
=0
≠0
FROM RZ323
RZ444
$\Delta \dot{X} = \Delta \dot{Y} = \Delta \dot{Z} = 0$
RZ445
SET LC2 = +
RZ446
i = 0
RZ447
$T_M = T_M + \Delta T_M$
RZ448
$(\frac{\pi}{2} +) - \omega_T t_{PR}$
0,+
RZ449
$\Delta \dot{Z} = 0$
TO
X105
MODULE I
RZ428
N_S
=0
≠0
RZ430
$\Delta V_i = \sqrt{\Delta \dot{X}^2 + \Delta \dot{Y}^2 + \Delta \dot{Z}^2}$
RZ429
$\Delta V_T = 0$
RZ431
$\Delta V_T = \Delta V_i + \Delta V_f$
RZ433
0,+
$\Delta V_T - 999$
RZ434
$\Delta V_{Xb} = 999$
RZ435
$\Delta V_{Xb} = \Delta V_T$
RZ432
$TVX = TVX + \Delta V_T + \Delta V_{Xb}$
RZ436
LC7
RZ439
LC7 -
RZ437
LC7 +
RZ440
LC3
TO RZ530
RZ441
LC1J -
TO RZ528
RZ438
$\dot{X}_R = \dot{X}_R + \Delta \dot{X}$
$\dot{Y}_R = \dot{Y}_R + \Delta \dot{Y}$
$\dot{Z}_R = \dot{Z}_R - \Delta \dot{Z}$
TO RZ330

REFERENCE DRAWING
MODULE III

LIST OF MATERIAL OR PARTS LIST

INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
OWEGO, NEW YORK 13827

TITLE: GEMINI COMPUTER
SYSTEM MATH FLOW DIAGRAM
MODULE III - CATCH-UP AND RENDEZVOUS

DSGN CHK: E. H. Mertz 3/7/66
DRAWING CHECK: D. Bachman 3/1/66

SIZE F | CODE IDENT NO. 03640 | DRAWING NO. 6449883

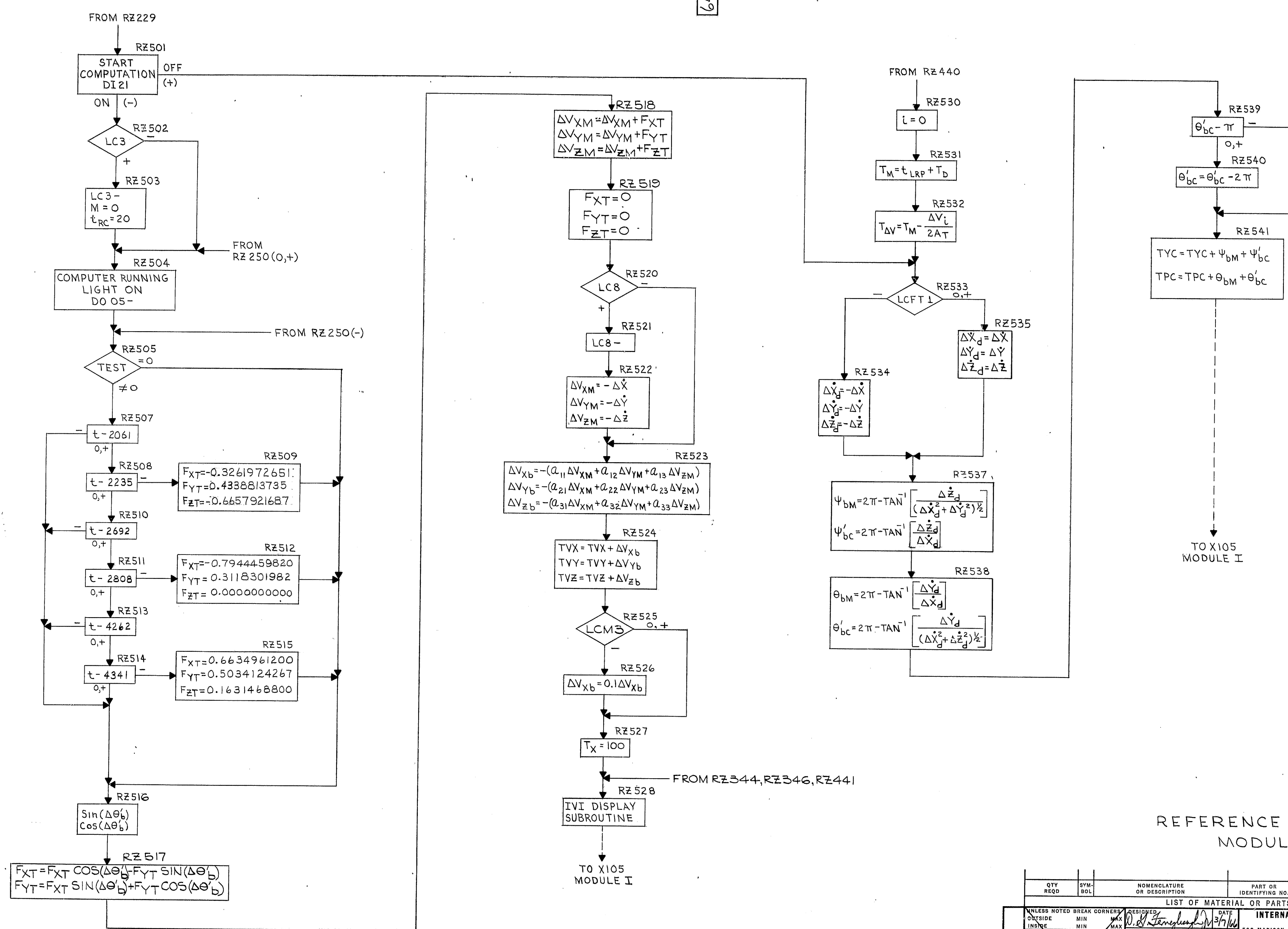
SCALE NONE | SHEET 4

APPLICABLE IBM SPECIFICATIONS

CHECK BLOCK ☒ IF APPLICABLE

6449883

SYM	ENGRG NOTICE	DESCRIPTION	DATE	CHK	APPROVAL
		RELEASE			



REFERENCE DRAWING
MODULE III

QTY REQD	SYMBOL	NOMENCLATURE OR DESCRIPTION	PART OR IDENTIFYING NO.	SPECIFICATION	MATERIAL OR NOTES	CODE IDENT NO.	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS NOTED BREAK CORNERS OUTSIDE MIN MAX INSIDE MIN MAX
ALL DIMENSIONS AND TOLERANCES APPLY TO FINISHED PART
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON 2 PLACE DECIMALS 3 PLACE DECIMALS ANGLES
MATL
HARD CASE DEPTH
SURF TREAT
CONTRACT NO.

		DATE
DESIGNED	D. G. Feneghough	3/7/66
DESIGN CHECK	E. H. Mertz	3/7/66
DRAWN	A. F. Serino	12/21/65
DRAWING CHECK	D Bachman	3/7/66
DESIGN APPROVAL	H. J. Manning	3-7-66

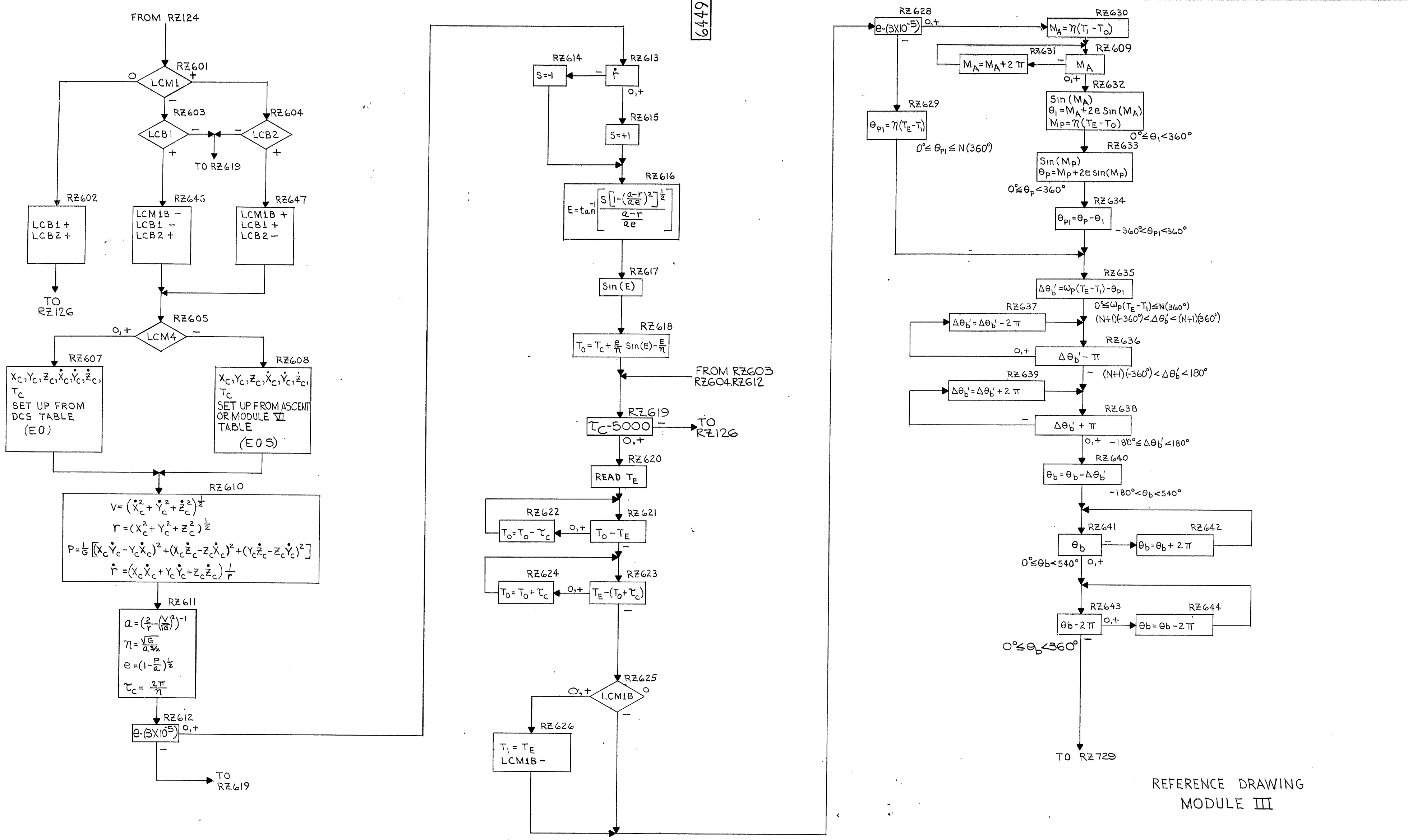
INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
590 MADISON AVE. NEW YORK 22, N.Y.

TITLE
GEMINI COMPUTER, SYSTEM MATH FLOW DIAGRAM MODULE III - CATCH-UP AND RENDEZVOUS

CODE IDENT NO. | SIZE F | 6449883
SCALE NONE | WT | SHEET 5

6449883

SYM	ENGRG NOTICE	DESCRIPTION	DATE	CHK	APPROVAL
		RELEASE			



REFERENCE DRAWING
MODULE III

QTY REQD	SYMBOL	NOMENCLATURE OR DESCRIPTION	PART OR IDENTIFYING NO.	SPECIFICATION	MATERIAL OR NOTES	CODE IDENT NO.	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
590 MADISON AVE. NEW YORK 22, N.Y.

UNLESS NOTED BREAK CORNERS: OUTSIDE MIN MAX, INSIDE MIN MAX. ALL DIMENSIONS AND TOLERANCES APPLY TO FINISHED PART. UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCE ON 2 PLACE DECIMALS, 3 PLACE DECIMALS, ANGLES.

DESIGNED: D. H. Fanenbaum 3/7/66
DESIGN CHECK: E. H. Mertz 3/7/66
DRAWN: A. Lederer 12/31/65
DRAWING CHECK: D Bachman 3/7/66
DESIGN APPROVAL: 3-7-66

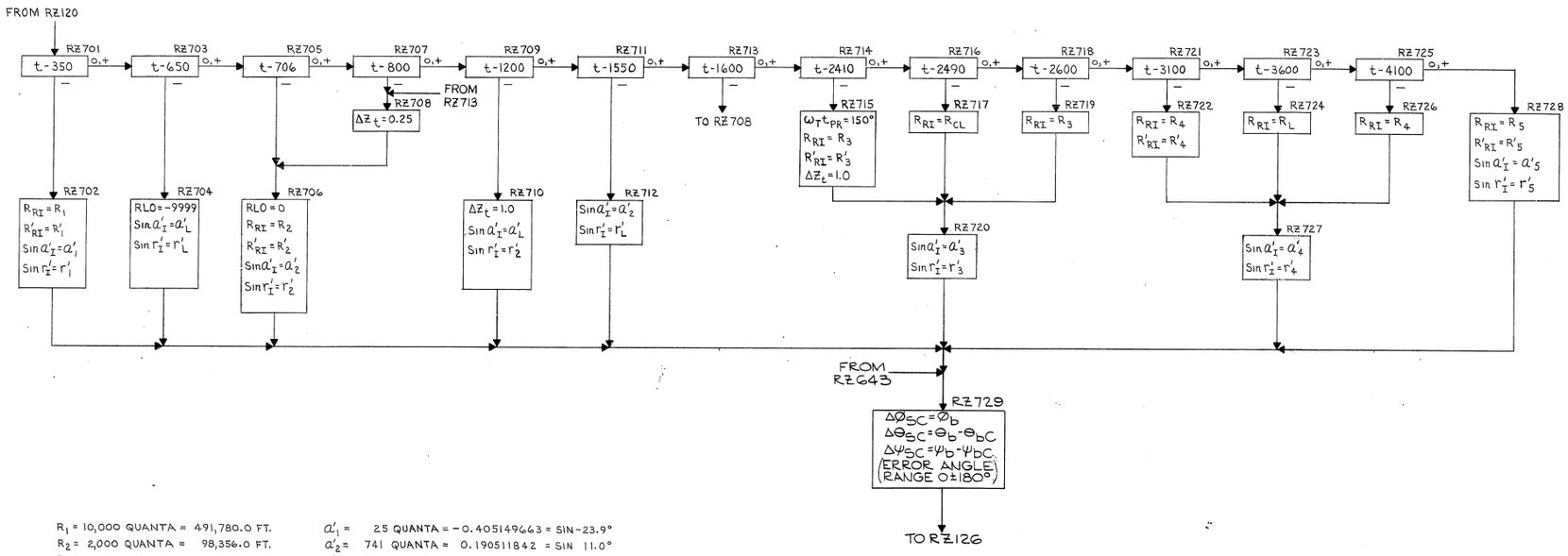
TITLE: GEMINI COMPUTER, SYSTEM MATH FLOW DIAGRAM MODULE III - CATCH-UP AND RENDEZVOUS

CODE IDENT NO. SIZE F 6449883

SCALE NONE WT SHEET 6

6449883

REVISIONS					
SYM	ENGRG NOTICE	DESCRIPTION	DATE	CHK	APPROVAL
		RELEASE			



R_1 = 10,000 QUANTA = 491,780.0 FT.
R_2 = 2,000 QUANTA = 98,356.0 FT.
R_3 = 1,500 QUANTA = 73,767.0 FT.
R_4 = 1,000 QUANTA = 49,178.0 FT.
R_5 = 500 QUANTA = 24,589.0 FT.
R_{CL} = 1,550 QUANTA = 76,225.9 FT.
R_L = 30,750 QUANTA = 1,512,223.5 FT.
R'_1 = 10,100 QUANTA = 496,697.8 FT.
R'_2 = 2,100 QUANTA = 103,273.8 FT.
R'_3 = 1,400 QUANTA = 68,849.2 FT.
R'_4 = 1,050 QUANTA = 51,631.9 FT.
R'_5 = 400 QUANTA = 19,671.2 FT.

α'_1 = 25 QUANTA = −0.405149663 = SIN −23.9°
α'_2 = 741 QUANTA = 0.190511842 = SIN 11.0°
α'_3 = 700 QUANTA = 0.156402735 = SIN 9.0°
α'_4 = 658 QUANTA = 0.121461706 = SIN 7.0°
α'_5 = 617 QUANTA = 0.087352597 = SIN 5.0°
α'_L = 1010 QUANTA = 0.414300861 = SIN 24.5°
r'_1 = 68 QUANTA = −0.369376695 = SIN −21.7°
r'_2 = 843 QUANTA = 0.275368645 = SIN 16.0°
r'_3 = 803 QUANTA = 0.242091467 = SIN 14.0°
r'_4 = 762 QUANTA = 0.207982373 = SIN 12.0°
r'_5 = 721 QUANTA = 0.173873244 = SIN 10.0°
r'_L = 14 QUANTA = −0.414300861 = SIN −24.5°

REFERENCE DRAWING
MODULE III

QTY REQD	SYM BOL	NOMENCLATURE OR DESCRIPTION	PART OR IDENTIFYING NO.	SPECIFICATION	MATERIAL OR NOTES	CODE IDENT NO.	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS NOTED BREAK CORNERS OUTSIDE MIN INSIDE MIN
ALL DIMENSIONS AND TOLERANCES APPLY TO FINISHED PART
UNLESS OTHERWISE SPECIFIED DIMENSIONS AT RIGHT ANGLES TO PLANE OF DECIMALS DECIMALS ANGLES
MATL
HARD CASE DEPTH
SURF TREAT
CONTRACT NOS.

DESIGNED	D. J. Tamplin Jr.	2-11-66
DESIGN CHECK	E. H. Mertz	3/1/66
DRAWN	R. L. Serino	12/21/65
DRAWING CHECK	D Bachman	3/1/66
DESIGN APPROVAL	A. F. Manning	3-7-66

INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
590 MADISON AVE. NEW YORK 22, N.Y.

TITLE
GEMINI COMPUTER,
SYSTEM MATH FLOW DIAGRAM
MODULE III - CATCH-UP AND
RENDEZVOUS

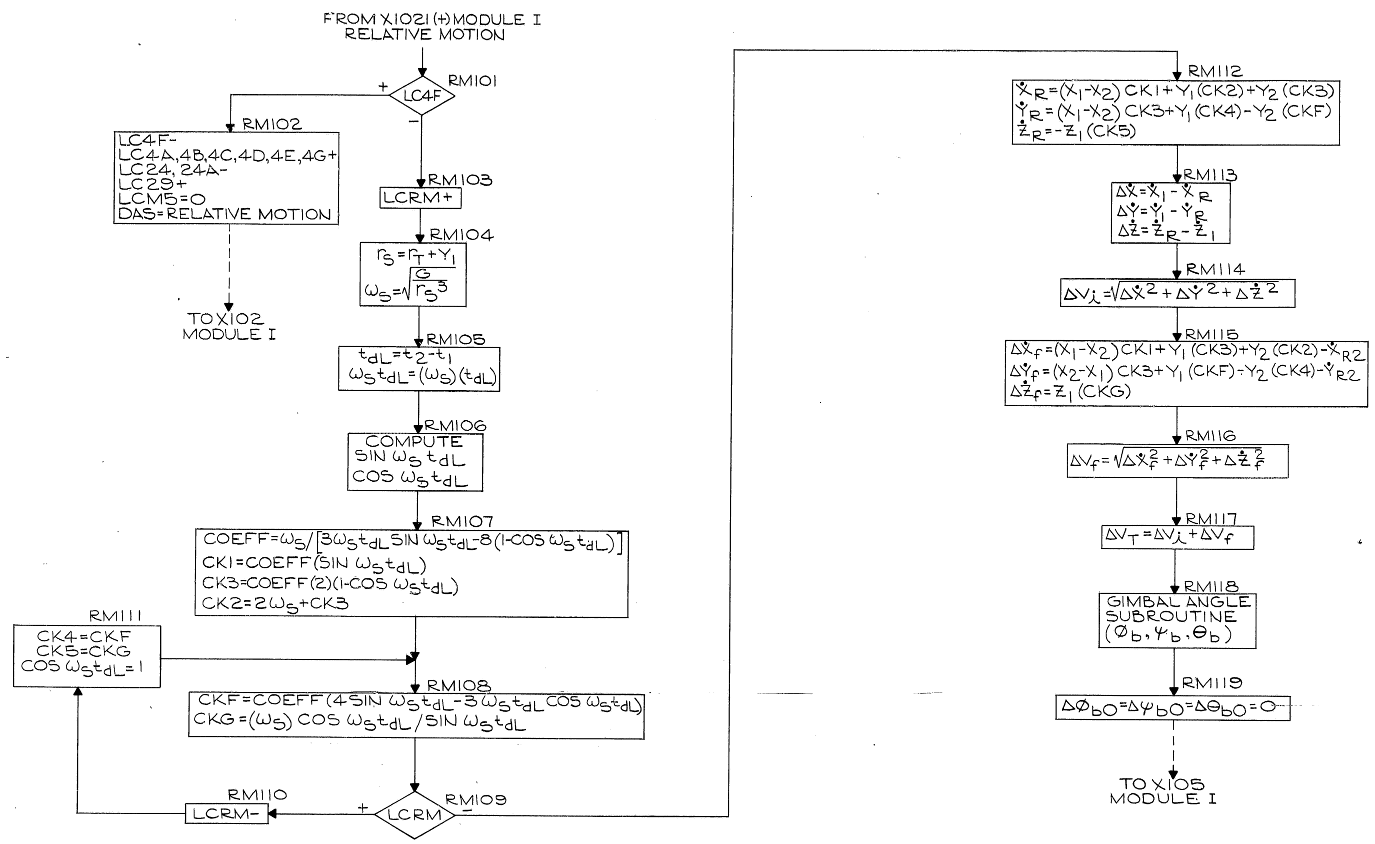
CODE IDENT NO. F SIZE 6449883
SCALE NONE WT SHEET 7

DRAWING NO. 6449883

SOURCE OF SUPPLY

VENDOR	VENDOR ADDRESS	VENDOR CODE	VENDOR CAT. OR P/N

CHK	ENGRG NOTICE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED
			RELEASE		



REFERENCE DRAWING
MODULE III

QTY REQD	SYMBOL	NOMENCLATURE OR DESCRIPTION	PART OR IDENTIFYING NO.	SPECIFICATION	MATERIAL OR NOTES	CODE IDENT NO.	ITEM NO

LIST OF MATERIAL OR PARTS LIST

SPECIFICATION NUMBER AND TYPE | NOTE | ITEM NO. | APPLIES TO

APPLICABLE IBM SPECIFICATIONS

ONLY THE ITEM(S) LISTED ON THIS DRAWING AND IDENTIFIED BY VENDOR NAME(S), ADDRESS(ES), AND PART NUMBER(S) HAVE BEEN TESTED AND APPROVED BY IBM FOR USE IN ( ). A SUBSTITUTE ITEM SHALL NOT BE USED WITHOUT PRIOR TESTING AND APPROVAL BY IBM

COMMERCIAL PRODUCT MUST BE EQUAL TO AND COMPLETELY INTERCHANGEABLE WITH (SEE SOURCE OF SUPPLY)

CHECK BLOCK ☒ IF APPLICABLE

IDENT. OF SYM: V-VENDOR ITEM SEE SPEC OR SOURCE CONT DWG R-REF QTY

ALL DIMENSIONS AND TOLERANCES APPLY TO FINISHED PART

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON 2 PLACE DEC 3 PLACE DEC ANGLES

MATL | HARD | CASE DEPTH | SURF TREAT

CONTR NO.

PREPARATION LIG 2/2/66

DSGN CHK E. H. Mertz 3/7/66

DRAWING CHECK D Bachman 3/7/66

DESIGN APPROVAL H. F. Branning 3-7-66

INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
ARMONK, NEW YORK 10504

TITLE
GEMINI COMPUTER
SYSTEM MATH FLOW DIAGRAM
MODULE III RELATIVE MOTION

SIZE F | CODE IDENT NO. 03640 | DRAWING NO. 6449883

SCALE NONE | WT | SHEET 8

REFERENCED NOTES ARE FOUND ON SHEET 10

ADDRESS (NOTE 1)	PARAMETER NAME	SYMBOL	MODE (NOTE 2)	PARAMETER RANGE (NOTE 3)	COMPUTER SCALING (NOTE 4)	DCS RESOLUTION (NOTE 5)	MDIU (NOTE 6) INSERT	MDIU (NOTE 6) DISPLAY	FORMAT	COMMENTS
00	CLEAR		ALL			NO DCS	YES	NO	00000	PROCEDURAL ERROR GENERATES "00000"
01	EQUIPMENT RESET TIME	T_X	ALL	0 TO +900 MIN	22(SEC)	NO DCS	YES	NO	MIN SEC XXX XX	SEE NOTE 13
02	TIME TO GO TO RETROFIRE	T_R	R/E	0 TO +270 MIN	22(SEC)	NO DCS	YES	YES	MIN SEC XXX XX	SEE NOTE 10 AND 13
03, 04, 05	RE-ENTRY INITIAL POSITION COMPONENTS (POSITIVE)	X_{ER+}, Y_{ER+}, Z_{ER+}	R/E	0 TO +24 X 10^6FT	25(FT)	256 FT	YES	YES	XXXXX 100 YDS	SEE NOTES 11 AND 12
06, 07, 08	RE-ENTRY INITIAL VELOCITY COMPONENTS (POSITIVE)	$\dot{X}_{ER+}$, $\dot{Y}_{ER+}$, $\dot{Z}_{ER+}$	R/E	0 TO +26,000 FT/SEC	15(FT/SEC)	0.25 FT/SEC	YES	YES	XXXX.X YD/SEC	SEE NOTES 11 AND 12
09	INITIAL EARTH LONGITUDE OF X_E AXIS	$\Delta\theta_R$	R/E	0 TO +360 DEG	3 (RAD)	2^{-14} RAD	YES	YES	XXX.XX DEG	
10	TARGET LATITUDE	ϕ_{TR}	A,R/E	0 ± 90 DEG	3 (RAD)	2^{-14} RAD	YES	YES	±XX.XX DEG	
11	TARGET LONGITUDE	θ_{TR}	A,R/E	0 TO + 360 DEG	3 (RAD)	2^{-14} RAD	YES	YES	XXX.XX DEG	
12	INITIAL TIME	T_F	T,N,P,D	-90 TO + 270 MIN	14(SEC)	2^{-3} SEC	YES	YES	MIN SEC XXX XX	SEE NOTE 19
13, 14, 15	STATE VECTOR POSITION COMPONENTS (POSITIVE)	$(X_1^+, X_2^+)\ X_{EO+}$, $(Y_1^+, Y_2^+)\ Y_{EO+}$, $(Z_1^+)\ Z_{EO+}$	(RM)T,N,P,D	0 TO +24 X 10^6FT	25(FT)	256 FT	YES	YES	XXXXX 100 YDS (XXXX.XNM)	SEE NOTES 11 AND 19
16, 17, 18	STATE VECTOR VELOCITY COMPONENTS (POSITIVE)	$(\dot{X}_1^+, \dot{X}_{R2}^+)\ \dot{X}_{EO+}$, $(\dot{Y}_1^+, \dot{Y}_{R2}^+)\ \dot{Y}_{EO+}$, $(\dot{Z}_1^+)\ \dot{Z}_{EO+}$	(RM)T,N,P,D	0 TO +26,000 FT/SEC	15 (FT/SEC)	0.25 FT/SEC	YES	YES	XXXX.X YD/SEC (XXXX.X FT/SEC)	SEE NOTES 11 AND 19
19	INITIAL EARTH LONGITUDE OF X_E AXIS	$\Delta\theta_0$	T	0 TO +360 DEG	3 (RAD)	2^{-14} RAD	YES	YES	XXX.XX DEG	
20	RADAR SAMPLE INTERVAL	ΔT_I	C,RZ	50 TO 120 SEC	17(SEC)	NO DCS	YES	YES	MIN SEC XXX XX	
21						NO DCS	NO	NO		
22	DESIRED INSERTION VELOCITY	V_f^*	A	1±0.1 CANONICAL UNITS	1(CAN UNITS)	2^{-16}CAN UNITS	NO	YES	X.XXXX CAN UNITS	
23	SPARE						NO	NO		
24	RECIPROCAL OF AFT THRUSTER ACCELERATION	$1/A_T$	RZ	+0.3333 TO+1.25 $\frac{SEC^2}{FT}$	1(SEC^2/FT)	$2^{-16}SEC^2$/FT	YES	YES	X.XXXX SEC^2/FT	
25, 26, 27	DESIRED VELOCITY CHANGES (GUIDANCE AXES)	$\Delta\dot{X}$, $\Delta\dot{Y}$, $\Delta\dot{Z}$	A,RM,C,RZ, N,P	0 ± 300 FT/SEC	13(FT/SEC)	2^{-4} FT/SEC	YES	YES	±XXX.X FT/SEC	CAN BE INSERTED VIA DCS EXCEPT WHEN COMPUTER IS IN RENDEZVOUS MODE
28	UPDATED VELOCITY(GUIDANCE X AXIS)	V_{XG}	A	0 TO +26,000 FT/SEC	15 (FT/SEC)	0.25 FT/SEC	NO	NO		
29	UPDATED VELOCITY(GUIDANCE Y AXIS)	V_{YG}	A	0 ± 4,000 FT/SEC	15 (FT/SEC)	0.25 FT/SEC	NO	NO		
30	UPDATED VELOCITY(GUIDANCE Z AXIS)	V_{ZG}	A	0 ± 2,000 FT/SEC	15 (FT/SEC)	0.25 FT/SEC	NO	NO		
31	UPDATE COMMAND	LC21	A,PRELAUNCH	+ OR −		SEE COMMENT	NO	NO		CHANGED TO MINUS FOR EACH UPDATE
32	AZIMUTH OF ORBIT PLANE	γ	A	0 ± 20 DEG	3 (RAD)	2^{-14} RAD	NO	YES	±XX.XX DEG	
33	SINE OF ANGLE: Y-AXIS AND NORMAL TO ORBIT PLANE AT LIFT-OFF	SINδ	A	0 ± 0.01745	-4	2^{-21}	NO	YES	±.XXXX	
34	DESIRED ROLL MANEUVER	$\Delta\phi_R$	A	0 ± 20 DEG	3 (RAD)	2^{-14} RAD	NO	YES	±XX.XX DEG	
35	RANGE RATE	$\dot{R}_R$	C,RZ	0 ± 1000 FT/SEC	14 (FT/SEC)	NO DCS	NO	YES	±XXXX FT/SEC	SEE NOTE 8
36	INSTANTANEOUS RADAR RANGE	R_{RG}	C,RZ	0 TO 250 N. MILE	21 (FT)	NO DCS	NO	YES	XXX.XX N. MILE	
37	DESIRED RANGE RATE BIAS	C_0	C,RZ	0 TO 100 FT/SEC	9 (FT/SEC)	2^{-8} FT/SEC	YES	YES	XXX.XX FT/SEC	USED IN MODULE III ONLY
38	DESIRED RANGE RATE FACTOR	C_2	C,RZ	0 TO 2 $FT^{1/2}$/SEC	4 ($FT^{1/2}$/SEC)	$2^{-13}FT^{1/2}$/SEC	YES	YES	X.XXXX $FT^{1/2}$/SEC	USED IN MODULE III ONLY
39	EARTH LONGITUDE OF X_E AXIS AT LIFT-OFF	$\Delta\theta_{DCS}$	A,N,P,D	0 TO +360 DEG	3 (RAD)	2^{-14} RAD	YES	YES	XXX.XX DEG	
40	RETRO PITCH ANGLE	θ_{ABT}	A	0 ± 40 DEG	3 (RAD)	2^{-14} RAD	YES	YES	±XX.XX DEG	
41	SPACECRAFT SURFACE/MASS RATIO	$(S/M)_S$	N,P,D	0 TO + 0.5 FT^2/SLUG	2(FT^2/SLUG)	2^{-15} FT^2/SLUG	YES	YES	X.XXXX FT^2/SLUG	
42	TARGET SURFACE/MASS RATIO	$(S/M)_T$	P	0 TO +2.0 FT^2/SLUG	2(FT^2/SLUG)	2^{-15} FT^2/SLUG	YES	YES	X.XXXX FT^2/SLUG	
43	SPARE						NO	NO		
44	SPARE						NO	NO		
45	SPARE						NO	NO		
46	RANGE RATE ERROR	$\Delta\dot{R}_R$	C,RZ	0 ± 500 FT/SEC	14 (FT/SEC)	NO DCS	NO	YES	±XXXX FT/SEC	SEE NOTE 8
47, 48, 49	ACCELEROMETER BIAS	K_{X4}, K_{Y4}, K_{Z4}	ALL	0 ± 3.6 PULSE/SEC	2(PULSE/SEC)	2^{-15}PULSE/SEC	NO	YES	±X.XXX PULSE/SEC	
50	SPARE						NO	NO		
51	RE-ENTRY ACCELERATION THRESHOLD	K	A,R/E	1 TO 15 FT/SEC^2	9 (FT/SEC^2)	2^{-8} FT/SEC^2	NO	YES	XXX.XX FT/SEC^2	
52						NO DCS	NO	NO		
53	ORBITAL PERIOD (AGENA)	T	RZ	5200 TO 7021 SEC	13 (SEC)	2^{-4} SEC	YES	YES	XXXX.X SEC	
54	ORBITAL RADIUS (AGENA)	r_T	RM,RZ	21.3X10^6 TO 26.0X10^6FT	25 (FT)	256 FT	YES	YES	XXXXX 100 YDS	
55	FWD/AFT THRUSTER SELECT	LCFTI	A,C,RZ,N	SEE NOTE 15		NO DCS	YES	YES	XXXXX	
56	COMMANDED YAW ANGLE	ψ_{bc}'	A,C,RZ	0 TO +360 DEG	3 (RAD)	NO DCS	NO	YES	+XXX.X DEG	
57	COMMANDED PITCH ANGLE	θ_{bc}'	A,C,RZ	0 ±90 DEG	3 (RAD)	NO DCS	NO	YES	±XXX.X DEG	
58	YAW ERROR	$\Delta\psi_{SC}$	A,C,RZ,N	0 ± 180 DEG	3 (RAD)	NO DCS	NO	YES	±XXX.X DEG	
59	PITCH ERROR	$\Delta\theta_{SC}$	A,C,RZ,N	0 ± 180 DEG	3 (RAD)	NO DCS	NO	YES	±XXX.X DEG	
60	HIGH-ORDER DCS DATA		ALL			SEE NOTE 18	NO	NO		
61	EXTENDED DCS ADDR.S & LOW ORDER DCS DATA		ALL			SEE NOTE 18	NO	NO		
62	ATM READ COMMAND		ALL			NO DCS	YES	NO	SEE NOTE 17	
63, 64, 65	RE-ENTRY INITIAL POSITION COMPONENTS(NEGATIVE)	X_{ER-}, Y_{ER-}, Z_{ER-}	R/E	0 TO -24 X 10^6FT	25 (FT)		YES	YES	XXXXX 100 YDS	SEE NOTES 11 AND 12
66, 67, 68	RE-ENTRY INITIAL VELOCITY COMPONENTS (NEGATIVE)	$\dot{X}_{ER-}$, $\dot{Y}_{ER-}$, $\dot{Z}_{ER-}$	R/E	0 TO -26,000 FT/SEC	15(FT/SEC)		YES	YES	XXXX.X YD/SEC	SEE NOTES 11 AND 12
69	RADAR RANGE	R_R	C,RZ	0 TO +250 N.MILE	21 (FT)		NO	YES	XXX.XX N.MILE	
70	TOTAL VELOCITY CHANGE	ΔV_T	RM,RZ	0 TO +8000 FT/SEC	15 (FT/SEC)		NO	YES	XXXX.X FT/SEC	
71	INITIAL VELOCITY CHANGE	ΔV_i	RM,RZ	0 TO +500 FT/SEC	15 (FT/SEC)		NO	YES	XXXX.X FT/SEC	
72	TOTAL INERTIAL VELOCITY	V	A	0 TO +30,000 FT/SEC	15 (FT/SEC)		NO	YES	XXXXX FT/SEC	
73, 74, 75	STATE VECTOR POSITION COMPONENTS (NEGATIVE)	$(X_1^-, X_2^-)\ X_{EO-}$, $(Y_1^-, Y_2^-)\ Y_{EO-}$, $(Z_1^-)\ Z_{EO-}$	(RM)T, N,P,D	0 TO -24 X 10^6 FT	25 (FT)		YES	YES	XXXXX 100 YD (XXXX.X NM)	SEE NOTES 11 AND 19
76, 77, 78	STATE VECTOR VELOCITY COMPONENTS (NEGATIVE)	$(\dot{X}_1^-, \dot{X}_{R2}^-)\ \dot{X}_{EO-}$, $(\dot{Y}_1^-, \dot{Y}_{R2}^-)\ \dot{Y}_{EO-}$, $(\dot{Z}_1^-)\ \dot{Z}_{EO-}$	(RM)T, N,P,D	0 TO -26,000 FT/SEC	15 (FT/SEC)		YES	YES	XXXX.X YD/SEC (XXXX.X FT/SEC)	SEE NOTES 11 AND 19
79	SINE OF RADAR AZIMUTH ANGLE	SIN r_G'	C,RZ	0 ± 0.407	1		NO	YES	±.XXXX	SEE NOTE 14
80	VELOCITY CHANGE(BODY X AXIS)	ΔV_{Xb}	A,C,RZ,R/E,N	0 ± 540 FT/SEC	12 (FT/SEC)		NO	YES	±XXX.X FT/SEC	
81	VELOCITY CHANGE(BODY Y AXIS)	ΔV_{Yb}	A,C,RZ,R/E,N	0 ± 150 FT/SEC	12 (FT/SEC)		NO	YES	±XXX.X FT/SEC	
82	VELOCITY CHANGE(BODY Z AXIS)	ΔV_{Zb}	A,C,RZ,R/E,N	0 ± 150 FT/SEC	12 (FT/SEC)		NO	YES	±XXX.X FT/SEC	
83	ANGLE TO GO TO RENDEZVOUS	$\omega_T t_{PR}$	RZ	SEE NOTE 7	3 (RAD)		YES	YES	XXX.XX DEG	
84	SINE OF RADAR ELEVATION ANGLE	SINa_G'	C,RZ	0 ± 0.407	1		NO	YES	±.XXXX	SEE NOTE 14
85, 86, 87	DESIRED VELOCITY CHANGES FOR SECOND IMPULSE (GUIDANCE AXES)	$\Delta\dot{X}_f$, $\Delta\dot{Y}_f$, $\Delta\dot{Z}_f$	RM	0 ± 300 FT/SEC	13 (FT/SEC)		NO	YES	±XXX.X FT/SEC	
88	INITIAL TIME	t_1	RM	0 TO 89,000 SEC	22 (SEC)		YES	YES	XXXXX SEC	
89							NO	NO		
90	FINAL TIME	t_2	RM	0 TO 89,000 SEC	22 (SEC)		YES	YES	XXXXX SEC	
91	START COMMAND	LCS	A,RZ,R/E	SEE NOTE 15			YES	YES	XXXXX	
92	RADAR ANGLE REJECTION SIGNAL	RLO	C,RZ	SEE NOTE 15			YES	YES	XXXXX	
93	ORBITAL ANGLE BETWEEN VERNIER CORRECTIONS	Δ	RZ	SEE NOTE 7	3 (RAD)		YES	YES	XXX.XX DEG	
94							NO	NO		
95							NO	NO		
96	PITCH GIMBAL ANGLE	θ_b	ALL	0 TO 360 DEG	14 (10^{-4} REV)		NO	YES	±XXX.X DEG	
97	YAW GIMBAL ANGLE	ψ_b	ALL	0 TO 360 DEG	14 (10^{-4} REV)		NO	YES	±XXX.X DEG	
98	ROLL GIMBAL ANGLE	ϕ_b	ALL	0 TO 360 DEG	14 (10^{-4} REV)		NO	YES	±XXX.X DEG	
99	MULTIPLEXED LOGICAL CHOICES		C,RZ	SEE NOTE 20			YES	YES	XXXXX	

REFERENCE DRAWING

6449883

REVISIONS

SYM	ENGRG NOTICE	DESCRIPTION	DATE	CHK	APPROVAL
		RELEASE			

CONTRACT NO.	
UNLESS NOTED BREAK CORNERS OUTSIDE MIN MAX, INSIDE MIN MAX	
ALL DIMENSIONS AND TOLERANCES APPLY TO FINISHED PART	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES, TOLERANCE ON 2 PLACE DECIMALS, 3 PLACE DECIMALS, ANGLES	
MATL	
HARD	CASE DEPTH
SURF TREAT	
DESIGNED: D. Bachman	2/10/66
DESIGN CHECK: E.H. Metz	3/7/66
DRAWN: D. Chwalow	2/15/66
DRAWING CHECK: D. Bachman	3/7/66
DESIGN APPROVAL: H.J. Manning	3-7-66

INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
590 MADISON AVE. NEW YORK 22, N.Y.

TITLE: GEMINI COMPUTER—SYSTEM MATH FLOW DIAGRAM—MODULE III—MDIU/DCS FORMAT

CODE IDENT NO. 03640 | SIZE F | 6449883

SCALE NONE | WT | SHEET 9

ADDRESS (NOTE 1)	PARAMETER NAME	SYMBOL	MODE (NOTE 2)	PARAMETER RANGE (NOTE 3)	COMPUTER SCALING (NOTE 4)	DCS RESOLUTION (NOTE 5)	COMMENTS
100	BANK ANGLE BIAS	K_{BA}	A,R/E	0 ± 15 DEG	3 (RAD)	2^{-22}RAD	
101	APOGEE TIME PERTURBATION CONSTANT	C_{T2}	A	± .0001 SEC/(FPS)^3	-13 SEC/(FPS)^3	2^{-38} SEC/(FPS)^3	
102	BIAS USED FOR SECO TAILOFF COMPENSATION	t_K	A	0.4 TO 1.0 SEC	10 (SEC)	2^{-15} SEC	SEE NOTE 16
103	FINAL VALUE OF INSERTION RADIUS	R_F	A	21,438,000±50,000 FT	25 (FT)	1 FT	SEE NOTE 16
104	EFFECTIVE EXHAUST VELOCITY	C*	A	10,000±500 FT/SEC	14(FT/SEC)	2^{-11} FT/SEC	SEE NOTE 16
105	STAGE II GUIDANCE INITIATE TIME	t_{ST2}	A	160 TO 170 SEC	17(SEC)	2^{-8} (SEC)	SEE NOTE 16
106	PITCH STEP 2 INITIATE TIME	t_{P2}	A	50 TO 100 SEC	17 (SEC)	2^{-8} (SEC)	SEE NOTE 16
107	PITCH STEP 3 INITIATE TIME	t_{P3}	A	100 TO 125 SEC	17 (SEC)	2^{-8} (SEC)	SEE NOTE 16
108	LV PITCH RATE, STEP 1	C_{P1}	A	-.5 TO -1.0 DEG/SEC	-5 (RAD/SEC)	2^{-30} RAD/SEC	SEE NOTE 16
109	LV PITCH RATE, STEP 2	C_{P2}	A	0 TO -.7 DEG/SEC	-5 (RAD/SEC)	2^{-30} RAD/SEC	SEE NOTE 16
110	LV PITCH RATE, STEP 3	C_{P3}	A	0 TO -.5 DEG/SEC	-5 (RAD/SEC)	2^{-30} RAD/SEC	SEE NOTE 16
111	RADAR RANGE TOLERANCE CONSTANT	C_R	RZ	+200 TO +10,000 FT	24(QUANTA)	2^{-1} QUANTA	1 QUANTA=49.178 FT.
112	INSERTION RADIAL VELOCITY	V_{PSS}	A	±2000 FT/SEC	15(FT/SEC)	2^{-10}FT/SEC	SEE NOTE 16
113	INSERTION PERTURBATION COEFFICIENT	K_{A5}	A	±.0006	-10(SEC/FT)	2^{-35}SEC/FT	
114	INSERTION PERTURBATION COEEFICIENT	A_7*	A	±.001	-10(FPS/FT)	2^{-35}FPS/FT	
115	INSERTION PERTURBATION COEEFICIENT	A_9*	A	±.0006	-10(FPS/FT)	2^{-35}FPS/FT	
116	APOGEE TIME PERTURBATION COEFFICIENT	C_{T1}	A	0 TO 4	2(SEC/FPS)	2^{-23}SEC/FPS	
117	FADE-IN CONSTANT	KFI	A	0.8 TO 0.999	0	2^{-25}	SEE NOTE 16
118	SEPARATION VELOCITY TO BE APPLIED	δV_F	A	0 ± 50 FT/SEC	15(FT/SEC)	2^{-10}FT/SEC	SEE NOTE 16
119	DESIRED OUT-OF-PLANE VELOCITY TARGETING BIAS	$V_{\perp F}$	A	0 ± 250 FT/SEC	15(FT/SEC)	2^{-10}FT/SEC	SEE NOTE 16
120	EFFECTIVE GRAVITY AT SECO	g_{ePF}	A	0 ± 1 FT/SEC^2	2(FT/SEC^2)	2^{-23}FT/SEC^2	SEE NOTE 16
121	SPACECRAFT Y-AXIS WITH RESPECT TO EAST	C_5	A	+4 TO +6 DEG	3 (RAD)	2^{-22} RAD	SEE NOTE 16
122	TARGETED RADIAL VELOCITY	V_{PF}	A	-1200 TO +1000 FT/SEC	15(FT/SEC)	2^{-10} FT/SEC	SEE NOTE 16
123	TIME OF GAIN CHANGE	t_{GC}	A	100 TO 120 SEC	17 (SEC)	2^{-8} SEC	SEE NOTE 16
124	SIMULATED RETROGRADE VELOCITY INCREMENT, X AXIS (THRUST MIDPOINT)	F_{XR}	T	-284 TO -335 FT/SEC	15 (FT/SEC)	2^{-10} FT/SEC	SEE NOTE 9
125	SIMULATED RETROGRADE VELOCITY INCREMENT, Y AXIS (THRUST MIDPOINT)	F_{YR}	T	+90 TO +174 FT/SEC	15 (FT/SEC)	2^{-10} FT/SEC	SEE NOTE 9
126	LIFT TO DRAG RATIO	L/D	T	0.04 TO 0.4	0	2^{-25}	SEE NOTE 9
127	TERMINATION TIME, ALTITUDE STEERING	T_{AS}	A	30 TO 60 SEC	10 (SEC)	2^{-15} SEC	SEE NOTE 16
128	PITCH ERROR COMPENSATION	A_{EP}	A	0 TO 0.4	0	2^{-25}	SEE NOTE 16
129	YAW ERROR COMPENSATION	A_{EY}	A	0 TO 0.4	0	2^{-25}	SEE NOTE 16
130	PITCH STEP 4 INITIATE TIME	t_{P4}	A	155 TO 165 SEC	17 (SEC)	2^{-8} SEC	SEE NOTE 16
131	PLATFORM TORQUING RATE	ω_P	C,RZ	0 TO +0.0012 RAD/SEC	-8 (RAD/SEC)	2^{-33} RAD/SEC	
132	CHECKOUT TEST OPTION	LC31	A	+ OR -		SEE COMMENT	+, FLIGHT SIMULATION, -, ACCEPTANCE TEST
133	DESIRED RANGE RATE BIAS	C_0	C,RZ	0 TO 100 FT/SEC	9 (FT/SEC)	2^{-16} FT/SEC	} USED IN MODULE V ONLY
134	DESIRED RANGE RATE FACTOR	C_2	C,RZ	0 TO 2 FT$^{1/2}$/SEC	4 (FT$^{1/2}$/SEC)	2^{-21} FT$^{1/2}$/SEC	} USED IN MODULE V ONLY
135	PITCH GIMBAL BIAS	K_θ	ALL	0 TO 360 DEG	14 (10^{-4} REV)	2^{-11} 10^{-4}REV	
136	YAW GIMBAL BIAS	K_ψ	ALL	0 TO 360 DEG	14 (10^{-4} REV)	2^{-11} 10^{-4}REV	
137	ROLL GIMBAL BIAS	K_ϕ	ALL	0 TO 360 DEG	14 (10^{-4} REV)	2^{-11} 10^{-4}REV	
138-146	MISALIGNMENT AND SCALE FACTOR MATRIX		ALL	0±0.11 FT/SEC / PULSE	-2 FT/SEC / PULSE	2^{-27} FT/SEC / PULSE	$K_{X1}, K_{X2}, K_{X3}, K_{Y1}, K_{Y2}, K_{Y3}, K_{Z1}, K_{Z2}, K_{Z3}$
147	RADAR AZIMUTH BIAS	C_{rB}	C,RZ	0±.018	1	2^{-24}	
148	RADAR AZIMUTH SLOPE	C_{rS}	C,RZ	0±.2	0	2^{-25}	
149	RADAR ELEVATION BIAS	$C_{\alpha B}$	C,RZ	0±.018	1	2^{-24}	
150	RADAR ELEVATION SLOPE	$C_{\alpha S}$	C,RZ	0±.2	0	2^{-25}	
151-156	G-SENSITIVE DRIFT COEFFICIENTS		A	0±1.0 DEG/HR / G	-22 (RAD/SEC / FT/SEC^2)	2^{-47} RAD/SEC / FT/SEC^2	$\varepsilon_{PGIA}, \varepsilon_{PGSA}, \varepsilon_{YGIA}, \varepsilon_{YGSA}, \varepsilon_{RGIA}, \varepsilon_{RGSA}$
157-159	CONSTANT DRIFT COEFFICIENTS		A	0±1.0 DEG/HR	-8(RAD/SEC)	2^{-33}RAD/SEC	$\varepsilon_{LT\theta B}, \varepsilon_{LT\psi B}, \varepsilon_{LT\phi B}$
160	SPARE						
161	SPARE						
162	SPARE						

REFERENCE DRAWING

NOTES:

1. SINCE A 6-BIT ADDRESS IS USED, ALL NORMAL ADDRESS DCS QUANTITIES MUST BE IN ADDRESSES 00-63. EXTENDED ADDRESS DCS QUANTITIES CAN BE INSERTED IN ADDRESSES 100 AND HIGHER USING NORMAL ADDRESSES 60 AND 61. QUANTITIES HAVING ADDRESSES 100 AND HIGHER ARE INSERTABLE BY DCS ONLY, NO PROVISION IS MADE FOR MDIU
2. THE "MODE" COLUMN INDICATES THE MODE(S) IN WHICH THE PARAMETERS SHOWN ARE LIKELY TO BE USED. ABBREVIATIONS IN THIS COLUMN ARE AS FOLLOWS: A ASCENT; C CATCH-UP; RZ RENDEZVOUS; RM RELATIVE MOTION; T TOUCHDOWN PREDICT; R/E RE-ENTRY; N ORBIT NAVIGATION; P ORBIT PREDICT; D ORBIT DETERMINATION.
3. "PARAMETER RANGE" SPECIFIES THE RANGE THROUGH WHICH THE PARAMETERS SHOWN ARE EXPECTED TO VARY.
4. THE NUMBERS IN THE "COMPUTER SCALING" COLUMN DENOTE THE POSITION OF THE BINARY POINT TO THE RIGHT OF THE SIGN POSITION. THESE NUMBERS INDICATE THE MAXIMUM VALUES WHICH THE COMPUTER IS CAPABLE OF HANDLING
5. "DCS RESOLUTION" DEFINES THE VALUE OF THE LEAST SIGNIFICANT BIT OF DATA TRANSMITTED VIA DCS. THIS IS DETERMINED BY THE SCALING AND THE NUMBER OF DATA BITS AVAILABLE (17 FOR NORMAL ADDRESS, 25 FOR EXTENDED ADDRESS). "NO DCS" INDICATES THE QUANTITY CANNOT BE ENTERED INTO THE COMPUTER VIA DCS.
6. A "YES" IN THE "MDIU INSERT" COLUMN INDICATES THAT THE PARAMETER MAY BE INSERTED WHEN THIS MODULE IS LOADED, EXCEPT AS NOTED. A "YES" IN THE "MDIU DISPLAY" COLUMN INDICATES THAT THE PARAMETER MAY BE DISPLAYED ON THE MDIU WHEN THIS MODULE IS LOADED, EXCEPT AS NOTED. IN THE "FORMAT" COLUMN, X'S INDICATE THE 5 DIGIT POSITIONS OF THE MDRU, WITH RELATIVE LOCATION OF THE DECIMAL POINT. ± INDICATES THAT THE MOST SIGNIFICANT POSITION WILL ORDINARILY BE USED ONLY FOR SIGN RATHER THAN A NON-ZERO DIGIT. NORMAL DISPLAY RANGE IS FROM -9999 TO +89999. THE MDIU IS NOT USABLE IN ASCENT MODE UNTIL SECO OR RECOGNITION OF THE ABORT DISCRETE.
7. ANY COMBINATIONS OF $\omega_T t_{PR}$ AND Δ WHICH CAUSE THE PARAMETER $\omega_S t_{dL}$ TO FALL WITHIN ANY ALLOWABLE RANGE SHOWN BELOW MAY BE INSERTED. OTHERS WILL CAUSE COMPUTER OVERFLOWS DURING THE RENDEZVOUS COMPUTATIONS AND THEREFORE SHOULD NOT BE INSERTED.

   0° 10° — ALLOWABLE — 171° 189° — ALLOWABLE — 351° 360°

8. WHENEVER THE RANGE RATE CALCULATIONS ARE BYPASSED FOR THREE SECONDS AFTER THE NOMINAL TIMES (EVERY 5 SECONDS WHEN IN CATCH-UP MODE PRIOR TO "START COMP", EVERY 20 SECONDS OTHERWISE) A DISPLAY REQUEST WILL RESULT IN A FLAG TO 09999. THE RANGE RATE CALCULATIONS ARE BYPASSED IF GOOD RADAR DATA CANNOT BE OBTAINED (E.G. DURING PLATFORM REALIGNMENT)
9. THE SELECTED COMBINATION OF ORBIT, RETRO-TIME, RETRO-GRADE, AND L/D RATIO MUST BE SUCH THAT THE TOTAL PEAK ACCELERATION DOES NOT EXCEED 256 FT/SEC^2 DURING SIMULATED RE-ENTRY
10. VALUES OF T_R LESS THAN 128 SECONDS CANNOT BE INSERTED.
11. LOCATIONS 03 THROUGH 08 AND 13 THROUGH 18 ARE USED FOR MDIU INSERTS AND DISPLAYS OF POSITIVE NUMBERS ONLY, AND FOR DCS INSERTS OF EITHER POSITIVE OR NEGATIVE NUMBERS. MDIU INSERTS AND DISPLAYS OF NEGATIVE QUANTITIES MUST USE LOCATIONS 63 THROUGH 68 AND 73 THROUGH 78.
12. NOT APPLICABLE
13. TRANSFERS BETWEEN THE COMPUTER AND THE TIME REFERENCE SYSTEM OCCUR WITH LEAST SIGNIFICANT BIT EQUIVALENT TO 0.125 SECONDS . DCS UPDATE OF T_X OR T_R IS MADE BY WAY OF DIRECT DCS TO TRS TRANSFER.
14. DISPLAYED VALUES OF SINr'_G AND SINα'_G HAVE BEEN COMPENSATED FOR MEASUREMENT ERRORS.
15. CERTAIN ADDRESSES ARE USED ONLY FOR QUALITATIVE DATA, RECOGNIZED BY THE COMPUTER AS EITHER +, -, OR 0. RESPECTIVE MDIU INSERTS FOR THESE CONDITIONS ARE 11111,-9999,OR 00000. EFFECTS OF EACH INSERT ARE AS FOLLOWS:

ADDRESS	11111 ALLOWS	-9999 ALLOWS	00000 ALLOWS
55	USE OF AFT-FIRING THRUSTERS	USE OF FORWARD-FIRING THRUSTERS	USE OF AFT-FIRING THRUSTERS
91	NORMAL PROGRAM,NO TEST	SELF-TEST	NOT USED
92	NOT USED	REJECTION OF RADAR ANGLE DATA	NORMAL PROGRAM

16. THESE QUANTITIES ARE TO BE MODIFIED VIA DCS PRIOR TO 45 DAYS BEFORE LAUNCH TO PERMIT ADEQUATE MISSION SIMULATION.
17. THE FIRST THREE DIGITS OF THE ATM READ COMMAND ARE MODULE TAPE POSITION NUMBER, THE LAST TWO ARE THE OPERATION CODE (01 REPROGRAM; 02 VERIFY; 03 REPROGRAM AND VERIFY)
18. THE EXTENDED DCS FORMAT IS: ADDRESS 60, HIGH ORDER DATA IN POSITIONS 1-18; ADDRESS 61, LOW ORDER DATA IN POSITIONS 1-8 AND EXTENDED DCS ADDRESS IN POSITIONS 9-18
19. MDIU ADDRESS 12 CAN BE USED FOR INSERT AND DISPLAY OF THE SPACECRAFT STATE VECTOR INITIAL TIME WITH THIS MODULE LOADED. MDIU ADDRESSES 13 THROUGH 18 AND 73 THROUGH 78 ARE MULTIPLEXED AS FOLLOWS:

CONTROL	MDIU INSERT AND DISPLAY PARAMETER
LCM5+	SPACECRAFT INITIAL STATE VECTOR $(X_{EO}, Y_{EO}, Z_{EO}, \dot{X}_{EO}, \dot{Y}_{EO}, \dot{Z}_{EO})$
LCM5=0	INITIAL RELATIVE STATE VECTOR $(X_1, Y_1, Z_1, \dot{X}_1, \dot{Y}_1, \dot{Z}_1)$
LCM5-	FINAL RELATIVE STATE VECTOR $(X_2, Y_2$, ILLEGAL, $\dot{X}_{R2}, \dot{Y}_{R2}$, ILLEGAL)

20. THE FIRST DIGIT OF THE MULTIPLEXED LOGICAL CHOICES IS THE DESIRED STATE (1, PLUS; -, MINUS; 0, ZERO), THE FIFTH DIGIT IS THE LOGICAL CHOICE NUMBER TO BE SET OR DISPLAYED AS SHOWN BELOW. THE SECOND, THIRD, AND FOURTH DIGITS ARE NOT USED IN THE PROGRAM.

LOGICAL CHOICE NO.	1 ALLOWS	- ALLOWS	0 ALLOWS
M1	START ORBIT RATE COMPENSATION WITH NEW TIMING MARK	START ORBIT RATE COMPENSATION WITH PREVIOUS TIMING MARK	NORMAL PROGRAM
M2	LOCAL VERTICAL DISPLAY REFERENCE OPTION	INERTIAL DISPLAY REFERENCE OPTION	NORMAL COMMANDS
M3	NORMAL PROGRAM	10/1 ATTENUATION IN FWD/AFT IVI & MDIU DISPLAY OF ΔV_{Xb}	NORMAL PROGRAM
M4	SELECTION OF MDIU/DCS INITIAL CONDITIONS	SELECTION OF ON-BOARD INITIAL CONDITIONS	SELECTION OF MDIU/DCS INITIAL CONDITIONS
M5	NORMAL MDIU OPERATION	MDIU INSERT AND DISPLAY OF FINAL RELATIVE STATE VECTOR	MDIU INSERT AND DISPLAY OF INITIAL RELATIVE STATE VECTOR

6449883

REVISIONS					
SYM	ENGRG NOTICE	DESCRIPTION	DATE	CHK	APPROVAL
		RELEASE			

CONTRACT NO.

UNLESS NOTED BREAK CORNERS OUTSIDE MIN MAX INSIDE MIN MAX. ALL DIMENSIONS AND TOLERANCES APPLY TO FINISHED PART. UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON 2 PLACE DECIMALS 3 PLACE DECIMALS ANGLES. MATL. HARD. SURF TREAT. CASE DEPTH

		DATE
DESIGNED	D Bachman	3/10/66
DESIGN CHECK	E.H. Mertz	3/3/66
DRAWN	D. Chevalier	2/16/66
DRAWING CHECK	D Bachman	3/7/66
DESIGN APPROVAL	[illegible]	3-7-66

INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
590 MADISON AVE. NEW YORK 22, N.Y.

TITLE: GEMINI COMPUTER-SYSTEM MATH FLOW DIAGRAM-MODULE III-EXTENDED DCS FORMAT

CODE IDENT NO. 03640 SIZE F 6449883

SCALE NONE WT SHEET 10

MODE	SEQUENCE NO.	DAS PARAMETER	SYMBOL	SCALING	LOW ORDER BIT VALUE	UNITS	NOTES
ALL	1	PITCH PLATFORM GIMBAL ANGLE	θ_b	14	1	QUANTA	2,5,7
ALL	2	YAW PLATFORM GIMBAL ANGLE	ψ_b	14	1	QUANTA	2,5,7
ALL	3	ROLL PLATFORM GIMBAL ANGLE	ϕ_b	14	1	QUANTA	2,5,7
ALL	4	SUM OF X ACCELEROMETER OUTPUTS	SF_X'	20	1	QUANTA	2,8,18
ALL	5	SUM OF Y ACCELEROMETER OUTPUTS	SF_Y'	20	1	QUANTA	2,8
ALL	6	SUM OF Z ACCELEROMETER OUTPUTS	SF_Z'	20	1	QUANTA	2,8
ALL	7	COMPUTER TIME-IN-MODE	t_{DAS}	13	2^{-10}	SEC	
ALL	8	FLOW TAG AND	F_{TAG}	23	1		10
		COMPUTATION CYCLE TIME	ΔT	0	2^{-7}	SEC	10
PRE-LAUNCH	9	CORRECTED X VELOCITY INCREMENT	F_X	15	2^{-8}	FT/SEC	14
	10	CORRECTED Y VELOCITY INCREMENT	F_Y	15	2^{-8}	FT/SEC	14
	11	CORRECTED Z VELOCITY INCREMENT	F_Z	15	2^{-8}	FT/SEC	14
	12	YAW ATTITUDE ERROR SIGNAL	$\Delta\psi_{bo}$	13	1	QUANTA	2,9,13,16
	13	PITCH ATTITUDE ERROR SIGNAL	$\Delta\theta_{bo}$	13	1	QUANTA	2,9,13,16
	14	ROLL ATTITUDE ERROR SIGNAL	$\Delta\phi_{bo}$	13	1	QUANTA	2,9,13,16
	15	MDIU/DCS ADDRESS TAG	A_{TAG}	23	1		15
	16-21	MULTIPLEX OF MDIU/DCS ADDRESSES					15
CATCH-UP RENDEZVOUS	9	COMPUTED FORWARD/AFT IVI READING	ΔV_{XO}	12	1	FT/SEC	2,4
	10	COMPUTED RIGHT/LEFT IVI READING	ΔV_{YO}	12	1	FT/SEC	2,4
	11	COMPUTED DOWN/UP IVI READING	ΔV_{ZO}	12	1	FT/SEC	2,4
	12	COMPUTED PITCH COMMAND	θ_{bc}	3	2^{-20}	RADIANS	
	13	COMPUTED YAW COMMAND	ψ_{bc}	3	2^{-20}	RADIANS	
	14	LOGIC TIME	T_X	17	2^{-6}	SEC	
	15	NEGATIVE OF VELOCITY COMPONENTS TO BE ADDED ALONG S/C NAVIGATIONAL AXES	ΔV_{XM}	13	2^{-10}	FT/SEC	
	16		ΔV_{YM}	13	2^{-10}	FT/SEC	
	17		ΔV_{ZM}	13	2^{-10}	FT/SEC	
	18	RADAR RANGE	R_R	21	2^{-2}	FEET	11
	19	SINE OF RADAR ELEVATION ANGLE	$\sin\alpha'$	1	2^{-22}		11,12
	20	SINE OF RADAR AZIMUTH ANGLE	$\sin r'$	1	2^{-22}		11,12
	21	TIME OF THRUST MIDPOINT	T_M	17	2^{-6}	SEC	
RELATIVE MOTION	9	INITIAL RELATIVE STATE VECTOR	X_1	25	4	FEET	
	10		Y_1	25	4	FEET	
	11		Z_1	25	4	FEET	
	12		$\dot{X}_1$	15	2^{-8}	FT/SEC	
	13		$\dot{Y}_1$	15	2^{-8}	FT/SEC	
	14		$\dot{Z}_1$	15	2^{-8}	FT/SEC	
	15	FINAL RELATIVE STATE VECTOR	X_2	25	4	FEET	
	16		Y_2	25	4	FEET	
	17		$\dot{X}_{R2}$	15	2^{-8}	FT/SEC	
	18		$\dot{Y}_{R2}$	15	2^{-8}	FT/SEC	
	19	INITIAL TIME	t_1	22	1	SEC	2
	20	FINAL TIME	t_2	22	1	SEC	2
	21	TOTAL VELOCITY CHANGE	ΔV_T	15	2^{-8}	FT/SEC	

NOTES:

1. LOW ORDER BIT VALUE IS DETERMINED BY DAS TRUNCATION UNLESS NOTE 2 IS INDICATED
2. LOW ORDER BIT VALUE DETERMINED BY INPUT MEDIUM
3. NOT APPLICABLE
4. POSITIVE VALUES OF THE PARAMETERS INDICATE FORWARD, RIGHT, OR DOWN READINGS ON THE IVI
5. GIMBAL ANGLES SHALL BE PROVIDED AS ±180 DEGREE MEASUREMENTS UNTIL SECO PLUS 20 SECONDS, AND AS ZERO TO 360 DEGREE MEASUREMENTS THEREAFTER
6. NOT APPLICABLE
7. ONE QUANTA REPRESENTS 10^{-4} REVOLUTION (0.036 DEG)
8. ONE QUANTA REPRESENTS 0.10 FT/SEC + 10, -14%
9. ONE QUANTA REPRESENTS 0.12 DEGREES
10. ΔT OCCUPIES SIGN BIT AND BITS 1-7 (SIGN POSITION CONTAINS QUANTITATIVE DATA); FLOW TAG OCCUPIES BITS 8-23
11. CATCH-UP, DATA EACH CYCLE, IF VALID; RENDEZVOUS, DATA USED IN RENDEZVOUS EQUATIONS
12. COMPENSATED FOR MEASUREMENT ERRORS
13. ATTITUDE ERROR SIGNAL DATA REFLECTS COMMANDS FROM THE AGE BIT POSITIONS 15-17 MAY CONTAIN EXTRANEOUS DATA REPRESENTING AGE MODE CODES
14. NAVIGATIONAL COORDINATE SYSTEM
15. THE MULTIPLEXING OF MDIU/DCS QUANTITIES STARTS AT ADDRESS 01 AND TERMINATES WITH EXTENDED DCS ADDRESS 162. THE A_{TAG} DEFINES THE GROUP OF SIX MDIU/DCS PARAMETERS TO BE TRANSMITTED IN THAT PRE-LAUNCH FRAME
16. POSITIVE ERROR SIGNAL VALUES INDICATE FOR DEFLECTIONS OF DOWN, LEFT, AND LEFT FOR PITCH, YAW, AND ROLL RESPECTIVELY
17. UNUSED COMPUTER MODE SWITCH POSITIONS RESULT IN PRE-LAUNCH DAS DATA
18. A MODULE CODE OF "011" IS CONTAINED IN BITS 21-23 OF SEQUENCE NO. 4 EXCEPT WHEN PRELAUNCH DAS DATA IS SUPPLIED

REVISIONS: RELEASE

6449883

REFERENCE DRAWING

INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
590 MADISON AVE. NEW YORK 22, N.Y.

TITLE: GEMINI COMPUTER- SYSTEM MATH FLOW DIAGRAM- MODULE III - DAS FORMAT

DESIGNED: D. Bachman 3/1/66
DESIGN CHECK: F. H. Metz 3/7/66
DRAWN: D. Chwalow 3/4/66
DRAWING CHECK: D Bachman 3/7/66
DESIGN APPROVAL: [signature] 3-7-66

CODE IDENT NO. 03640 | SIZE F | 6449883
SCALE NONE | SHEET 11

6449883

REVISIONS					
SYM	ENGRG NOTICE	DESCRIPTION	DATE	CHK	APPROVAL
		RELEASE			

CHANGE RECORD

MATH FLOW CHANGE NO.	ECN NO.	DIRECTED CHANGE NO.	SHEET NO.	REVISION LEVEL	DESCRIPTION

CHANGE RECORD

MATH FLOW CHANGE NO.	ECN NO.	DIRECTED CHANGE NO.	SHEET NO.	REVISION LEVEL	DESCRIPTION

REFERENCE DRAWING

QTY REQD	SYM-BOL	NOMENCLATURE OR DESCRIPTION	PART OR IDENTIFYING NO.	SPECIFICATION	MATERIAL OR NOTES	CODE IDENT NO.	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS NOTED BREAK CORNERS ON SIDE MIN MAX, INSIDE MIN MAX
ALL DIMENSIONS AND TOLERANCES APPLY TO FINISHED PART
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCE ON 2 PLACE DECIMALS 3 PLACE DECIMALS ANGLES
MATL
HARD / CASE DEPTH
SURF TREAT
CONTRACT NO.

DESIGNED	D Bachman	1/5/66
DESIGN CHECK	D Bachman	1/5/66
DRAWN	R.O. Wakefield	1/4/66
DRAWING CHECK	D Bachman	3/1/66
DESIGN APPROVAL	H.H. Manning	3-7-66

INTERNATIONAL BUSINESS MACHINES CORP.
FEDERAL SYSTEMS DIVISION
590 MADISON AVE. NEW YORK 22, N.Y.

TITLE
GEMINI COMPUTER
SYSTEM MATH FLOW DIAGRAM - MODULE III
CHANGE RECORD

CODE IDENT NO. 03640 | SIZE F | 6449883
SCALE NONE | WT | SHEET 12