



STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP
001	*LBL0	21 16 15	TOGGLE PRINTER(1) OR HANDHELD (0) MODES	058	GSB3	23 03	LOOP WITHIN SEGMENT	
002	F00	16 23 00		059	ST04	35 04		
003	GTO0	22 00		060	DSZ1	16 25 46		
004	SF0	16 21 00		061	GSB2	23 02		
005	0	00		062	RCL0	36 00		
006	RTN	24		063	+	-55		
007	*LBL0	21 00		064	ST05	35 05		
008	CF0	16 22 00		065	GSB1	23 01		
009	1	01		066	ST01	35 01		
010	RTN	24		067	GSB3	23 03		
011	*LBLA	21 11	LOAD THRUST CURVE TO SECONDARY REGS	068	ST03	35 03	INTERPOLATION	
012	P2S	16-51		069	RCL0	36 00		
013	RCL0	36 15		070	*LBL5	21 05		
014	ST01	35 01		071	ST06	35 06		
015	RCLD	36 14		072	RCL0	36 00		
016	ST02	35 02		073	-	-45		
017	RCLC	36 13		074	RCL5	36 05		
018	ST03	35 03		075	RCL0	36 00		
019	RCLB	36 12		076	-	-45		
020	ST04	35 04		077	÷	-24		
021	RCLA	36 11	078	ENT1	-21	← USING T REGISTER REPLICATION		
022	ST05	35 05	079	RCL4	36 04			
023	P2S	16-51	080	RCL3	36 03			
024	RCLI	36 46	081	-	-45			
025	ST0E	35 15	082	x	-35			
026	RTN	24	083	RCL3	36 03			
027	*LBLB	21 12	084	+	-55			
028	ST0A	35 11	085	X2Y	-41			
029	RTN	24	086	RCL2	36 02			
030	*LBLC	21 13	087	RCL1	36 01			
031	RCL8	36 08	088	-	-45	GRAVITY		
032	+	-55	089	x	-35			
033	EEX	-23	090	-	-45			
034	3	03	091	x	-35			
035	÷	-24	092	RCL1	36 01			
036	ST0B	35 12	093	+	-55			
037	RTN	24	094	RCLA	36 11			
038	*LBLD	21 14	095	RCL9	36 09			
039	2	02	096	X2	53			
040	EEX	-23	097	x	-35			
041	4	04	098	RCLC	36 13			
042	÷	-24	099	x	-35			
043	x	-35	100	-	-45			
044	ST0C	35 13	101	X2Y	-41			
045	RTN	24	102	RCLB	36 12			
046	*LBL0	21 15	103	X2Y	-41	GRAVITY		
047	ST0D	35 14	104	-	-45			
048	CLX	-51	105	÷	-24			
049	ST00	35 00	106	9	09			
050	ST07	35 07	107	.	-62			
051	ST09	35 09	108	8	08			
052	RCL0	36 15	109	-	-45			
053	ST01	35 46	110	ENT1	-21			
054	*LBL4	21 04	111	ENT1	-21			
055	ISZ1	16 26 46	112	2	02			
056	GSB1	23 01						
057	ST02	35 02						

REGISTERS

0 TIME	1 $NN.N_t$	2 $NN.N_{t+1}$	3 $GG.G_t$	4 $GG.G_{t+1}$	5 SEG TIME END	6 SEG TIME CURRENT	7 ALTITUDE CURRENT	8 ENGINE MASS	9 Velocity CURRENT	A Load
S0	S1 $T_5$	S2 $T_4$	S3 $T_3$	S4 $T_2$	S5 $T_1$	S6	S7	S8	S9	a
A AIR DENSITY	B Litrobb MASS	C $C_D * AREA / 2$	D $dt$	E $T_c$ Index INITIAL	I $T_c$ Index CURRENT					5 Loop SEG

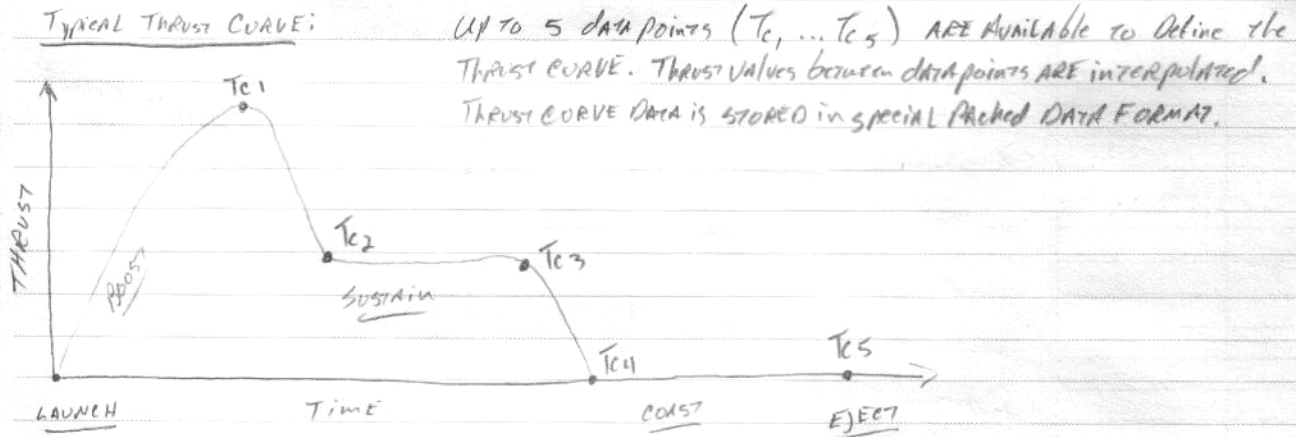


# Program Description

**Program Title** MODEL ROCKET PERFORMANCE II  
**Name** John GARZA (3665) **Date** JAN 3, 1998  
**Address** 405 S. RIVERSHIRE  
**City** CONROE **State** TX **Zip Code** 77304

**Program Description, Equations, Variables, etc.** This upgrade to my original MRP program takes into account Engine Thrust Curves instead of assuming a uniform thrust, and stores engine data on separate data cards.

$$\Delta H_{th} = \left( \frac{\text{Thrust} - \text{Density} * V^2 * CD * \text{Area} / 2}{\text{Mass} + \text{Fuel Mass}} - G \right) / 2 * DT^2 + V * DT + \Delta H_n$$

$$V_{th} = \left( \frac{\text{Thrust} - \text{Density} * V_n^2 * CD * \text{Area} / 2}{\text{Mass} + \text{Fuel Mass}} - G \right) * DT + V_n$$


THRUST CURVE DATA FORMAT:

0. NNN SS, 666 0  
 ↳ 66.6 (cumulative grams burned)  
 ↳ S.S (seconds this segment)  
 ↳ NNN (Newtons Thrust this segment)

$R_B$  = Engine Mass (including fuel) in grams  
 $R_I$  = Number of Thrust Curve Data points  
 $R_A - R_E$  = Thrust Curve Data in Above Format

NOTES ON DRAG COEFFICIENT ESTIMATES:

Alpha Rocket, NO paint, NO sanding:  $C_D = 0.98$   
 Alpha Rocket, sanded, painted, sq fins:  $C_D = 0.78$   
 Alpha Rocket, sanded, painted, airfoils:  $C_D = 0.65$   
 High Efficiency Design (ESES Sprint):  $C_D = 0.42$   
 Expert finish, airfoils, boat tail, small fins

SOURCE: ESES TR11  
ESES TR11



**Operating Limits and Warnings** According to ESES TR-11 p.41, it's NOT uncommon to HAVE  $\pm 5\%$  variation in Altitude using AB-5 Engines in Identical Alpha Rockets.