Carbon Parameter Modifications

# Parameters

The following parameters are important in the context of the carbon curve

* y is the token amount left to sell on the curve, in native token units (assume: ETH); we always have yint>=y>=0
* x is a token amount in the other token; its absolute value is not important (and not tracked as it can be obtained by the invariant equation) but differences are (assume: USDC)
* yint is the maximal capacity of the curve; at y=yint the curve is full
* pa is the starting price of the range, ie the best price for the trader, worst for the LP, AMM; like all prices, it is always quoted in the native convention of the curve, dy/dx (here: ETH per USDC [sic])
* pb is the end price of the range, ie the worst price for the trader, best for LP, AMM; we have pb<=pa in the price convention dy/dx
* A, B are related to pa, pb; specifically: B=sqrt(pb), A=sqrt(pa)-sqrt(pb)
* pm is the current marginal price of the range; it depends on all parameters above; note: changing pm downwards (-dpm) is safe except for the fact the price moves further away from the market, changing it upwards (+dpm) may not be for an active range, as the marginal price may move beyond market price and into the money

# Modifications

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| ID | Action | **y** | **yint** | **x** | **pa** | **pb** | **pm** |
| T | trade | -dy | . | +dx | . | . | -dpm |
| AL | add liquidity | +dy | . | . | . | . | +dpm |
| ALX | add liquidity expand | +dy | =y | . | . | . | .[=pa] |
| ALC | add liquidity (const pm) | +dy | +dyint | . | . | . | . |
| RL | remove liquidity | -dy | . | . | . | . | -dpm |
| RLC | remove liquidity (const pm) | -dy | -dyint | . | . | . | . |
| SPU | start price up | . | . | . | +dpa | . | +dpm |
| SPD | start price down | . | . | . | -dpa | . | -dpm |
| EPU | end price up | . | . | . | . | +dpb | +dpm |
| EPD | end price down | . | . | . | . | -dpb | -dpm |
| BP | change both prices | . | . | . | dpa | dpb | dpm |
| BPC1 | both prices (const pm) | . |  | . | dpa | dpb | . |
| BPC2 | both prices (const pm) | . | dyint | . | dpa | dpb | . |
| MPU | change marg price up | . | -dyint | . | . | . | +dpm |
| MPD | change marg price down | . | +dyint | . | . | . | -dpm |
| BPM | change prices (const pm) | . | dyint | . | dpa | dpb | . |

xxx – provided as parameter; +dpm – danger zone

# Implemented actions

* Trade (**T**) is obviously implemented and can be used by everyone
* Add liquidity (**AL**) and add liquidity expand (**ALX**) will be triggered by trading on the associated curve, and therefore can be used by everyone; it increases pm, therefore is in theory not safe; however, as long as the curves are not overlapping there is not risk that pm will end up in the unsafe zone
* Add liquidity (**AL**) however may not be safe to trigger on an active curve because it does move the marginal price into the wrong direction; instead of **AL** we should always use **ALC**.
* Remove liquidity (**RL**) is safe to call as the marginal price is pushed away from the market; if this is not desired, **RLC** could be called instead (arguably this has the better semantics); **RL** needs to be able to deal with liquidity changes that have been introduced by other transaction (up or down) and react gracefully
* Price changes can be dangerous if either of the prices pa, pb go up, because in this case the marginal price pm will go up as well; there are two way of keeping pm constant:
  + the first one involves changing pa and pb in different directions, essentially symmetrically around pm; this runs into problems if pm has changed since because a trade has happened
  + the second one involves changing yint to ensure that pm sits where it was; this calculation can be done in the smart contract, and is in this case robust against intermittent changes
* Changing marginal price down (**MPD**) is always safe; changing it upwards (**MPU**) is potentially dangerous, and can possibly be front run
  + if the LP adjusts yint to obtain the desired pm and if y has been changed then it can be higher (liquidity transferred from linked curve; bad) or lower (liquidity traded on this curve; not that bad)
  + alternative the marginal price adjustment function can specify the desired marginal price pm directly, and yint is calculated; this again can be bad: if markets move since than pm can be set at the old level which can be too high