

# Early Block Change

## Overview



**Early Block Change (EBC) allows the system to start the execution of the next NC block before the current block has completed its execution. This allows for faster machining cycle times and the ability to execute asynchronous movements within the part-program.**

### Overview

NUM's new firmware feature named Early Block Change (EBC), G-code G777, gives the user the ability to begin execution of the next block of code while the current block is still executing. This allows the machine to be performing two blocks of machine motion at one time. This feature gives users the ability to dramatically speed up production cycles in many different industries.

The EBC function also provides a very fast signal exchange between the PLC and the part program, allowing the PLC to control machine motion and get information about program execution using 32 dedicated input and 32 dedicated output bits.

Furthermore, the NCK communicates to the PLC when certain conditions in the program execution have been reached, allowing the PLC to start auxiliary operations without the need to program M functions – and thus without stopping any axis motion.

All of these features are easily programmed with a single G function and a few parameters.

### Early Block Change Rules

Two NC code block can be run at the same time as long as these simple rules are followed:

- Only one additional block can be run at a time. If a third block of code was triggered to begin execution while the first two were still executing, the system will wait for one of the first two to complete its movement before starting the third.
- The same axis cannot be programmed on two consecutive blocks; if they were, the EBC simply will not occur.
- Auxiliary functions (S, T, and some M codes etc.) will prevent EBC. F and Go are always allowed and some M codes are allowed.

### G-Code Features

G777[+] [Q..] [D..] [I..] [O..] [R..] [P..]

The G777 code can be added to a single block to allow EBC or bit control on that single block. G777+ activates the modal EBC feature, which remains active until a G777- is programmed, the program ends, or a Reset command is given.

### Scope (NCK)



[Q..] selects the mode of EBC functioning.

- Q1: Begin next block after traveling some distance from the start of the current block.
- Q2: Begin next block when the current block is some distance from the end position.
- Q3: Begin next block when given an input by the PLC.
- Q4: Immediate EBC, next block starts immediately after the current block starts.
- Q5: Wait for confirmation bit, next block only if PLC sends signal.
- Q6: No EBC, sets a PLC bit after the block has travelled some distance.
- Q7: No EBC, sets a PLC bit when the remaining distance to go is below some distance.

[D..] sets the distance along the path – travelled or to be travelled – for the Early Block Change.

[I..] specifies the input bit which control the block change.

[O..] specifies the output bit to set when a block change occurs.

[R..] specifies the output bit to clear when a block change occurs.

[P..] specifies the output bit to set when the traversed /residual distance has reached the value D.

# Early Block Change

## Sample Code and Graphics



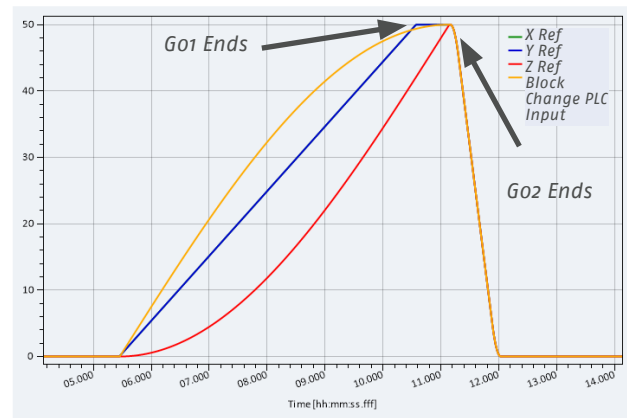
```
Z100 G777 Q1 D40 P24 I25
```

This simple statement to the left moves the Z axis to the Z100 position. When 40mm has been traversed from the start of the movement, bit 24 will be set, and then as soon as input bit 25 is set by the PLC, the execution of the next block will start. In the meantime the Z axis will arrive at its final position.

```
G777+ Q4 (Immediate EBC)
G01 X50 Y50 (Linear Interpolation)
G17 G02 U50 V50 R50 (Circular Interpolation)
G00 X0 Y0 Z0 U0 V0
```

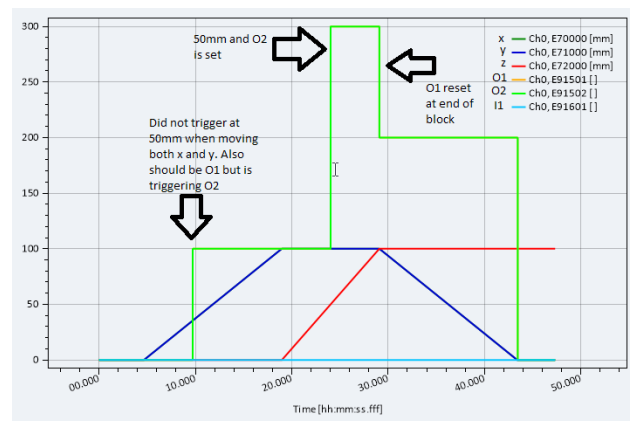
This simple program above shows EBC's ability to have both linear and circular interpolation occurring at the same time. Here we can see that the G02 block begins executing as soon as the G01 block starts (though they end at different times).

Scope (NCK)



```
M00
G01 X100 Y100 G777 D50 Q6 P1
G01 Z100 G777 D50 Q6 P2 R1
G01 X0 Y0
```

This program shows how EBC can set multiple output bits from a condition in the part program. Here output 1 is set when 50 mm from the X100 Y100 position. Output 2 is set the same way in the next block and Output 1 is reset at the end of the block.



# Early Block Change Implementations



With Early Block Change's focus being to run two block simultaneously or setting a dedicated output bit, G777 can be used to reduce cycle times in many industries.

For example, cutting fabrication machines, like laser, plasma, or water jet, can use EBC to change their federate for corners and small radii without stopping the machines movement. This would allow the machine to deliver the desired surface quality to the cut faster.

The same principle can apply for 3D printers and their need to manipulate the extrusion axis speed at the start or end of a movement, to deposit more or less material onto the part.

Grinding and transfer machines can see a benefit from EBC by moving an axis into position that is not directly, but soon to be, involved on the work piece; therefore, reducing the cycle time.

Cutting fabrication machine can also see a smoother and quicker production when implementing micro-joints and fly cutting, by using EBC to control federates and output bits for the cutting process at some specified distance in the movement.

With careful timing a loader or robot can be sent a signal, through a dedicated out bit, to start an unloading process near the end of a program. The time spent simultaneously performing two blocks reduces cycle times.

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