

Chapter 46 - The Rotozoomer In BASIC

The first real demo effect is the rotozoomer. A texture is rotated and scaled across the screen every frame. On Intuition Engine, BASIC does not draw every pixel. BASIC computes the affine parameters, then the VideoChip Mode 7 blitter draws the frame.

The supplied BASIC demo `rotozoomer_basic.bas` uses this pattern:

1. Allocate a front buffer, a back buffer, a texture, and music staging memory.
2. Load a texture and start SID playback.
3. Compute angle and zoom each frame.
4. Convert the values to 16.16 fixed point.
5. Run `BLIT MODE7` into the back buffer.
6. Run `BLIT MEMCOPY` to present the finished frame.
7. `VSYNC`, advance the phases, and repeat.

46.1 Mode 7 In One Listing

This small version uses a generated checker texture instead of a file.

```
10 REM SMALL BASIC ROTOZOOMER
20 FB=MEMALLOC(1228800,4096):BB=MEMALLOC(1228800,4096)
30 TB=MEMALLOC(262144,4096):ST=1024:FP=65536
40 POKE32 &H000F0004,0:POKE32 &H000F0080,0
50 POKE32 &H000F0084,FB:POKE32 &H000F0000,1
60 BLIT FILL TB,128,128,&H003060A0,ST
70 BLIT FILL TB+128*4,128,128,&H00A06030,ST
80 BLIT FILL TB+128*ST,128,128,&H00A06030,ST
90 BLIT FILL TB+128*ST+128*4,128,128,&H003060A0,ST
100 A=0:Z=0
110 SC=0.5+SIN(Z)*0.3:IF SC<0.2 THEN SC=0.2
120 CA=COS(A)/SC:SA=SIN(A)/SC
130 DC=INT(CA*FP):DS=INT(SA*FP)
140 U0=INT((128-320*CA+240*SA)*FP)
150 V0=INT((128-320*SA-240*CA)*FP)
160 BLIT MODE7 TB,BB,640,480,U0,V0,DC,DS,0-DS,DC,255,255,ST,2560
170 BLIT MEMCOPY BB,FB,1228800
180 VSYNC
190 A=A+0.03:IF A>6.28318 THEN A=A-6.28318
200 Z=Z+0.01:IF Z>6.28318 THEN Z=Z-6.28318
210 GOTO 110
```

Expected result: the checker texture rotates and zooms across the screen. The picture is rendered into BB first, then copied to FB.

46.2 The Fixed-Point Step

Mode 7 uses 16.16 fixed-point values. The upper 16 bits are the whole texture coordinate. The lower 16 bits are the fractional part.

In BASIC:

```
FP=65536
DC=INT(CA*FP)
DS=INT(SA*FP)
```

If CA is 1.0, DC becomes 65536. That means "advance one texture pixel for each screen pixel". If CA is 0.5, DC becomes 32768. That means "advance half a texture pixel per screen pixel".

The same rule applies to U0, V0, duCol, dvCol, duRow, and dvRow.

46.3 The Matrix

The blitter uses this mapping:

```
U = U0 + col * duCol + row * duRow
V = V0 + col * dvCol + row * dvRow
```

For a rotation and zoom:

```
duCol = cos(A) / scale
dvCol = sin(A) / scale
duRow = -sin(A) / scale
dvRow = cos(A) / scale
```

The BASIC listing writes 0-DS instead of -DS in the argument list. That is a safe spelling for a negative value in IE64 BASIC expressions.

46.4 Double Buffering

The Mode 7 draw goes to BB, not directly to the displayed framebuffer:

```
160 BLIT MODE7 TB, BB, 640, 480, U0, V0, DC, DS, 0-DS, DC, 255, 255, ST, 2560
170 BLIT MEMCOPY BB, FB, 1228800
180 VSYNC
```

The important number is 1228800: 640 * 480 * 4. BLIT MEMCOPY takes a byte count, not a pixel count.

This is a simple back-buffer method. More advanced machine-code versions often present by changing VIDEO_FB_BASE at VBlank.

46.5 Music Beside Visuals

The full BASIC demo starts SID playback before the frame loop. Once the player is running, the visual loop does not call it every frame:

```
SA=MEMALLOC(4096, 4096)
BLOAD "YUMMY.SID", SA
SID PLAY SA, 3725
POKE8 &H000F0E18, 15
```

The point is architectural. Audio is another card on the same machine. The CPU starts it, then keeps drawing while the audio engine advances in parallel.

46.6 What To Change

Change	Effect
Line 110, change 0.3	Zoom depth.
Line 190, change 0.03	Rotation speed.
Line 200, change 0.01	Zoom pulse speed.
Lines 60 to 90	Texture colours.
Line 170, copy less than 1228800	Only part of the frame is presented.

Chapter 47 drives the same VideoChip registers from IE Script so the effect can be used as a repeatable laboratory experiment.