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AGS Internal Targets Operation Note

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J. Ryan and E. Gill

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Purpose

This note describes how to use the flipping targets located in the AGS ring at J-5, D-15 and J-19. To use these targets, a program called TGT in R-R must be used and an AGAST panel must be used. The targets can be used to shave the beam or to measure the beam size.

Authors

1. R-R TGT - R. Thern
2. Target motors and controls - E. Gill, S. Naase, J. Gabusi

Target Locations

At present there are two horizontal locations and one vertical. The horizontal targets cut into the beam horizontally and the vertical targets, vertically. The horizontals are located at J-5 (Beta max) and D-15 (Beta min), and the vertical at J-19 (Beta max).

Description of Geometry

Figure 1 shows a block diagram of the system. A flip motor is used to flip a target 90° from one limit position to another limit. The motor current magnitude and direction determine when the motor flips the target up into the beam or when the target is flipped down.

Figure 2 shows the geometry of the D-15 target. Figure 2 shows only one target at D-15, the D-15HO or D-15 horizontal outer target. Figure 3 shows that two targets are located on the same transversal mechanism--the D-15HO and D-15HI. Hardware prevents both targets from being up at the same time.

The flip target motor is controlled with the R-R TGT program. The target transversal motor is controlled with AGAST. For D-15, the transversal motor is RTD15. For J-5 and J-19, the beam axis is Ø. Sending Ø to AGAST to RTD15 moves the transversal mechanism until x = Ø. Nominally for x = + 2300, the RTD15 and RTJØ5 move to the right or to the outside of the ring. For x = - 2300, the target moves to the inside of the ring and may intercept all of the beam if flipped up. For x = + 2300, the vertical target transversal motor moves the mechanism down below the center line. A negative x moves the mechanism above the center line. The AGAST readback is approximately (± 20%) of x in mils. A program TARCAL is available to convert AGAST readbacks to the true distance x. This calibration data will be added to the TGT program in the future.

Figure 3 shows that x is the same for both the HO and HI targets. The targets are displaced about one inch in the beam direction so that they never touch. They can not both be flipped up at the same time. Figure 2 shows a readback pot connected to each flip target. The location of each target is determined by observing the voltage waveform on the pot by selecting with AGAST which pot is connected to the flipping target multiplexer TFMXA and TFMXB. These outputs can be observed at the injection console TGTTPTA or TGTTPTB outputs.

Figure 4 shows that D-15HO is connected to TGTTPTA (TFMXA) and D-15HI to TGTTPTB (TFMXB) outputs. The D-15 mechanism is + 1.492 inches nominally from the center line to the outside of the ring (x = + 1.492).

Flipping the Target

From the enclosed schematic of Figure 1, the target is flipped up when a positive current is sent to the motor. The motor is suddenly stopped by reversing the current. The motor is held in position by giving a small positive current. Therefore, when the motor is pulsed determines how long the target is up and also how fast it goes up. It is possible to drive the motor so that the target bounces. The target position can be observed from the TGTTPT outputs.

A typical current waveform to the motor is shown in Figure 5.

From Figure 1, the function generator and amplifier produces this current waveform to the motor once each AGS cycle. The R-R TGT program is used to load the function generator with the six necessary amplitudes (A1 - A6) and the six times (T1 - T6) and to turn the flip motor on/off.

Description of the TGT Program

Figure 6 gives the HELP file for R. Thern's TGT program. The program does more then just control the flipping targets. It is also used to record data of the position of the target and certain AGS parameters (L15 current, etc.) used by R. Thern to measure the beam size at different times in the AGS cycle. Sizes are measured by moving a target into the beam using the transversal motor until the L15 indicates a beam loss of 5 percent.

The HELP file is divided into four sections:

A. Control for TGT Program

B. Target selection

C. Target control, TIME/AMP

D. Data control

For operations needs, the sections A - C are only important. This program is only used to load the function generator and turn on the motor. The function generators can be loaded, however, in several different ways. Two different function generators can be used and connected to any of the six flipping motors at the three different ring positions.

Figure 7 shows the simplest means to start the D-15HI target flipping:

1. The function generator to be loaded is specified "A".
2. The target connected to this function generator is #1 (D-15HI).
3. RESTORE goes to the disk and retrives the D-15HI TGT file from (25,27) and loads this into the function generator "A".
4. "ON" turns the flipping motor on.
5. ↑C ↑C exits the programs keeping the motor flipping.

The other commands are used to change this data.

1. FG--goes back to the function generator question.
2. DEF--select the new target channel.
3. NAME--change the name of the file that will have the amplitude and times for the function generator. It assumes initially that the file has the same name as the target name.
4. RESTORE--restore data from NAME.TGT in (25,27).
5. SAVE--save modified data on NAME.TGT file.

Section C can be used to change the amplitudes and times sent to the function generator. These can be changed in several ways depending on the operator's desires.

6. AMP and TIME commands: these commands will give the existing AMP and TIMES (refer to Figure 5).

A1--acceleration up current (TYP = + 1000) at T1 (ms after TØ).

A2--up brake current (TYP = - 800) at T2 (time motor brake turned on).

A3--up holding current (TYP = + 400) at T3 (time target position is held in the beam).

A4--down acceleration current (TYP = - 900) at T4 (time flip target is started down).

A5--down braking current (TYP = + 400) at time the brake is turned on (T5).

A6--down holding current (TYP = - 400) at T6 (time when target is down).

These amplitudes and times must be chosen to produce a target that does not bounce. Figure 8 shows a scope waveform for a target flipping properly. The AU, BU, HU, AD, BD, HD can be used to change each pair of amplitude and times or the DELTA command will change the amplitudes by a fixed percentage. Once the bounce is eliminated, the UP time and DWELL time can be given and the program calculates the new A's and T's to change the start and dwell times. Once this data is found, the "OUT" command will output the new amplitudes and times to the function generator and change the target flipping times. The function generator must be "on" to flip the target.

Examples

The following examples are given:

1. Turn off all fliping targets. Stop them from flipping.
2. Keep a target up always so that it can be observed in the ring.
3. Simple way to flip targets.
4. Flip target and vary amplitudes and times.

Problems

As of June 10, 1981, all flipping targets work properly except at J-5. The J-5 target works properly, but it is misnamed. The J-05HI target is actually the outer target--it should be named J-05HO. The J-05HO is actually the inner target.

If the beam is off, one can go into the ring and watch the target flipping through the glass windows at the target locations.

If the beam is on, one should move the target to the outer limit (+ 2000 for H), - 2000 for HI, + 2000 for VL, - 2000 for VU) and start flipping the target observing the TGTTPA multiplexer output and the L15 current transformer.

The drive (RTJ05, etc.) should be driven into zero. When the target intercepts the beam, the L15 will have a notch in it and read lower or disappear.

A typical printout that the program can produce if "RON" command is used, is shown in Figure 13. R. Thern uses this data to calculate beam widths at different times in the AGS cycle.

Due to electronic problems in the hardware, the location "x" is only approximately the AGAST readback and the error is a function of "x" and is not constant. The drives have been calibrated with vernier calipers and this data is in the program R-R TARCAL.

EXAMPLE

Address 1376
1367
PPC

Select Motor

MPX
A B

RING

FLIP MOTOR

RELAY SW.
D11-E466-2
D11-E467-3

Hold Supply
D11 E467-2

A

ADDRESS (FUNCTION GEN
1376 PPC

D11-E82-3

D11-E468-2

FUNCTION GEN. D09-E659-3

B

ADDRESS
1377 PPC

READ TPT OUT

MPX

A

B

MCR

DRIVE Motor

D09-E834-3

DRIVE Amp. & RELAY Switch

D/A

A/D

MPX

6.8A SURGE
2A D.C

10K 3T.

Down = 5ow ± 2ms
Up = 15ow ± 2ms

Address 0055 PPB J5
0059 PPB J19
—— PPB D15

Figure 1

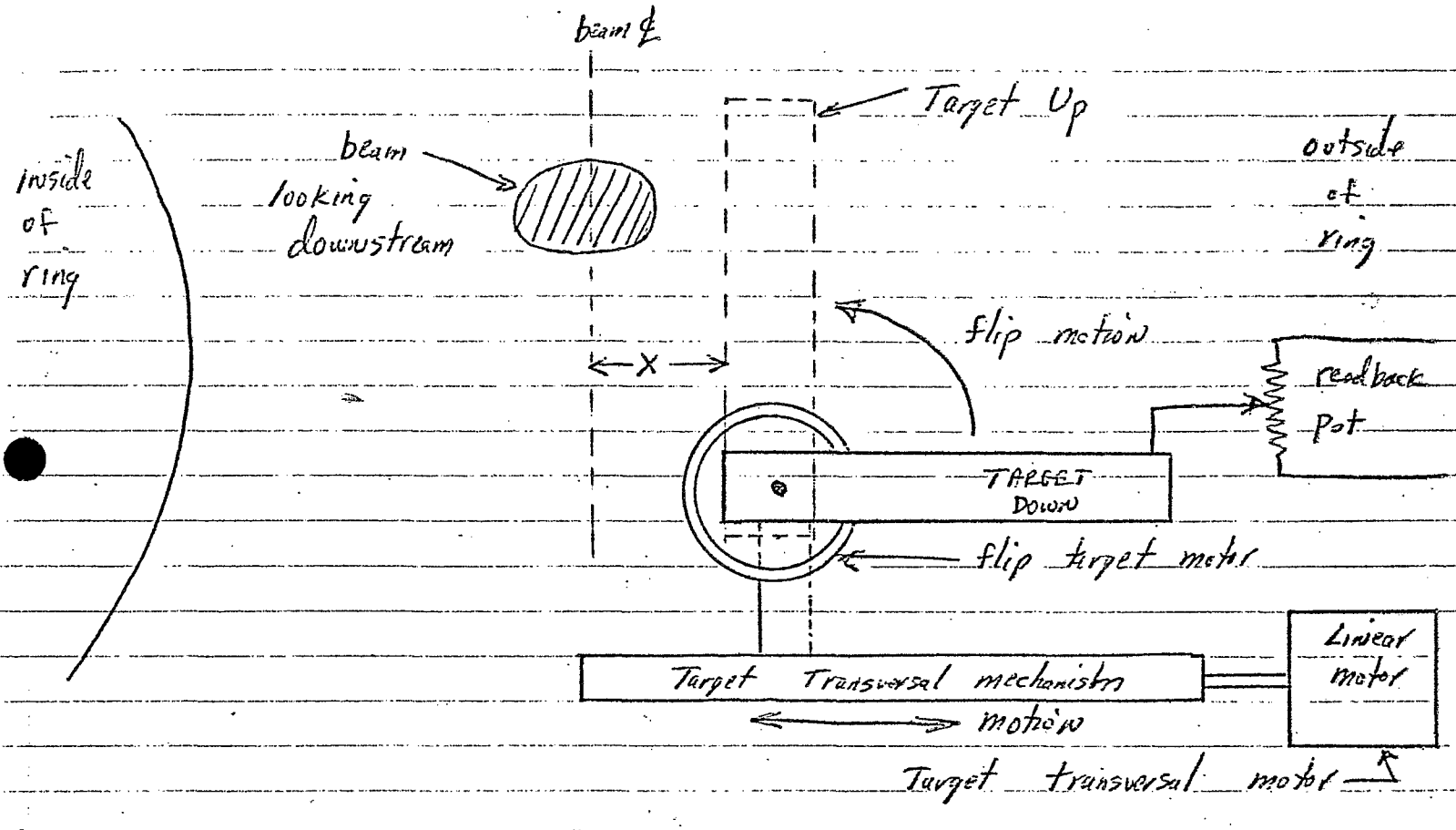

Figure 2 - Target Geometry, D15

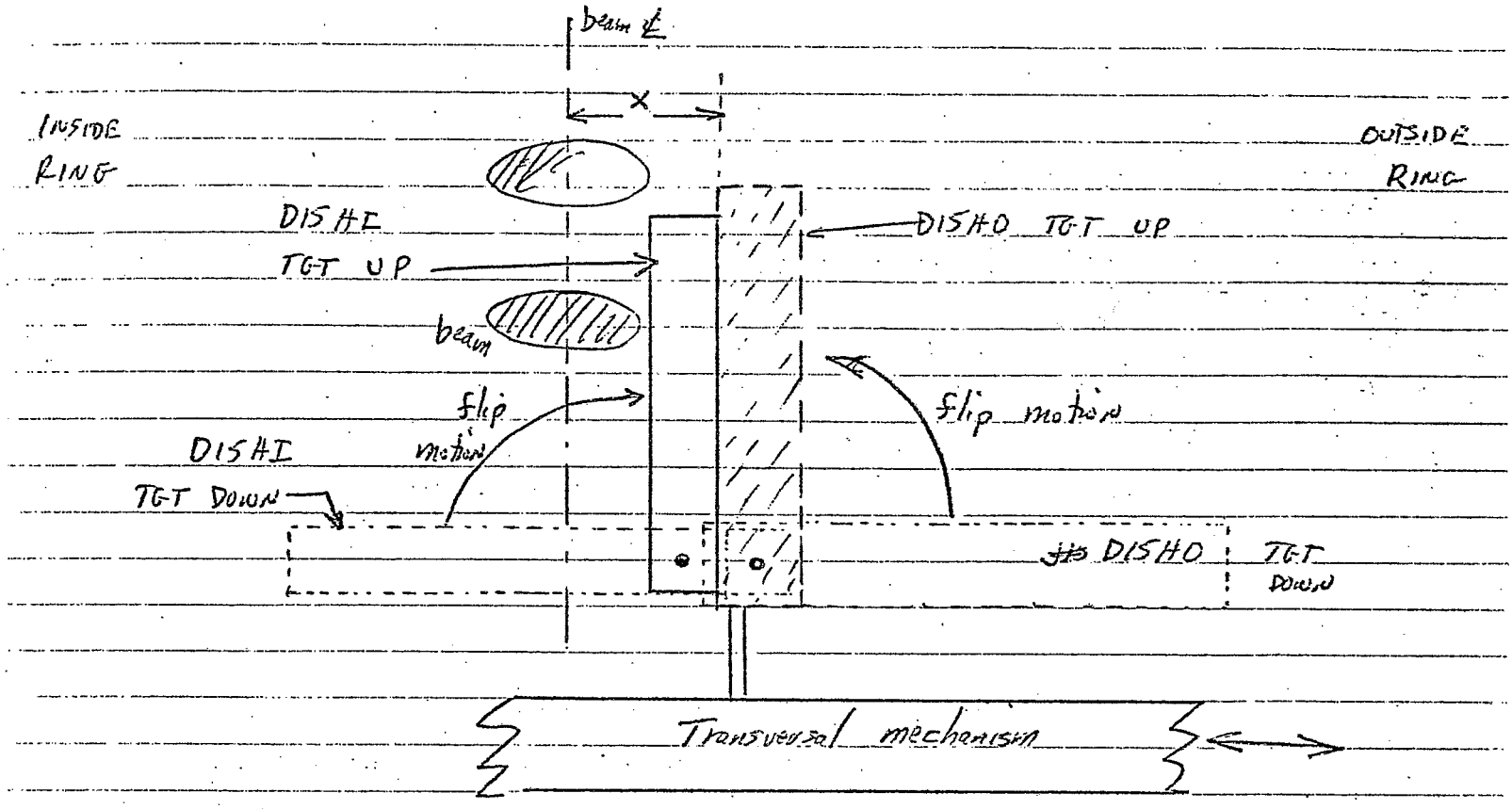

Figure 3

RIN TARGT 9-Jun-81 14:51 33.2
TIME= 40 PRIORITY= 2

	AREA	EQPT	REQUEST		READBACK	
1	RIN	D15HO	0		215	-215
2	RIN	D15HI	1		115	-114
3	RIN	J05HO	2		510	-508
4	RIN	J05HI	3		610	-607
5	RIN	J19VU	4		410	-406
6	RIN	J19VL	5		500	-495
7	RIN	SPAT1	6		0	6
8	RIN	SPAT2	7		0	7
9	SEB	RTJ05	-2300	ON	-2012	-288
10	SEB	RTJ19	-2200	ON	-2240	40
11	SEB	RTD15	1500	ON	1492	8
12	RIN	TFMXA		0		
13	RIN	TFMXB		1		

Figure 4

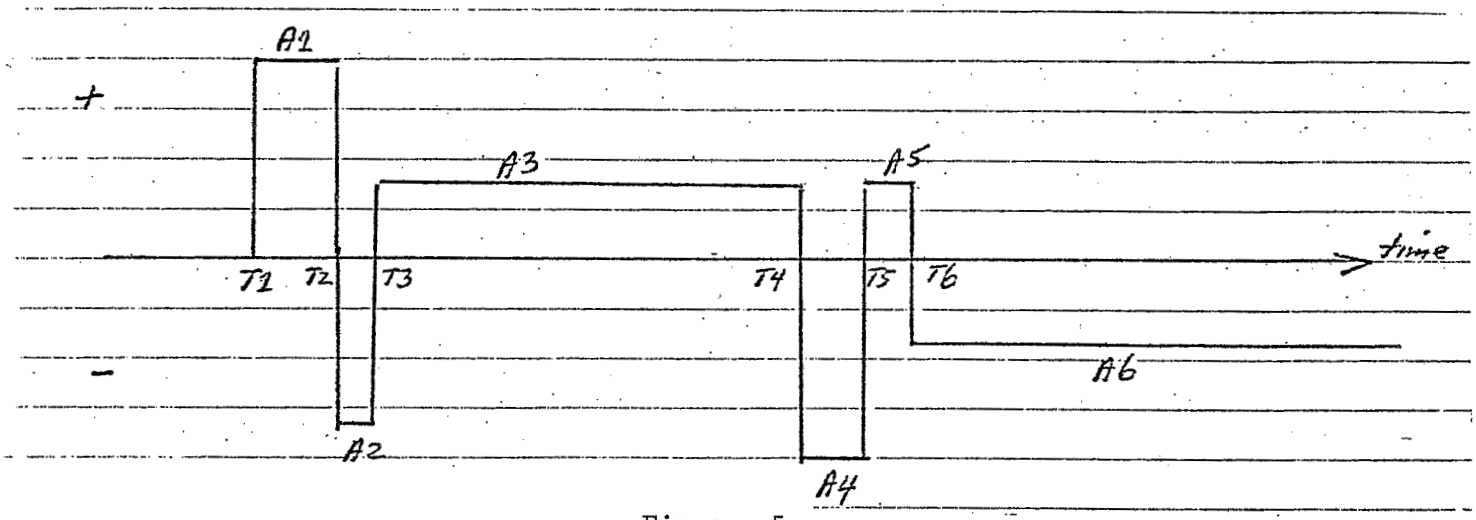

Figure 5

```
→CONTROL FOR TGT PROGRAM:
  INIT      REINIT PDP8 ETC
  EXIT      EXIT (BETTER THAN ^C)
→TARGET SELECTION: ———
  FG        SELECT FUNCTION GENERATOR
  DEF       SELECT TARGET CHAN NO.
  NAME      CHANGE NAME OF SAVE/RESTO
  RESTO     RESTORE TIME/AMP FROM FILE
  SAVE      SAVE TIME/AMP IN 'NAME'.TGT
→TARGET CONTROL, TIME/AMP
  TIME      SET 6 FUNCTION TIMES
  AMP       SET 6 FUNCTION AMPLITUDES
  AU BU HU  SET ACCEL,BRAKE,HOLD-
  AD BD HD  TIME+AMP FOR UP/DOWN
  UP        SET UP TIME
  DWELL     SET DWELL TIME
  DELTA     VARY AMP'S BY N%
  OUT       OUTPUT FUNCTION TO F.G.
  ON        TURN F.G. ON
  OFF       TURN F.G. OFF
→DATA CONTROL:
  RON       TURN DATA MODE ON
  ROFF      TURN DATA MODE OFF
  SA        SET SAMPLE TIME
  DL        SET TGT RISE TIME AND LOSS WIN
  EL        SET EARLY+LATE FIXED TIMES
  DA        TAKE DATA POINT
  NP        NO. OF AGS PULSES FOR DATA POI
  IFLAG     DATA TYPEOUT CONTROL:
     =3     TYPE MAGNITUDES
     =4        .  .+ READ TIMES
     =5        .  .+ AGS PULSE NO.

     =6      TYPE LOSS %
     =7        .  .+PRE/POST LOSS %
  EF        ENDFILE LPT OUTPUT,START NEW
  AV        TYPE CUMULATIVE AVERAGES
  RS        RESET AVERAGES
```

Figure 6 - TGT HELP File

```
R R
TGT

 #FUNCTION (A) : A

SPAT1 (0006) : 1
FG=A CHN=01/76 D15HI   UP,SAMPL,DN @ 100 200 100, XXXXX @  9999 OFF
^
FG=A CHN=01/76 D15HI   UP,SAMPL,DN @ 100 200 100, XXXXX @  9999 OFF
RESTORE
ON
^
FG=A CHN=01/01 D15HI   UP,SAMPL,DN @ 150 200 205, RTD15 @ -1986  ON
^
↑C
↑C
```

Figure 7

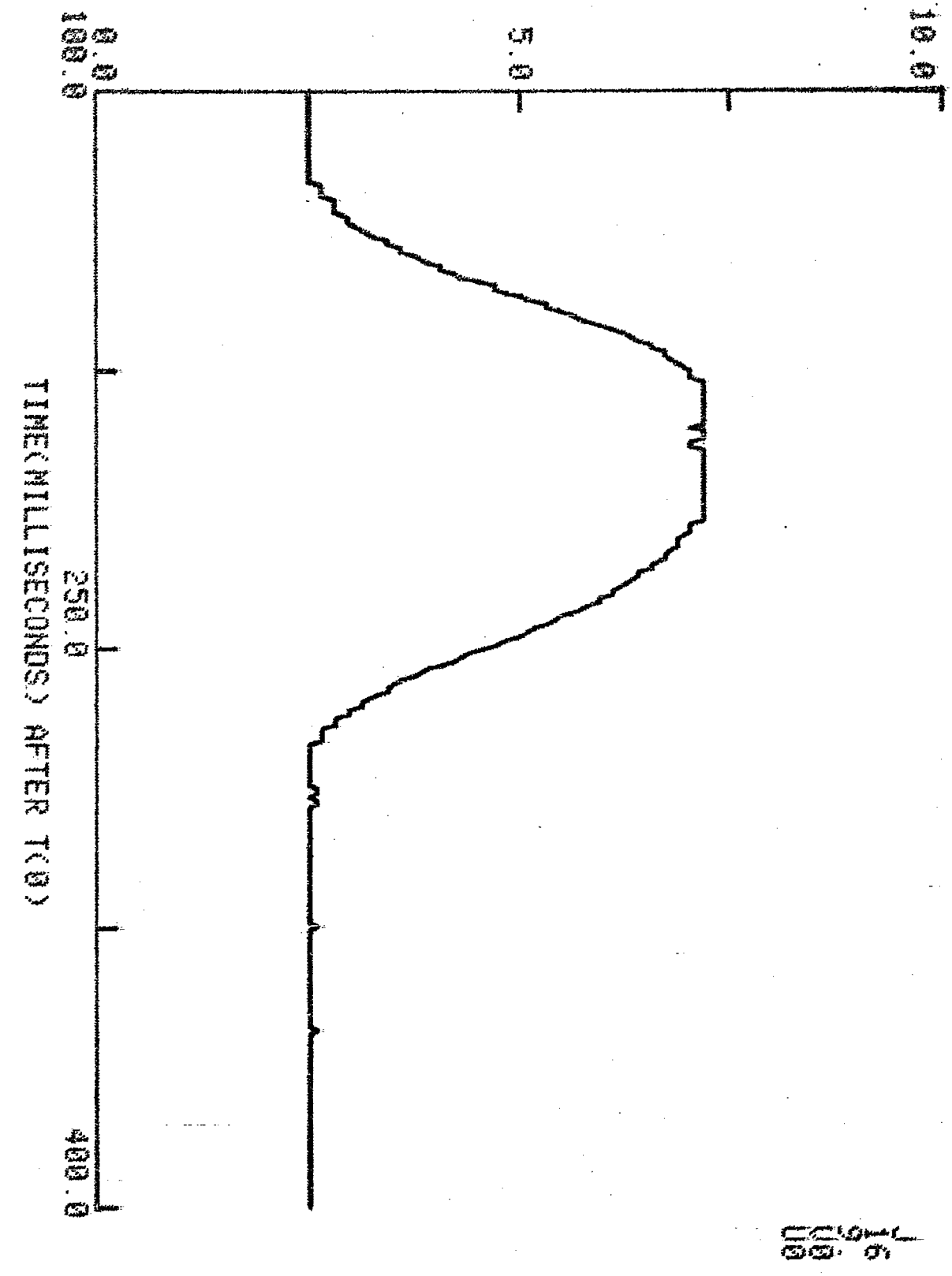

Figure 8 - Typical target flipping

```
R R

TGT

 *FUNCTION (A): A

 SPAT1 (0006) : 1
 FG=A CHN=01/76 D15HI  UP,SAMPL,DN @ 100 200 100, XXXXX @  9999 OFF
 ^
 FG=A CHN=01/76 D15HI  UP,SAMPL,DN @ 100 200 100, XXXXX @  9999 OFF
 EXIT

 CPU TIME: 0.61  ELAPSED TIME: 22.10
 NO EXECUTION ERRORS DETECTED

 EXIT
```

EXIT CMD -- TURNS off all flipping TGTS.

Example 1--Turn off all flipping targets.

Figure 9

```
R R
T
GT

 *FUNCTION (A) : A

SPAT1 (0006) : 1
FG=A CHN=01/76 D15HI  UP,SAMPL,ON @ 100 200 100, XXXXX @  9999 OFF
RESTORE
ON
^
FG=A CHN=01/01 D15HI  UP,SAMPL,ON @ 150 200 205, RTD15 @ -1383  ON
UP
UP ( 150 MS) : 300
DWELL
DWELL (  10 MS) : 300
^
FG=A CHN=01/01 D15HI  UP,SAMPL,ON @ 300 350 645, RTD15 @ -1381  ON
AMP
AMPLITUDES ( 1000, -800,  400, -800,  300, -400)
           : 1000,1000,1000
OUT
^
FG=A CHN=01/01 D15HI  UP,SAMPL,ON @ 300 350 645, RTD15 @ -1386  ON
TIME
TIMES ( 300, 337, 345, 645, 680, 705)

^C

EXIT

.^C
```

TGT not flipping

Just get old information and turn TGT on

transverse mechanism dis = "X"

TGT flipping

change up time or start of flip from 150 ms to 300 ms after TP

change time target is up from 10 ms to 300 ms

get amplitudes

output info. to F. Generator

now, every run keeps tgt up always.

now TGT up always.

TGT left up & pgm ended.

Example 2--Make some modifications to start of flipping and time up and then keep a target up always.

Figure 10

```
R R
T
GT

 *FUNCTION (A) : A

 SPAT1 (0006) : 1
 FG=A CHN=01/76 D15HI  UP,SAMPL,DN @ 100 200 100, XXXXX @  9999 OFF
 RESTORE ──────────────────────────────→ get old information
 ON  ──────── Turn F.G. on
 X
 FG=A CHN=01/01 D15HI  UP,SAMPL,DN @ 150 200 205, RTD15 @ -1585  ON
 ^C
 ^C  ──────→ TOT left flipping & PGM exit.

 EXIT
```

Example 3--Simple way to flip targets.

Figure 11

```
R R
TGT

 *FUNCTION (A) : A

SPATI (0006) : 1
FG=A CHN=01/76 D15HI  UP,SAMPL,DN @ 100 200 100, XXXXX @  9999 OFF
RESTORE
AN
UP
UP ( 150 MS) : 300
DWELL
DWELL ( 100 MS) : 200
AMP
AMPLITUDES ( 1100, -880,  440, -880,  330, -440)
           : <CR>
AU
AU     AMP,TIME=   1100    37 : 2000,40
^
FG=A CHN=01/01 D15HI  UP,SAMPL,DN @ 300 350 548, RTD15 @ -1185  ON
AMP
AMPLITUDES ( 2000, -880,  440, -880,  330, -440)
           : <CR>
TIME
TIMES ( 300, 340, 348, 548, 583, 608)
      : <CR>
AU
AU     AMP,TIME=   2000    40 : 2500,50
AMP
AMPLITUDES ( 2047, -880,  440, -880,  330, -440)
           : <CR>
TIME
TIMES ( 300, 350, 358, 558, 593, 618)
      : <CR>

↑C
↑C
```

Example 4--Varying amplitudes and times.

Figure 12

KE DATA POINT AT 300 MSEC WITH 10 PULSES

-Jun-81	23:19:36.3	TARGET J19VU AT			235	276	295	305	350	370 MSEC														
O	AGS	RXL15	RXL15	RXL15	RXL15	RXL15	RXL15	D14DF	SUMDF	GSCUP	RTJ19	J19VU	2-3	3-4	4-5	TIME ERRORS								TGT
MES---		55	287	290	310	313	600	300	300	300	300	300				1	2	3	4	5	6	7	8	91011	
1	1393	155	136	136	126	126	-4	-1	-4	26028	-381	1345	0.00	7.35	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
2	1394	147	136	137	126	126	-5	47	-5	26250	-381	1340	-0.74	8.03	0.00	1	0	0	0	0	0	0	2	1 0 0	ON
3	1395	166	145	145	133	133	-5	47	-5	26024	-381	1340	0.00	8.28	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
4	1396	161	143	144	134	134	117	47	-5	26021	-381	1345	-0.70	6.94	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
5	1397	169	147	148	136	136	117	31	-5	26024	-381	1340	-0.68	8.11	0.00	1	0	0	0	0	0	0	2	1 0 0	ON
6	1398	144	128	128	119	119	-5	-1	-5	26022	-381	1340	0.00	7.03	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
7	1399	159	143	143	132	132	115	-1	-5	26249	-381	1345	0.00	7.69	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
8	1400	140	123	123	114	114	97	-1	-5	26024	-381	1345	0.00	7.32	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
9	1401	152	136	136	126	126	108	63	-5	26026	-381	1340	0.00	7.35	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
0	1403	172	152	152	141	141	-5	47	-5	26023	-381	1345	0.00	7.24	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
ERAGE, RMS, MIN, MAX FOR 10 PULSES																									
AMES		RXL15	RXL15	RXL15	RXL15	RXL15	RXL15	D14DF	SUMDF	GSCUP	RTJ19	J19VU	2-3	3-4	4-5										
VERAGE		156.5	138.9	139.2	128.7	128.7	53.0	27.8	-4.9	26069.	-381.	1342.5	-0.211	7.534	0.000										
MS		10.27	8.40	8.52	7.71	7.71	58.05	24.58	0.30	90.24	0.00	2.50	0.323	0.442	0.000										
IN		140.0	123.0	123.0	114.0	114.0	-5.0	-1.0	-5.0	26021.	-381.	1340.0	-0.735	6.944	0.000										
AX		172.0	152.0	152.0	141.0	141.0	117.0	63.0	-4.0	26250.	-381.	1345.0	0.000	8.276	0.000										

KE DATA POINT AT 300 MSEC WITH 10 PULSES

-Jun-81	23:20:05.4	TARGET J19VU AT			235	276	295	305	350	370 MSEC														
O	AGS	RXL15	RXL15	RXL15	RXL15	RXL15	RXL15	D14DF	SUMDF	GSCUP	RTJ19	J19VU	2-3	3-4	4-5	TIME ERRORS								TGT
MES---		55	287	290	310	313	600	300	300	300	300	300				1	2	3	4	5	6	7	8	91011	
1	1411	165	147	147	136	136	135	-1	-5	26024	-381	1345	0.00	7.48	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
TA, TIME, OR PULSE ERR			4	0	0																			
1	1412	126	-5	-4	-4	-4	-4	31	-5	26036	-381	1345	20.00	0.00	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
2	1413	178	152	152	152	151	150	47	-5	26019	-458	1345	0.00	0.00	0.66	0	0	0	0	0	0	0	2	1 0 0	ON
3	1414	145	126	127	127	126	125	-1	-5	26021	-482	1345	-0.79	0.00	0.79	0	0	0	0	0	0	0	2	1 0 0	ON
4	1415	170	146	146	146	146	145	63	-5	26019	-482	1340	0.00	0.00	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
5	1416	146	128	129	129	129	127	-1	-4	26021	-482	1340	-0.78	0.00	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
6	1417	165	143	144	130	130	131	47	-5	26021	-231	1340	-0.70	9.72	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
7	1418	154	135	136	126	126	126	63	-5	26024	-381	1340	-0.74	7.35	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
8	1419	162	143	143	131	131	131	-1	-5	26022	-378	1340	0.00	8.39	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
9	1420	145	125	126	116	116	116	47	-5	26026	-378	1340	-0.80	7.94	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
0	1421	178	157	156	154	154	155	-1	-5	26023	-438	1340	0.64	1.28	0.00	1	0	0	0	0	0	0	2	1 0 0	ON
ERAGE, RMS, MIN, MAX FOR 10 PULSES																									
AMES		RXL15	RXL15	RXL15	RXL15	RXL15	RXL15	D14DF	SUMDF	GSCUP	RTJ19	J19VU	2-3	3-4	4-5										
VERAGE		160.3	140.2	140.6	134.7	134.5	134.1	26.2	-4.9	26022.	-409.	1341.5	-0.318	4.217	0.145										
MS		11.52	10.61	10.04	11.64	11.56	11.64	27.76	0.30	2.83	73.76	2.29	0.481	4.023	0.291										
IN		145.0	123.0	126.0	116.0	116.0	116.0	-1.0	-5.0	26019.	-482.	1340.0	-0.800	0.000	0.000										
AX		178.0	157.0	156.0	154.0	154.0	155.0	63.0	-4.0	26026.	-231.	1345.0	0.637	9.722	0.787										

Figure 13 - Typical file output

KE DATA POINT AT 300 MSEC WITH 10 PULSES

-Jun-81	23:20:51.6	TARGET J19VU AT			235	276	295	305	350	370 MSEC														
O	AGS	RXL15	RXL15	RXL15	RXL15	RXL15	RXL15	D14DF	SUMDF	GSCUP	RTJ19	J19VU	2-3	3-4	4-5	TIME ERRORS								TGT
MES---		55	287	290	310	313	600	300	300	300	300	300				1	2	3	4	5	6	7	8	91011	
1	1440	151	131	131	125	125	125	31	-5	26018	-394	1350	0.00	4.58	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
2	1441	176	152	152	144	144	144	-1	-5	26246	-394	1350	0.00	5.26	0.00	0	0	0	2	0	0	0	2	1 0 0	ON
3	1442	157	136	137	130	130	130	55	-5	26017	-394	1350	-0.74	5.11	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
4	1443	163	141	141	133	133	133	31	-5	26023	-394	1350	0.00	5.67	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
5	1444	159	140	140	132	132	133	-1	-5	26022	-394	1345	0.00	5.71	0.00	0	0	0	0	0	0	0	2	1 0 0	ON
6	1445	163	145	145	137	137	137	31	-5	26025	-394	1345	0.00	5.52	0.00	1	0	0	0	0	0	0	2	1 0 0	ON

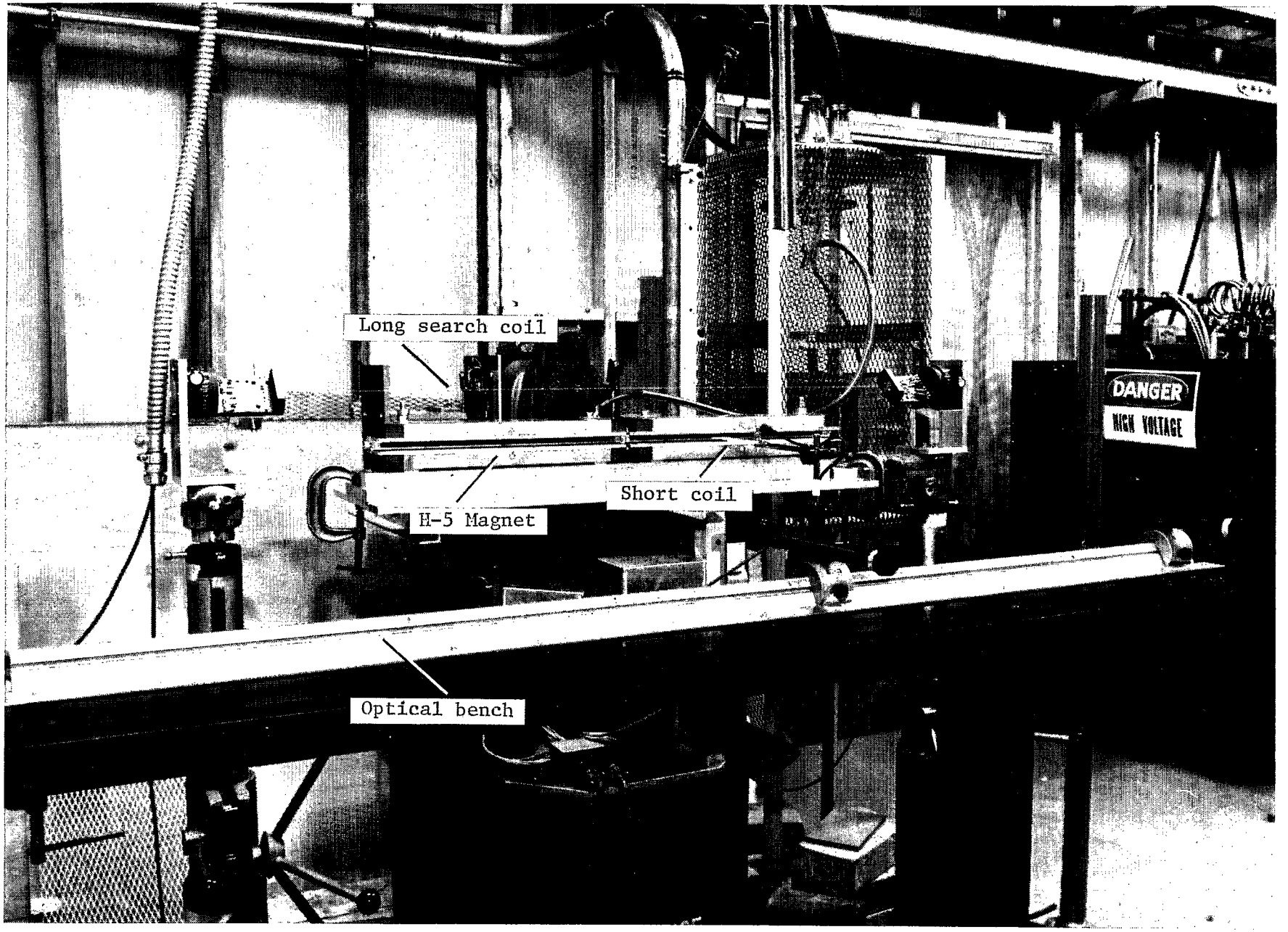

Fig. 6. Layout of test apparatus