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 $\emptyset$. Sending $\emptyset$ to AGAST to RTD15 moves the transversal mechanism until $x = \emptyset$. Nominal for $x = +2300$, the RTD15 and RTJ$\emptyset$5 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 ($\pm$ 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 than 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 retrieves 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 T0).
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 flipping 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.
Figure 1

Down = 500 + \frac{300}{n}

Address = 0059 pp8 ppg 015

Address 1376 ppm

Address 1377 ppm

Example: 0

SELECT MOTOR

FUNCTION: DOG-E659-3

1377 ppm

ADDRESS (FUNCTION)

1376 ppm

B

A

\text{DOG-E963-2}

\text{DOG-E854-3}

\text{RELAY SW.

\text{AIR SUPPLY

\text{DRIVE AMP

\text{RELAY SWITCH

\text{DRIVE MOTOR

\text{RING

\text{FLIP MOTOR

\text{SURGE
Figure 2 - Target Geometry, D15
Figure 3

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<th>READBACK</th>
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</table>

Figure 4
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
FUNCTION 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

22-JUN-81 10:57 T0  1KHZ RPL B DATA
Example 1--Turn off all flipping targets.

Figure 9
*FUNCTION (A) : A

SPAT1 (0006) : 1

FG=A CHN=01/01 D15HI UP, SAMPL, DN @ 150 200 205, RTD15 @ -1381 ON

Dwell (10ms) : 300

UP (150ms) : 300

AMP get &phib

AMPLITUDES (1000, -800, 400, -800, 300, -400)

OUT : 1000, 1000, 1000

FG=A CHN=01/01 D15HI UP, SAMPL, DN @ 300 350 645, RTD15 @ -1386 ON

TIME TIMES (300, 337, 345, 645, 680, 705)

EXIT

Example 2 -- Make some modifications to start of flipping and time up and then keep a target up always.
Example 3---Simple way to flip targets.

Figure 11
**Example 4—Varying amplitudes and times.**

*Figure 12*
| Time | Data | Figure 13 - Typical file output |
Fig. 6. Layout of test apparatus