RTCC MFD Inputs Guide

by jalexb88 - 16/08/2022

IF LAUNCH DELAY - UTI, IU, LAU: Record new launch azimuth *After insertion, subtract delay from PTC GET*

TLI

TLI PAD *Advanced method using MPT, for a simpler way see RTCC MFD PAD pages*

- Press TLI (M68) on MPT display, Use DMT (MSK 54) for TB6=TIG-9m38s, RPY(TLI), BT, DVC

- Use Checkout Monitor (MSK 1619) REF: MVE for VI and TLI cut-off GET

- RPY(SEP): Add 0 DV maneuver to MPT: Press INP (M66), CSM, TIG: TLI cutoff+15, THR: CSM RCS+X(2 quads), ATT: Inertial, BPA: P1, COO: LVLH=X Y Z (see mission-specific data)

- Use DMT (MSK 54) to view RPY(SEP)

- RPY(EXT): R(SEP)-56, P(SEP)+180, Y(SEP)+/-

TLI+90 ITERATE

- TAR, ENT, AST, TYP: Specific Site, SIT: AOL (Apollo 16: MPL), TIM: TLI TIG+90min, TZ: Block Data, INC: 0.00

TLC

P37/Direct Abort PAD ITERATE, HDS-DWN

- TAR, ENT, AST, TYP: Specific Site, SIT: MPL, TIM: Block Data, TZ: Block Data, INC: 0.00

TLMCC

- TAR, MCC, TIG: flight plan

MCC-1&2: Apollo 8,10,11: Use Option 3 (Free-Return)

Apollo 12: Use Option 5 (Non-FR without LOI ellipse rotation)

Apollo 13+: Use Option 4 (Non-FR with LOI ellipse rotation)

MCC 3&4: Use Option 1 (SFP 2)

- TAR, MCC, MAN: Option 1, SFP: 1 (no updated SFP) 2 (updated SFP)

Option 3, SFP: 1

Option 4, SFP: 1, Adjust LOI ignition time (below)

Option 5, SFP: 1, Adjust LOI ignition time (below)

Important: After final option 2-5 calculation, move column to SFP block 2 (TAR, MCC, MID, F30)

To adjust LOI ignition time (option 4-5 only & on-time TLI):

TAR, MCC, CON, F23: Adjust TLMIN/TLMAX until “GET LOI” corresponds to flight plan LOI GET.

If late TLI, see “TLMCC after Late TLI (Mode 4 & 5)” in Common Functions

FLY BY & PC+2 ITERATE, (fly-by targets a slow return, PC+2 targets a fast return)

- TAR, ENT, AST, TYP: Specific Site, SIT: MPL, TIM: LOI-5/PC+2 hours, TZ: Block Data, INC: 0.00
(tweak TZ to find lowest safe fly-by altitude)

For PC+2, TAR, ENT, CON, set VRMAX to 37500 fps, the revert to previous (36323 fps) afterwards

LIFTOFF TIME UPDATE (Apollo 14+) *Advanced method, requires MPT active and initialized*

FP REV X GET: A pre-determined REV crossing GET specified in the flight plan

- Checkout monitor (MSK 1619): U02,CSM,GET,FP REV X GET(-Liftoff Delay on 1st update),,MCT;

- LONG C: REV X longitude, Delta T = 1 minute per 3-degree difference from 180. If LONG C is West (-) of 180, Delta T is positive. If LONG C is East (+) of 180, Delta T is negative. For example, LONG C: +177, Delta T = -1 minute.

- UPL, DIS: 08: CMC Liftoff Time Update, INP: Delta T(-Liftoff Delay on 1st update), UPL

- After uplink is complete: UPD

*Add total time difference to PTC GET, any TIG & Vector times *

LUNAR ORBIT

LOI ITERATE, HDS-DWN

- TAR, LOI, DIS: Apollo 12 and prior: Plane (LOI-2)

Apollo 13 and later: Intersection (No LOI-2)

Each mode has 2 solutions, if they are different, use the solution with the correct HPC.

LOI-2 ITERATE, HDS-DWN

- TAR, LDP, MOD: Single CSM Maneuver, SEQ: CIR, DOI, TH1: threshold time before LOI-2 (nearest hour), TH2: threshold time before DOI (nearest hour)

DOI ITERATE, (if DPS: 10P: -15s, DPS: 0.4) *for Apollo 17 DOI-1, see common functions*, HDS-DWN
If DOI-2/Trim: TAR, LDP, INI, N: revs before PDI, Apollo 17 DOI-2: HDP: 40000 ft
Before DOI calculation, update RLS in RTCC MFD

- TAR, LDP, MOD: LM Maneuver Sequence, SEQ: DOI, TH1: threshold time before DOI (nearest hour)

TEI ITERATE, HDS-DWN

- TAR, ENT, AST, TYP: Lunar Search, SIT: MPL/EOM, TIM: FP/Block Data TIG, TZ: EI GET, INC: 0.00
(Trick to get proper TIG/TZ for early TEI's: tweak TZ until solution TIG corresponds to block data TIG)

CIRC ITERATE

- TAR, ORB, TYP: Circularization or Apo/Peri change, PNT: Height=60 or Time, GET: flight plan

PDI-0 ITERATE, 10P: -15s, DPS: 0.4

- Find Peri GET: FDO Orbit Digitals LM, GET P = Peri GET (for later REV use GETR: U12,LEM,REV,desried REV)

- TAR, REN, DKI, INI, DH = 15, E: 26.6

- TAR, REN, DKI, OPT, MAN: Maneuver Line, RAD: Horizontal

- TAR, REN, DKI, PRO: CSI/CDH Seq, TIG: Peri GET, TPI: Sunrise-16min

NO PDI+12 (Apollo 12 and before) ITERATE, 10P: -15s, DPS: 0.4 TPI Time = Sunrise-23min

- TAR, REN, TI, OPT: First Fixed, T1: PDI TIG+12min, T2: TPI Time-45min, OFF: P51,15,4.475,26.6,130;

- TAR, REN, TI, DIS, CLC, use solution with the valid TPI time, if needed, adjust T2 time

NO PDI+12 (Apollo 13 and later) ITERATE, 10P: -15s, DPS: 0.4

- TAR, REN, DKI, INI, DH: 15, E: 26.6

- TAR, REN, DKI, TIG: PDI TIG+12min, TPI: Sunrise-16min

- TAR, REN, DKI, PRO: - Apollo 13 to 15 both PDIs & 16-17 PDI-2: HAM-CSI/CDH Seq - Apollo 16-17 PDI-1: CSI/CDH Seq

- TAR, REN, DKI, OPT, MAN: Spec DTs, RAD: -50 ft/s, DT1: - Apollo 16 PDI-1: 50min - Apollo 13-14-15-17 PDI-1/Apollo 16 PDI-2: 55min - Apollo 13-14-15-17 PDI-2: 60min

For Apollo 17: Calculate DVX of No PDI+12 for no DOI-2 case

PDI PAD, T1 & T2 TPI Times: Apollo 12 & earlier: Sunrise-23min, Apollo 13 & later: Sunrise-16min

- Apollo 11 PDI Abort > 10 min phasing TIG: PDI TIG + 67 min

- Apollo 11 T2: MPT: DOI+PDI+Ascent, use Ascent Processor with inputs +5515.2, +19.6, LTO: PDI TIG + 21:24, Checkout Monitor (MVE) for insertion GET, Phasing TIG = insertion GET + 50 min, CSI TIG = Phasing TIG + 2h48m

T3, ASCENT (Concentric) TPI Times: Apollo 14 & earlier: Sunrise-23min, Apollo 15+: Sunrise-16min

- TAR, LLW, INI, TAR, VLH: +5535.6, VLV: +32.0 - TAR, LLW, THT: Desired TPI Time, CSI: 50

- CLC solution - TAR, ASC, LTO: Desired LLW sol. GET, CLC - Go back to LLW and CLC again

CSI/CDH DON'T ITERATE, TIM: impulsive TIG, if DPS: 10P: -15s, DPS: 0.4

- TAR, REN, SPQ, INI, DH: 15 (for CDH: use DH from CSI solution, if different), E: 26.6, TPI: Desired TPI Time

CSI: TAR, REN, SPQ, MOD: Optimum CSI, TIG: 1st guess *Use input time +/- 15 mins to find good solution*

CDH: TAR, REN, SPQ, MOD: CDH, TIM: Find GETI, TIG: 1st guess

See Rendezvous Evaluation Display after calculating a solution with SPQ or DKI

TPI DON'T ITERATE, TIM: impulsive TIG, if DPS: 10P: -15s, DPS: 0.4

- TAR, REN, TI, OPT: Both Fixed, OFF: P51,0,0,26.6,130;, T1: -1:0:0, T2: -1:0:0

DIRECT ASCENT & TWEAK (Apollo 14+) TPI Times: Apollo 14: Sunrise-18.5min, Apollo 15+: Sunrise-16min

- TAR, LLT, DT: Apollo 14: 38min, Apollo 15: 45min, Apollo 16/17: 47min, TTH: Liftoff threshold time,

RDO: +32.0, CLC solution, - TAR, ASC, CLC - Go back to LLT and CLC again

- Adjust DT so TPI GET = Desired TPI Time

- TAR, ASC, CLC - Go back to LLT and CLC again *Note insertion GET (Checkout Monitor MVE)*

Before liftoff, pre-fill tweak-burn values below & set MPT to inactive, - TAR, REN, TI, DIS, MPT, THR: L2

- TAR, REN, TI, OPT: Both Fixed, T1: Insertion GET +3min, T2: Desired TPI Time, OFF: P51,15,1.7,26.6,130;

After insertion: - TAR, REN, TI, DIS, CLC, MPT, CLC, read tweak-burn DV's

PLANE CHANGE ITERATE, (update stored RLS or set desired coordinates) HDS-DWN

- TAR, DES, INI, AZI: Optimum or Desired,

- TAR, DES, MOD: CSM Prelaunch Plane Change, TH1: TIG-1hour, TH2: Align Time-1hour

SHAPE ITERATE, HDS-DWN

- TAR, ORB, TYP: Apogee & Perigee change, PNT: Time, GET/ApA/PeA: flight plan

TEC

TEMCC (Corridor Control)

- TAR, ENT, AST, TYP: Unspecified Area, SIT: FCUA, TIM: flight plan

MPT maneuver work-flow *Advanced method, use if a maneuver assumes a prior one, i.e. TEI-90 PAD*

1. Activate MPT & initialize desired tables (CSM/LEM), set desired REFSMMAT in the MFD, if desired, use M49 to update propellant masses. (1 KG = 2.205 LBS)

2. Build maneuver (TAR), transfer to MPT, If preferred REFSMMAT desired, use G11 to store it, then G00 to transfer it to CUR if desired, i.e. G11,CSM,DMT,1,DES,U or D; or G11,CSM,REP; then G00,CSM,DMT,CSM,CUR; or G00,CSM,DOD,CSM,CUR;08

3. Use M58 to set desired orientation, i.e. M58,CSM, 1,U/D; (Up/Down)

4. Use the DMT to display maneuver i.e. U20,CSM,1; or U20,CSM,1,,DMT; or U20,CSM,1,,DOD;

5. Use the GOST to calculate optics data i.e. ATT: 1 Burn Angles, BST: GET 1 CUR, SXT: GET 1 CUR

COMMON FUNCTIONS

REFSMMATs *Use G00 to transfer between slots, i.e. G00,CSM,LCV,CSM,CUR;*

- LVLH (LCV): Use G03 i.e. G03,CSM,GET; - Preferred (DMT): Use G11 i.e. G11,CSM,DMT,1,DES,U or D;

- Preferred (DOD): Use G11,CSM,REP or REM; - MED (MED): Can be used as a temporary storage slot.

Config change on MPT

Add 0 DV maneuver to MPT: Press INP, MPT: CSM or LEM, TIG: Desired TIG, THR: C1 or L1, ATT: Inertial, BPA: P1, Page 2: DOC: Desired config., CLC

Find VIO, GET 0.05 G, V400K, GET 400K "height": 0.05G = 48.4, 400K = 65.83

- Checkout monitor (MSK 1619): U02,CSM,ALT,"height",GET of EI-10 hours;

GET = GET 0.05 G/400K, V = VIO/V400K

TLMCC after Late TLI (Mode 4 & 5) *Advanced method using MPT, only for launch delay and/or 2nd op TLI)*

Apollo 13-16: Tweak REVS1 until DOI DVZ = 0. *REVS1 & ETA1 parameter in LOI processor must match TLMCC processor*

Constant trans-lunar flight time (Apollo 13 & prior): Do not specify a TLMIN/TLMAX constraint.

Constant lunar arrival GMT (Apollo 14+): Find Delta T for REV 2 GMT (Common Functions), Note initial GET LOI (TAR, MCC, MID), then TAR, MCC, CON, F23: Adjust TLMIN/TLMAX until new GET LOI = old GET LOI + Delta T

Find Delta T for REV 2 GMT MPT: MCC+LOI

REV 2 GMT = nominal liftoff GMT (mission-specific data) + FP REV 2 GET

- Checkout monitor (MSK 1619): U02,CSM,GMT,REV 2 GMT,,MCT;

- LONG C: REV 2 longitude, Delta T = 1 minute per 3-degree difference from 180. If LONG C is West (-) of 180, Delta T is negative. If LONG C is East (+) of 180, Delta T is positive. For example, LONG C: +177, Delta T = 1 minute.

Find Orbit Period, P+Delta T (Apollo 11 T3 PAD)

From CSM, Orbit Digitals (MSK 46), TO=Period (P), L: U13,CSM,liftoff REV,LDG SITE LONG;, Liftoff GET - GET L = Delta T

Apollo 17 DOI-1 transfer: ITE: iterate HDS-DWN

- TAR, ORB, TYP: Apo & Peri Change, PNT: Time, GET: flight plan, REF: Pad/LS, ApA: 60.0, PeA: 13.17, Tweak GET until LONG P = 31.36

Height Adjustment Maneuver (HAM) Use DKI with CSI/CDH Seq, Spec DTs, DT1=HAM to CSI time, Horiz. Man.

MISSION-SPECIFIC DATA

TLI PAD RPY(SEP) LVLH INPUTS

CSM LVLH P: +120 Y: +/-40 R: 0 = LVDC LVLH P: +41.6 Y: +/-120.8 R: +/-131.9
CSM LVLH P: +120 Y: +/-30 R: 0 = LVDC LVLH P: +48.6 Y: +/-130.9 R: +/-139.1

- Apollo 8: P: +60.0 Y: +180.0 R: +180.0 - Apollo 10: P: +41.6 Y: +120.8 R: +131.9
- Apollo 11 July 16: P: +41.6 Y: +120.8 R: +131.9 July 18/21: P: +41.6 Y: -120.8 R: -131.9
- Apollo 12: P: +48.6 Y: -130.9 R: -139.1 - Apollo 13/14/15/16: P: +41.6 Y: -120.8 R: -131.9
- Apollo 17: P: +41.6 Y: +120.8 R: +131.9

LM Impact Burn Targets

- Apollo 12: 149:28:17, DVX: -181.2 DVY: +60.3 DVZ: -1.5 - Apollo 13: 144:32:20, DVX: -180.0 DVY: 45.0 DVZ: 0
- Apollo 14: 147:52:59, DVX: -180.0 DVY: +36.5 DVZ: 0 - Apollo 15: 179:06:23, DVX: -161.1 DVY: +57.3 DVZ: +94.6 - Apollo 16: 179:16:29, DVX: -134.5 DVY: -80.0 DVZ: +168.0 - Apollo 17: 195:39:13, DVX: -219.2 DVY: +56.0 DVZ: +168.0

Nominal Liftoff GMT / TEPHEM

- Apollo 14: 20:23:00 / 00006 35223 16024 - Apollo 15: 13:34:00 / 00000 32251 26157 - Apollo 16: 17:54:00 / 00011 13352 37740 - Apollo 17: 02:53:00 / 00020 34666 32261

LM Undocking Longitude

- Apollo 12: 83.0 E - Apollo 13: 87.0 E - Apollo 14: 88.0 E - Apollo 15: 110.5 E - Apollo 16: 121.0 E
- Apollo 17: 136.0 E

SIM Door Jettison GET: MCC-4 + 30 min or LOI - 4.5 hours, ATT (Local Horizontal): Apollo 15: P -135 Y +30 Apollo 16 & 17: P -113.8 Y +32

SUB-SAT Jettison GET: At ascending node, ATT (Local Horizontal): P +94.9 Y -0.2 R +91.4