

## 4. Meals: Setting ISF\_weights in /Preferences

v.4.8



**Please note that with autoISF you are in an early-dev. environment,**

where the user interface is **not optimized for safety** of users who stray away from intended ways to use. Good safety features exist, but these are only as good as the development-oriented user understands and implements them. This is not a medical product, refer to disclaimer in [section 0](#)

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[Available related case studies:](#)

[Case study 4.1: Pizza](#)

[Case study 4.2: Low carb meal](#)

[Case study 4.3: Hands-off FCL on Xmas](#)

## 4.1 Getting started

Caution: This entire e-book is about Full Closed Looping (FCL).

**In case you intend to work with giving boli**, many suggestions made - notably in this [section 4](#), and in [section 2](#) – should **not** be followed. Y

You should then primarily use the autoISF Quick Guide (from <https://github.com/ga-zelle/autoISF>), and **do extra research**, on your own data. (Look at the chart in [section 4.1.2](#) - your bolus very much would change things there!).

If you shy away, for now, from FCL, please have a look into sections discussing methods with “**Meal Announcement**”, [section 07](#), and [section 13.3](#)-

### 4.1.1 Reminder of pre-requisites

This section 4. is about the core FCL aspects of autoISF. Before doing anything with this section, please make sure you have studied the preceding [sections 1](#) and [2](#) on the general pre-requisites for FCL and the developers “Quick guide” (see [section 3](#)) on the principal workings of autoISF.

Core points are briefly summarized below.

#### Start with proper “safety” settings

Before you start tuning your autoISF for FCL, **make sure you have** appropriately:

- **widened the SMB size restrictions** ([section 2.1](#)),
- **elevated** the max allowed ISF amplification via your set **autoISFmax** ( [section 2.2](#))

Both of these points are extremely important: If you set (or keep in place) narrow restrictions, this will **not** allow to see effects from a more aggressively tuned ISF. Even worse, it would cover-up too aggressive settings (e.g. on the ...\_ISF\_weights that we get to in a moment), and invariably make your loop bounce against the restriction(s).

This could even work fine, if your meal spectrum isn't broad: If, in your HCL, the **same** bolus size pretty much fitted all your meals, it could now, in FCL, be replaced by rushing, with super-aggressively modulated ISFs, into the set restrictions, to produce - with only a brief delay – the required iob that would be about equivalent to what you formerly had bolussed in your HCL.

A system that is really fit **for the variance** we all like to enjoy in our daily lives, though, would be characterized by “tolerating” pretty wide open safety restrictions\*), while having cautiously calibrated other, notably ISF modulating, parameters (as described in [sections 4.2 – 4.5](#)).

\*) Still, for safety (as also suggested in section 2.1 and 2.2), start your tuning on a middle ground, and only gradually widen SMB size and autoISFmax during your initial tuning.

80 Also make sure you have

- 81 • **set your iobTH%** (refer to [section 2.4](#) and if available [4.8](#))

82

83 Furthermore, in your early test phase, it is recommended to:

- 84 • Run the system as dummy, not connected to your body (or, on own risk, connect only as long  
85 as you watch closely)

- 86 • In AAPS preferences, switch your autoISF FCL ( = **autoISF/”Enable adaptation of ISF to  
87 glucose behavior”**) ON only during daytime hours of a meal, e.g. *11-18h*, for fully automatic  
88 “full closed loop” management *of lunches*.

89 You can do this switching manually *at 11 h and 18 h every day*, or set up an  
90 Automation that does that (see [section 3.4](#) ).

91 Take **typical but not extreme** meals. Omit sweet drinks, or drink only slowly. You are going for a  
92 “good enough” compromise, that works with your range of usual meals.

93

94 **It is wasted time to do a lot of iterations to “optimize” settings based on just 1 type of meal.**

95 See [case study 8.2](#)

96

97 Occasionally, watch the time-pattern of bg, iob (SMBs given), and insulin activity after meal start.

98 Aside from serious “mathematical” attempts to tune settings based on data from the SMB tab (or

99 the Emulator, section 10), just watching the curves develop on your AAPS main screen can, over

100 time, give you “a feel” what settings, and eating behaviors, are benign or detrimental to good %TIR  
101 performance.

102

103 [Importance of proper profile ISFs.](#)

104

105 Starters on autoISF FCL who are coming from using HCL with **dynamicISF** must be aware of the  
106 following: It is absolutely essential to build your FCL on a properly set **profile** ISFs (likely a  
107 circadian pattern over 24 hrs).

108

109 It may not apply to you, but many dynamicISF users did never bother to determine their ISFs that  
110 would maximize their HCL performance, but employ dynamicISF so to speak for going  
111 „dynamically“ through a wide range of possible ISFs, until eventually hitting a sweet spot, and the  
112 whole thing works better than before, with what they had *used* as a profile ISF (often only one, e.g.  
113 coming from Autotune).

114

115 The following is important to understand, as it leads straight into the core idea behind FCL with  
116 autoISF, too: It is a good idea to establish a well-running hybrid closed loop with set (non-dynamic)  
117 **ISF** (set in **profile** for each hour of the day). That ISF must be **aggressive enough** that it gets you  
118 down from a high around 200 mg/dl to target. That is roughly also the way you experimentally  
119 determined it (so I hope. See [https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-](https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings/blob/HCL--settings-main-repo-(pdf)/ISF%20determination%20V.3.33.pdf)  
120 [settings/blob/HCL--settings-main-repo-\(pdf\)/ISF%20determination V.3.33.pdf](https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings/blob/HCL--settings-main-repo-(pdf)/ISF%20determination%20V.3.33.pdf) ).

- 121 • Using *that strong* value also at *lower bg*, (on the way “up” , after meal start), is very positive:  
122 We do *not* want to have a *softer* acting loop when at *lower bg* (which is what dynamicISF  
123 tends to do!). autoISF will, in contrast, temporarily sharpen your ISF when, at low bg,  
124 acceleration is detected..
- 125 • On the way down from peak, towards glucose target, a somewhat too strong ISF should not  
126 hurt because much of the time your loop (well supplied with insulin before, „on the way up“) is  
127 zero temping , or at least has only a small gap to correct, from predicted bg to target bg.
- 128 • You have no business to be much above 200 mg/dl where an *even stronger ISF* may or  
129 may not help. It sure does not help at an occlusion which is about the only reason to see  
130 super high values as an experienced looper.

131

132 **Pegging ISF strength to bg level** therefore **does not make sense in FCL**. You will use the  
133 autoISF toolbox to get strongest ISF **at low** but beginning-to-rise bg,

134

135 Note: There are very much refined versions of dynamicISF that can have beneficial applications,  
136 notably in HCL ...And, yes, I know, bg levels can also correlate with insulin sensitivity. But let us not  
137 get into “chicken or egg type” discussions.

138 Rather, focus on doing a good tuning job, and use superior approaches to account for sensitivity  
139 changes in a more pro-active manner (before running into sky-high bg (or into hypos)):

140

141 Going to autoISF FCL, you absolutely must **anchor on the proper profile\_ISF**.

142

143 The profile is not “set in stone”, though. To use above terminology again: **Pegging ISF strength to**  
144 **your current insulin sensitivity** – very much like you had done all along in HCL - **does make**  
145 **sense in your FCL...**

146 (...and the fact that autoISF afterwards “anyways” often strongly modifies ISF is not a reasonable  
147 counter-argument).

148

149 There are fully automated, as well as manual ways for sensitivity adaptations of the profile ISF:

150

151 Profile ISFs can get **fully automatically adapted**, e.g. by Autosens, or by the Activity Monitor,  
152 which in autoISF we rather use ([section 6.5](#)).

153 Which of your basic related settings (in AAPS/Preferences) produce exactly which adaptation can  
154 be seen right in the top lines of your SMB tab, at each loop decision. Likewise, it can be retrieved  
155 later in logfile analysis (see Emulator, [section 10](#))

156

157 Furthermore, when using autoISF you can – as you did in the past, e.g. around exercise, or in  
158 times of illness – temporarily **manually modify** your profile ISFs

159

160 Also these effects are quantified in SMB tab and logfiles \*).

161 \*) Furthermore, the results from autoISF are explained in the SMB tab, and multiplied with (original or adjusted)  
162 profile ISF to result in the ISF (called “sens”) used in the current insulinRequired calculation

163

164 All three top buttons in AAPS (%profile switch, exercise and TT) can be freely used to adapt to  
165 changes in sensitivity/resistance, turning into a yellow color to alert you to this. (More about your  
166 “FCL cockpit” see [section 5.2.2.](#)).

167

168 For a start, please spend a couple of days (if not weeks) to **get your key autoISF related settings**  
169 **right**, strictly **on/for days with your normal insulin sensitivity**. This is what this [section 4](#) is  
170 about.

171

172 [Importance of starting from a well-performing Hybrid Closed Loop](#)

173

174 A **satisfying performance in Hybrid Closed Loop** mode is a pre-requisite. Expect to reproduce  
175 about the same %TIR also in your FCL, but with less daily interaction, once established.

176 Note that this refers to prior use of „vanilla“ software, without fancy „dynamic add-ons“ (such as:  
177 Autotune determined factors, dynamicISF etc). that may have introduced bias into the profile  
178 settings you bring with you into FCL now.

179

180 To reach a satisfying performance you must start from a hybrid closed loop in which you did  
181 **master your meal management well** using theoref(1) algo SMB+UAM.

182 This is a pre-requisite **to be able to forget it** ... - because the initial tuning that we now turn to  
183 demands, that you analyze your **prior best practice as your blueprint** to find appropriate settings  
184 and „teach“ your FCL to come up with the necessary job.

185

186 This is the main subject of this section 4 (finding settings for automatic meal management).

187

188

189

190

191 Do not copy settings from other FCL loopers

192  
193 When setting your parameters, don't use any given numerical example (not even as “a starting  
194 point”). Instead, anchor on **data from your *successful* Hybrid Closed Loop!**

195  
196 Most *examples given in this paper* are from an adult diabetic (Lyumjev, G6) whose insulin sensitivity  
197 can be characterized as follows: approximately 37 U TDD, thereof 13 U profile basal, at about 200g  
198 daily carbs from mainly lunch and dinner; no couch snacks or sweet drinks. The user also  
199 participates in multiple instances of daily moderate exercise such as dog walking, biking and  
200 gardening. In Hybrid Closed Loop, a typical meal bolus was 8 U that was sometimes reduced such  
201 as when activity followed the meal.

202 After seeing some more inputs from a variety of users we might put together a profile helper for  
203 some rough orientation, and for plausibility cross-checking, in [section 4.8](#)

204  
205 Importance of going step-by-step

206  
207 [Section 5](#) will explore avenues to manage “disturbances”, i.e. time blocks or situations that might  
208 demand enhanced or reduced loop aggressiveness.

209 [Section 6](#) will focus on the exercise mode, and the activity monitor.

210 In case you have a strong interest in the Activity monitor ([section 6.6](#)), you can start with  
211 calibrating that, and have it run already in the weeks when you go through sections 4 and 5.  
212 In case you use an EatingSoonTT at meal start (the author recommends to try without), note that any  
213 active TT shuts activity monitor automatically off while that TT is active.

214  
215 Resist the temptation to make use of the tools presented in sections 5 and 6 too early.

216 On your **first** setting-up and tuning attempt, **it is strongly recommended that you not “play**  
217 **around” with all ultimately available features, but stick to the sequence of steps to take.**

218  
219 Yes, “playing around” with the many extra buttons often will help find an improvement. But you  
220 likely create an instable FCL that, already at fairly standard situations, uses up some of your FCL's  
221 principal capacity to correct for disturbances. This limits what will be left to manage extreme  
222 situations.

223  
224 Caution: **Once you created a maze of little errors and counter-strategies/counter-errors, it will be**  
225 **nearly impossible to find your way** out of this mess, **towards better settings**, at any later point of time.

226  
227 Note that it is principally not easy to conclude on suitability of tuning:

228 • AutoISF comes with very many (currently 18) extra parameters, and even when employing the  
229 emulator ([sections 10](#) and [11](#)), it is quite hard to analyze their interaction.

230 One principal reason why things are difficult to analyze is, that you really can only analyze one  
231 decision, and that will put you on another bg curve. So, you can never see the full effect, along more  
232 than half an hour or so, that *any* change would really result in.

233

234 • Understandably, many loopers rather “move forward” to an over-patch for identified problems, and  
235 not bother with a more “puristic” step-by-step approach to do things right from the ground up.

236 • Aware of above sketched conundrum, the AAPS autoISF developers offer the ultimate tool to  
237 investigate “what-if”, regarding a setting change you may contemplate: A nice lady voice on your  
238 smartphone can tell you, at each loop decision, where your contemplated change would make a  
239 difference (in SMB size). This offers an opportunity to watch closely, with or without implementing  
240 that change. (It is always your spontaneous choice, whether you want to “follow the lady’s  
241 suggestion and manually add to the SMB, as suggested). More see in [Section 11.4](#)

242 But, we are getting ahead too far here. You first must find a starting point for key settings, which works  
243 reasonably for not too-challenging meals in your personal spectrum.

244 Before getting into this, let’s first have a look on how autoISF basically works. (More see in Quick guide by  
245 the developer, referenced in [section 3.2](#); or directly at <https://github.com/ga-zelle/autoISF>).

246

#### 247 4.1.2 autoISF factors overview in typical glucose chart

248

249 The core challenge of your UAM Full Closed Loop is to recognize a meal start from the glucose  
250 trend, and ramping up iob.

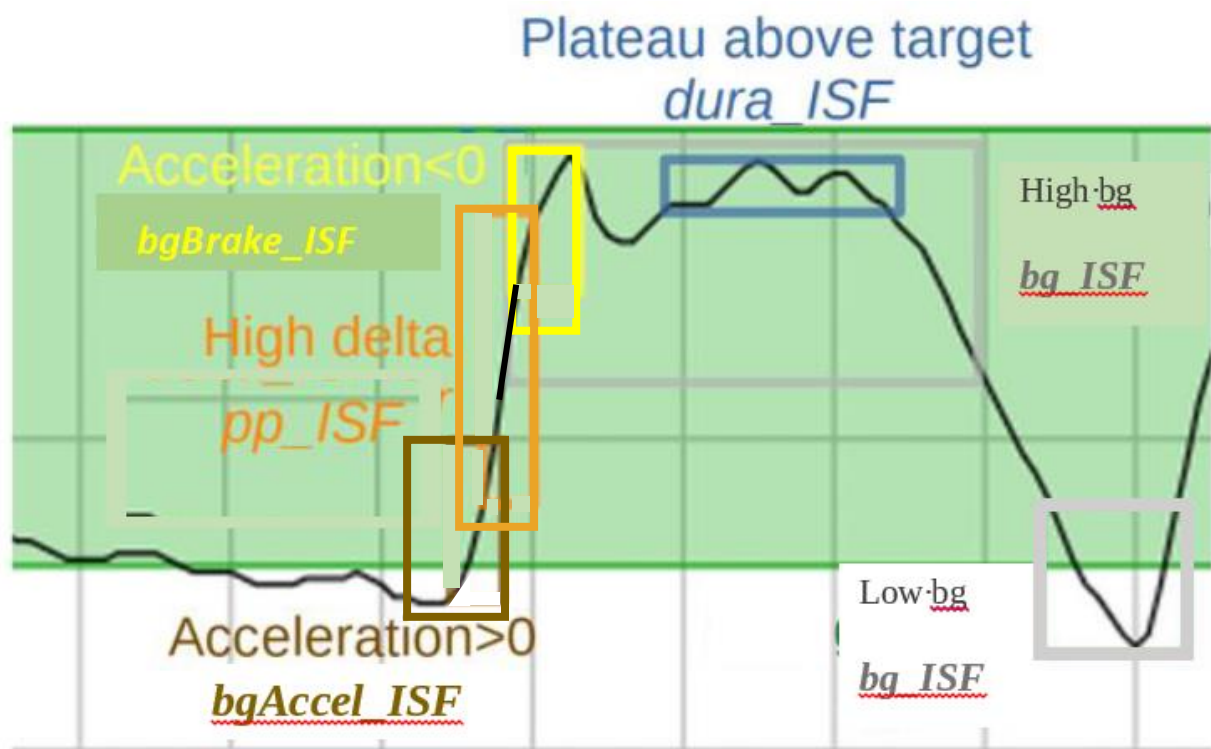
251

252 When setting up your autoISF Full Closed Loop, **you must set several ISF\_weight parameters**  
253 **in AAPS Preferences/OpenAPS SMB/autoISF settings.**

254

255 They relate to different stages of the typical glucose curve after starting a meal:





Note: **bg\_ISF** is not used much in FCL, as it is rather late to act on high (or low) bg level that developed. But, feel free to experiment, e.g. in case you have indications, in your data, that in the past dynamicISF was useful to manage bg extremes in some situations.

The core advantage of using autoISF withoref(1) SMB+UAM (in FCL as well as in hybrid closed loop) is that it manages the glucose curve it sees developing, **no matter what the underlying reason** is.

42 potential factors were identified (see: <https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings/blob/FCL-w/autoISF/42%20factors%20influence%20bg.pdf> ), so, no wonder, that loopers who meticulously input their carbs will often *not* see the expected result.

In case you like to learn more about the theoretical background for the autoISF development, here some core aspects the key developer shared in a DIY forum:

#### Theory behind autoISF

gazelle, Aug. 2024

I have recently managed to work through the large pile of older (German) diabetes journals. I've now reached issue 5/2024 and was amazed by the article "How insulin is produced and works in the body".

According to the article, there are essentially 2 phases of release:

- Phase (1) lasts only a few minutes and releases a large dose from the beta cell's supply when glucose rises.
- (2) After that, insulin is newly produced and released evenly over a period of hours.

These two phases remind me very much of initial *acce\_ISF* and later *dura\_ISF* in autoISF.

This may explain why it works so well for many users. I had no idea about this process in the body when I developed both effects.

1. *acce\_ISF* was based on **Newton's 2nd law of mechanics**, i.e. inertial mass \* acceleration = force.  
For me, this meant that when the FC is accelerated, a "sweet force" is acting.  
To counteract this, the acceleration must be counteracted.  
Strengthening the ISF, i.e. increasing resistance, corresponds to an increase in inertial mass, so to speak.
2. *dura\_ISF* was an analogy to the **PID controller** in technology:  
P stands for proportional control, in this case the deviation of the FC from the target value;  
I stands for integral of the deviation, in this case the sum of the deviation from the target;  
D stands for differential control, in this case the delta of the BG.



The components for P and D are contained in the regular AAPS, but the I component was missing. So I added it, as a rough approximation, using `dura_ISF`.

*I find it very interesting that both solutions came about from analogies to technology/mechanics without direct knowledge of **hormone metabolism**. I have always been interested in using analogies to transfer solutions to other fields.*  
*Translated with DeepL.com (free version)*

Remark: This just broadbrush sketches the general idea. Lots of dev work had unfortunately to go into details, like how to deal with everyday imperfections of our CGM systems, and still come up with meaningful mathematical (parabola fit) earliest-possible detection of "real" bg rises.

#### 4.1.3 Getting ready to set your `autoISF_weights`

Before you progress, make sure you studied the flowcharts in [section 3](#) that describe how `autoISF` calculates the **effective**(ly used) ISF.

**Warning:** Any bolus you „sneak in“ will severely distort the glucose curve. That could render your tuning of weights (see below) useless, and could **make your loop act in unpredictable ways** (potentially also dangerous, however, your set `iobTH` ([section 2.4](#)) should help here, too).

In case you feel tempted to use boli, be ready for some own extra research, and refer to [section 7](#).

After doing the prep work as outlined in [section 2](#) you now get to calibrate your FCL to your **normal meal spectrum** by initially **setting and tuning the various `_ISF_weights`**, that dynamically change with bg curve characteristics as sketched in the chart on the previous page.

**Please stay away from extremes** (regarding both, meals and exercise) **when you go through this [section 4](#)**. It is about getting a first *roughly right* set of settings, as a basis.

**Researching your standard meal patterns, and finding settings for the various `_ISF_weights` is the core job in setting up your `autoISF FCL`.**

Depending how varied your diet and general lifestyle are (and your expectation of %TIR you like to reach), this could be the main job at hand. However, there is much more you *could do later*, and that will be outlined in later sections 5 and 6.

Consult sometimes your SMB tab, to see how the applied effective ISF (named **sens** there) is calculated. (Example given in [section 5.4.5](#)).

## 4.2 Meal detection and managing the initial bg rise: bgAccel\_ISF

### 4.2.1 Mimicking a HCL bolus in FCL using bgAccel\_ISF

When looping without carb inputs and without giving a bolus ourselves, the first crucial setting is to set the **bgAccel\_ISF\_weight** so that SMBs are requested immediately when the loop detects an acceleration in your blood glucose (bg) that is starting to rise.

Ideally **within about 20 minutes after acceleration detection, which would be the first up to 4 SMBs, as much iob should automatically be supplied as we would have given with our bolus in hybrid closed loop.**

As the biggest principal challenge for the FCL is big **high/fast carb** meals (from within your personal “spectrum”), we start with a focus to get sufficiently big SMBs going for those.

Note, though, that in a **low carb** meal scenario, the first 4 SMBs would have to automatically result much smaller (which, after careful tuning, is possible with the same parameter settings, see e.g. [case studies 4.2 vs 4.3](#)).

Rule of thumb: Two of the first three SMBs each (in this test based on a big meal) should be about ¼ to 1/3 the size of a bolus in your HCL „career“ (for a similar meal).

#### **Going over 1/3 could be problematic**

- if your diet contains occasional **low carb** (or brief **snacking**), it is not helpful if your settings make your loop invariably “bounce” over your iobTH (and then you would need extra snacks to balance the auto-generated iob, to prevent hypos),
- also if your **CGM quality** is sometimes unreliable, and might produce an artefact that could be mistaken for a meal start.

Be vigilant about this topic! And please do not choose the supposedly easy way, to just set safety restrictions (allowed max SMB size, or autoISFmax) so low, that your loop never can exceed 1/3. Try to really tune the \_ISF\_weights appropriately. (Only that way, your loop can “accommodate” the entire meal spectrum, and also states of adapted general insulin sensitivity).

### 4.2.2 Widened safety restrictions

Already when tuning the bgAccel\_ISF\_weight it can become evident that safety restrictions (as discussed in [section 2](#)) must be **widened** further:

- 363 • Especially if your *profile basal* rate is very small, the **smb\_max\_range\_extention** and/or  
364 the **autoISF\_max** "must" often be increased further.
- 365 • Pay attention also to the **iobTH%** and, potentially, iobMAX
- 366 • Note that the smb\_delivery\_ratio "only" portions the insulinReq differently over the next 15  
367 minutes (see also [section 2.3](#)), and therefore is **not** a prime tuning parameter.

368 In the end you should **not set these safety limits too tight**, so "nudging" aggressiveness by  
369 another 10 or 20% from your cockpit, later, will not bounce into restrictions.

370

371 On the other hand, setting **narrower** restrictions for max allowed SMB size can also become  
372 necessary:

- 373 • Poorer CGM quality demands narrower restrictions for safety reasons.
- 374 • If you use a 1-minute CGM, please observe [section 1.4.2](#)

375

#### 376 [4.2.3 Start value for your bgAccel\\_ISF tuning](#)

377

378 bgAccel\_ISF\_weight is set default to zero in AAPS Preferences/SMB/autoISF.

379 **To start**, I would try 0.05 or **max 0.1**, and keep trying in max 0.05 steps. Soon move to 0.02 steps.  
380 From my (very limited) overview, many use around 0.2, and possibly even higher if their hourly  
381 basal rate is 0.1U or lower. ([Consult section 4.8 when available](#)). Do not be tempted to rush this  
382 setting by using large jumps in adjustments.

383 **To monitor what is happening**, and start tuning, in search of appropriate settings, you must keep  
384 (real-time) track of how autoISF uses your set bgAccel\_ISF\_weight:

385

- 386 • To do this in the **SMB tab** is possible but not very practical. You would end up making a lot  
387 of screenshots (quickly in the crucial minutes after a SMB was given, or when *you thought it*  
388 *should be* given), for later analysis.
- 389 • The superior method is to just copy **logfiles** from your phone/internal  
390 memory/AAPS/logs ...

391     ○ all zip files there

392     ○ look up how many days of data are covered there on a rolling basis, and copy out  
393     onto your PC (see [section 10.1.1](#)) before the older ones get forever lost

394 ... and analyze them at your convenience later, using the **emulator** (see [section 10](#); used  
395 e.g. in last pages of [case study 4.2](#)).

- 396 • Some emulator-based analysis is also possible within AAPS on your phone ([section-11](#)).

397 In any case, it is worth the effort to tune the **bgAccel\_ISF\_weight** in such a way that high glucose  
398 increases are already nipped in the bud, so to speak.

399

400 To summarize: In FCL, the first 3 or 4 SMBs should not be much delayed, and amount to similar  
401 iob like your “former boli in HCL”.

402 Depending on details about the carb absorption characteristics of your meal, and the performance  
403 of your CGM, also **pp\_ISF** (see 4.3) might be a fairly early contributor to getting iob up.

404

#### 405 4.2.4 How changing the \_weights influences the resulting calculated insulinRequired

406

407 (You can skip reading this section, unless you want to know quantitatively how things work).

408

409 The developers’ documentation (Quick Guide) [https://github.com/ga-](https://github.com/ga-zelle/autolSF/blob/A3.2.0.4_ai3.0.1/autolSF3.0.1_Quick_Guide.pdf)  
410 [zelle/autolSF/blob/A3.2.0.4\\_ai3.0.1/autolSF3.0.1\\_Quick\\_Guide.pdf](https://github.com/ga-zelle/autolSF/blob/A3.2.0.4_ai3.0.1/autolSF3.0.1_Quick_Guide.pdf) gives the following equation:

411

412 accelSF is the factor by which autoISF wants to sharpen the profile ISF in a certain  
413 situation of bg acceleration:

acce\_ISF is calculated by

$$\text{acce\_ISF} = 1 + \text{acce\_weight} * \text{fit\_share} * \text{cap\_weight} * \text{acceleration} \quad (\text{eq.1})$$

where fit\_share a measure of fit quality, i.e. 0% if unacceptable up to 100% if perfect;  
cap\_weight is 0.5 below target and 1.0 otherwise;  
acce\_weight is bgAccel\_ISF\_weight for acceleration away from target, i.e. mostly positive  
or bgBrake\_ISF\_weight for acceleration towards target, i.e. mostly negative

414

415 fit\_share should be close to 1.0 (if good CGM quality.

416 cap\_weight is 1.0 for bg>target

417

418 acce\_ISF \* profile\_ISF = effectively used ISF (sens)

419 ((if the acce influence dominates and is used as effective ISF))

420

421 When looking at the same acceleration moment, we can combine all three last factors of eq.1 into a term  
422 “iF”.

423 For estimating the effect from using another ISF\_weight, we then have two (eq.1) , with two unknowns, iF  
424 (“cancelling out”), and the sought acce\_ISF (for new \_weight).

425

426 **Example:** Your profile\_ISF is 40 mg/dl/U. Using bgAccel\_ISF\_weight of 0.2  
427 you saw effectively used ISF of 30.3 mg/dl/U (box C15 in table below) = 40 / 1.32 =>  
428 acce\_ISF factor =1.32. ( iF see next page ).

429 For an intended correction by – 10 mg/dl the insulinRequired would calculate to 10 / 30. 3 =  
430 0.330 U.

	A	B	C	D	E	F	G	H
1	Profil ISF	40						
2	InsReq bei acce=0	1						
3								
4								
5	bgAccel_ISF_weight	0,2			0,1			InsReq effect
6	acce	acce ISF_old	ISF_old	InsReq_old	acce ISF_new	ISF_new	InsReq_new	
7	0	1	40	1	1	40	1	0%
8	0,2	1,04	38,5	1,04	1,02	39,2	1,02	-2%
9	0,4	1,08	37,0	1,08	1,04	38,5	1,04	-4%
10	0,6	1,12	35,7	1,12	1,06	37,7	1,06	-5%
11	0,8	1,16	34,5	1,16	1,08	37,0	1,08	-7%
12	1	1,2	33,3	1,2	1,1	36,4	1,1	-8%
13	1,2	1,24	32,3	1,24	1,12	35,7	1,12	-10%
14	1,4	1,28	31,3	1,28	1,14	35,1	1,14	-11%
15	1,6	1,32	30,3	1,32	1,16	34,5	1,16	-12%
16	1,8	1,36	29,4	1,36	1,18	33,9	1,18	-13%
17	2	1,4	28,6	1,4	1,2	33,3	1,2	-14%
18	2,2	1,44	27,8	1,44	1,22	32,8	1,22	-15%
19	2,4	1,48	27,0	1,48	1,24	32,3	1,24	-16%
20	2,6	1,52	26,3	1,52	1,26	31,7	1,26	-17%
21	2,8	1,56	25,6	1,56	1,28	31,3	1,28	-18%
22	3	1,6	25,0	1,6	1,3	30,8	1,3	-19%
23	3,2	1,64	24,4	1,64	1,32	30,3	1,32	-20%
24	3,4	1,68	23,8	1,68	1,34	29,9	1,34	-20%
25	3,6	1,72	23,3	1,72	1,36	29,4	1,36	-21%
26	3,8	1,76	22,7	1,76	1,38	29,0	1,38	-22%
27	4	1,8	22,2	1,8	1,4	28,6	1,4	-22%
28	4,2	1,84	21,7	1,84	1,42	28,2	1,42	-23%
29	4,4	1,88	21,3	1,88	1,44	27,8	1,44	-23%
30	4,6	1,92	20,8	1,92	1,46	27,4	1,46	-24%
31	4,8	1,96	20,4	1,96	1,48	27,0	1,48	-24%
32	5	2	20	2	1,5	26,7	1,5	-25%
33	Formeln, letzte Zeile    '=1+\$A32*\$B\$5    '=\$B\$1/B28-\$2*\$B\$1/C32    '=1+\$A32*\$E\$5    '=\$B\$1/D28-\$B\$2*\$B\$1/F32							

Now, going with a 50% reduced bgAccel\_ISF\_weight of 0.10:

$$\text{acce\_ISF} = 1 + \text{bgAccel\_ISF\_weight} * \text{internalFactor}$$

before  $1,32 = 1 + 0,20 * iF \Rightarrow 0,32 = 0,20 * iF \Rightarrow iF = 1,60$

after  $? = 1 + 0,10 * iF \Rightarrow ? = 1 + 0,10 * 1,6 = 1,16$

New effective ISF would be  $40 / 1,16 = 34,48$  mg/dl/U (box F15).

For an intended correction by – 10 mg/dl the **insulinRequired** would now calculate to  $10 / 34,48 = 0,290$  U, which is **12 % less** ( H15 ).

At higher acceleration points of the bg curve (column A), the effects would be more pronounced (column H).

As these calculations are quite complex, a “trial and error” approach might be easier:

To get a feel for how changing the \_weights influences the resulting calculated insulinRequired, it is best to start cautiously and **just do 10 to max 20% steps up, and watch out for the effects.**

Doing similar step sizes should yield about similar effects each time.

Never forget to look into how other ..\_ISFs play into the effective ISF (named **sens** in the SMB tab), which overall results.

#### 4.2.5 Characteristics of a well tuned-in bgAccel\_ISF\_weight

452

453 Your starting point was to set the bgAccel\_ISF\_weight so FCL works in a rather high carb meal.

454

455 Now you must check (and potentially fine tune) so it **will not “shoot iob too high”** with the first 3

456 or 4 SMBs **in other meals from your spectrum:**

457

- 458 • For meals that are in the **lower** (!) range of the “fast **carb load**” of your cluster, the  
459 necessary insulin supply for the first two hours or so might pretty much be provided already  
460 with the first 3 or 4 SMBs

461 The glucose curve, at such meals, begins to flatten early in this SMB phase, so a de-

462 celeration (**braking**) follows very soon (-> [section 4.4](#)). Clearly, the first 3 SMBs, in such

463 cases, must remain below iobTH.

464

- 465 • **Low carb** meals are principally easiest for the FCL. However, you must secure that your  
466 bgAccel\_ISF driven **first SMBs** remain small. This is principally possible also with a fairly  
467 aggressive bgAccel\_ISF\_weight set, because both acceleration and initial deltas are small  
468 when eating low carb. (Regarding the detected acceleration, the stakes may be high for the  
469 CGM and smoothing method you chose).

- 470 • A stage where moderate amounts of carb absorption and of insulin usage/need hold a  
471 balance could protract – at moderate bg elevation -over hours. The **dura\_ISF** might play a  
472 bigger role, then, as e.g. in the low carb example in [case study 4.2](#).

473

474 In case you run into limitations, see next sub-chapter.

#### 4.2.6 Suitability for many types of meal

476

477 For a **hands-off FCL**, your settings have to fit

- 478 • **in each** of your **meal times**

479 What helps here is that, *between* your daily mealtime slots, your **circadian profile ISFs**  
480 (upon which the autoISF modulations build) automatically make a differentiation (as was  
481 the case in your HCL).

- 482 • for the whole **range of your meals**. All this is principally possible, but: ...

483

484

485

486 What if you still have meals that you cannot make fit?

487

488 In extreme cases you will have to balance too high running iob with additional carbs (a late  
489 additional snack against going too low), and in the opposite case, you will have to reckon with  
490 temporarily exceeding the glucose target range, and losing some %TIR for this day.

491

492 If your meals vary very strongly, there are **avenues to ease your initial tuning job, or to**  
493 **optimize overall resulting loop performance:**

494 • Automations allow you to differentiate. For instance it is possible to apply different  
495 iobTH\_percent and/or different bgAccel\_ISF\_weights for meals in different **time windows**  
496 or geo locations (details see [sections 3.4](#) and [5.1](#))

497 In case you use autoISF on the Trio or iAPS platform for i-phones, you may need to use a  
498 third party automation software, or “middleware“ (! call for a [case study 4.X](#) )

499 • you can pre-program **custom buttons for special** meal (or snack) **types**, with different  
500 underlying FCL settings (see “cockpit”, [section 5.2.2.3](#))

501 • You can **modulate FCL aggressiveness manually** making use of the top 3 buttons in the  
502 AAPS home screen: These turn yellow during temporary switched %profile or glucose  
503 target ([section 5.2.2.2](#))

504

505 Experimenting with the three above mentioned “avenues”, the author found:

506 • the last point easiest to occasionally use, and the first one hardest.

507 • it worth investing some effort (also using the emulator a couple of times) to iterate through  
508 the typical meal spectrum a couple of times, for finding a “good enough” set  
509 of ..\_ISF\_weights and other settings (like autoISFmax, iobTH% etc), **and not do much**  
510 **extra differentiation**. (More see in [section 5](#)).

511 4.2.7 Summary on tuning for the initial SMBs via bgAccel\_ISF

512

513 **Early strong iob** also will **ease the tuning task for the subsequent phases** of the meal, because  
514 there is, then, largely zero-temping (as well known from HCL-times after your administered bolus).  
515 Also, the lower and shorter lasting the glucose peak, the lesser the hypo danger from the activity  
516 tail of SMBs given *when* glucose was „stuck“ high.

517

518 However, it is important **not too super-aggressively** tune bgAccel\_ISF\_weight up, so, regardless  
519 of the type of meal, very big SMBs invariably would result.

520



521 Rather, the rough idea should be:

- 522 • SMBs driven by bgAccel\_ISF: initial iob for **all meals**. SMB sizes vary, because accelerations  
523 and deltas vary.

524 So, at high carb meals it depends on your settings, and on the evolving bg curve, whether the  
525 first few bgAccel\_ISF driven SMBs get you already up to iobTH in high carb meals, or whether  
526 this happens in the *overlapping* next stage.

527 So, looking a bit ahead to the next chapters:

- 528 • SMBs driven by pp\_ISF: to the extent there is strong (near-linear) bg rise (at **big meals rich in**  
529 **carbs**) with big or small deltas, iob is now driven towards (and potentially over) iobTH.

530 In low carb meals this period can be extremely short, with iob remaining under iobTH (example  
531 see [case study 4.2](#))

- 532 • SMBs driven by bgBrake\_ISF, bg\_ISF, or dura\_ISF:

533 Note that *all of these* can overlap with the pp\_ISF stage. Consult the csv table output  
534 from the Emulator (example given at end of [case study 4.2](#)) as to which of the \_ISF  
535 categories drives the effectively used ISF (and what change of the ...\_ISF\_weights  
536 would change this. Consult decision flowcharts for effective\_ISF in pages 1-6 of the  
537 Quick Guide.pdf in <https://github.com/ga-zelle/autolSF> ).

538 Depending on the shape of the bg curve after the initial strong rise, and depending on  
539 insulinReq. and on iob (> iobTH?), autolSF can provide more SMBs to bring bg to target. This  
540 case applies to **low carb** meals. The dura\_ISF is also useful to manage temporary insulin  
541 resistance often observed late in **fatty** meals.

542

543 **It is worth investing effort** (following the sequence of steps in sections 01-04 of this FCL e-book)  
544 **in your initial project to establish a good set of ISF\_weights** for your meal spectrum. This will  
545 keep interventions in daily life to a minimum.

546 Unless your lifestyle, or health and body weight change radically, this should be **a one-time effort**  
547 (in your initial weeks establishing your FCL), with *no need* to fine-tune much later (see [section 8](#)).

548

549 **4.2.8 Note regarding acceleration “happening again” in late part of [dropping](#) glucose**  
550 *(Skip, unless interested)*

551 After the peak, in the late stage of *falling* bg, the glucose curve is like an accelerating  
552 parabola again. The algorithm tries to evaluate when and at which bg level complete  
553 digestion of the meal and a bg minimum will result. Insulin required to stabilize around  
554 target bg is usually very small, and the adaptation of ISF in that stage relatively

555 unimportant. See in your SMB tab, how, at “already falling” bg, the ISF modulation is taken  
556 back.

In version 2.2.8.2 there was a potential deficiency in situations where glucose was falling and the glucose acceleration was already positive. That meant a minimum glucose level can be extrapolated. If that happens to be less than target and expected in less than 15 minutes then there should be no strengthening of ISF as it would lower glucose even more. Therefore bgBrake\_ISF\_weight is used now instead of bgAccel\_ISF\_weight. But those situations were rare and less critical than might be expected at first sight. The reason is that in most cases the predictions ended up even below their threshold meaning SMB were disabled.

557  
558

## 559 4.3 Managing strong bg rises: pp\_ISF

560

### 561 4.3.1 Main function of pp\_ISF in autoISF FCL

562

563 In the later phase of acceleration and in the earlier phase of deceleration there is a more or less  
564 linear increase of bg with **high deltas**, and corresponding extra insulin need.

565 • With **higher carb load** meals, or meals that come with a sweet drink, the increase will be  
566 particularly strong, and (if not already driven there by bgAccel\_ISF) now reach, and with the  
567 last “allowed” SMB exceed, the valid iobTH.

568 • With **low carb** meals, there is only a very un-pronounced (short, with weak deltas) “pp\_ISF  
569 phase”. (Example see end of [case study 4.2](#)).

570

571 autoISF should now “fight” this with the help of the post-prandial ISF, set via **pp\_ISF\_weight**, after  
572 you have set your bgAccel\_ISF\_weight.

573

### 574 4.3.2 Tuning pp\_ISF\_weight

575

576 To tune-in your **pp\_ISF\_weight**, please do this with a really high carb meal (from within your  
577 typical meal spectrum) *after* you have set a halfway suitable (not too aggressive)  
578 bgAccel\_ISF\_weight.

579 Note that if you rush into pp\_ISF tuning while “still having a too aggressive bgAccel\_ISF”,  
580 the latter is covering up the requirement you now really want to calibrate for in pp\_ISF!

581

582 So, at a meal in the upper spectrum of your carb load, carefully begin with a starting value for  
583 *pp\_ISF\_weight* of 0.005. Observe the reactions and check the SMB-tab before you increase it  
584 cautiously for the next days.

585 Best practice is to analyze the emulator tables (discussed in [section 10](#), and example given  
586 in the pizza [case study 4.1](#))

587

588

### 589 4.3.3 Loop states with very little insulin need ( $iob > iobTH$ , or 0 %TBR)

590

591 Normally (except for very low carb meals) the SMBs triggered by `bgAccel_ISF_weight` and  
592 `pp_ISF_weight` should be sufficient to reach and slightly exceed the **`iobTH`** (see [section 2.4](#)) so all  
593 *the other* autoISF parameters are relatively unimportant for now.

594

595 A reason why this can work at all, also for quite a variety of meals, lies in the fact that there  
596 is an hourly carb absorption limit of about 30g/h

597 (Reference: Dana

598 Lewis: [https://github.com/danamlewis/artificialpancreasbook/blob/master/8.-tips-and-tricks-](https://github.com/danamlewis/artificialpancreasbook/blob/master/8.-tips-and-tricks-for-real-life-with-an-aps.md#heres-the-detailed-explanation-of-what-we-learned)  
599 [for-real-life-with-an-aps.md#heres-the-detailed-explanation-of-what-we-learned](https://github.com/danamlewis/artificialpancreasbook/blob/master/8.-tips-and-tricks-for-real-life-with-an-aps.md#heres-the-detailed-explanation-of-what-we-learned). (That limit

600 can be lower, e.g. with gastroparesis or certain medications, but that would make things  
601 even easier)

602

603 So while meals might wildly vary in composition and size: What is digested, and needs insulin in  
604 the first ~90 minutes (when FCL tries to catch up with insulin need and differs strongly from HCL,  
605 with `bgAccel_ISF` and `pp_ISF` in the leading role), will be relatively close...for meals with similar  
606 *initial* glucose acceleration and rises, anyways...

607

608 The others, **low carb** with much slower initial acceleration and rise, are easily recognized as  
609 different by the loop, see [section 4.4](#) that follows.

610

611 Depending on the type of meal and "aggressiveness" of your `bgAccel_ISF_weight` and  
612 `pp_ISF_weight` tuning, the `iob` will already be so high that, in the phase of decelerated glucose rise  
613 towards the peak (the "last part of the rise"), no more `insulinRequired` is seen by the loop.

614

615 Therefore the **`bgBrake_ISF_weight`** is often unimportant in meals with a relevant carb content.

616 For potential relevance in low carb meals, see [section 4.4](#).

617

618

### 619 4.3.4 "Quality control" on how well your tuning can replace your former HCL bolussing

620

621 Warning: **Occasionally consult the SMB tab to see how your settings really work.**

622 A setting (...ISF\_weight) that is actually set too aggressive might be masked.

623 **Tuning only works if** the effects of the settings being tuned are **not** unintentionally **limited by**  
624 **other** (e.g. „safety“) **settings**.

625

626 Also, **always look at two or three *different* meals** before deciding whether a tuning "fits" („good  
627 enough“ for each of them). You probably will have to iterate back and forth doing this for two or  
628 three different kinds of meals ...

- 629 • [Case Study 4.1](#) (Pizza Meal) contains, towards the end, an example how you can go about  
630 tuning the `_weights` for various `_ISF` factors of `autoISF`.
- 631 • [Case Study 8.2](#) shows that it is **not** worth it to seek “optimized” settings based on just one  
632 (more extreme) meal.

633 ... until you find *one* good enough set of settings *for all* of them. Do not rush this, establishing a  
634 solid foundation will be well worth your time.

635  
636 **The following sections will deal with similar issues like you were facing in HCL after your**  
637 **given bolus lost much of its power, and SMBs were needed for the “eCarbs”.**

#### 638 639 4.4 Sluggish rise towards a bg peak: `bgBrake_ISF`

640 At a **low carb** meal, or an attempt at doing a **weight reduction diet**, (and probably also with  
642 gastroparesis, or if you take one of these novel GLP-1 drugs that slow meal absorption -  
643 **Somebody, please supply a case study!** )- the glucose goes up only sluggishly, and `iobTH` should  
644 not be reached at all.

645 In case you *exclusively* do very slow absorbing meals, you could of course also adjust your `iobTH`  
646 setting low enough to suit your *uniform* situation.

647  
648 Acceleration, and the phase of strong glucose rise, are quickly over at slow-absorbing meals, and  
649 there can be:

- 650 • a decelerating bulge of insulin action that projects over an hour or longer. This is where the  
651 importance of the **`bgBrake_ISF`** can come in.
- 652 • a bg curve that hovers for an hour or longer around an elevated bg level, because  
653 additionally absorbed carbs, and consumption of the moderate SMBs delivered, tend to  
654 keep a balance for a while. **`Dura_ISF`** can deal with this (see next chapter). An example for  
655 this is given in [Case study 4.2](#).

656 Note that in some data outputs (e.g. the csv/xls tables coming from the Emulator, e.g. in Case study 4.2,  
657 big table at the end there), you will see only “**`acce_ISF`**” results.

- 658 • In case of positive acceleration, these are driven by the `bgAccel_ISF_weight` setting, and results  
659 are  $>1$ .
- 660 • In case of negative acceleration (decelerating rise), **`bgBrake_ISF_weight` is applied**, , and  
661 results are  $<1$ . (Example see in graph in [section 10.3.3.3](#) ).

662

663 In full closed loop, the bgBrake\_ISF\_weight is often only about half as large as the  
664 bgAccel\_ISF\_weight (but that would also depend on your personal diet pattern and  
665 eating/digestion speed). Also here, one should approach the tuning gradually, increasing the  
666 weight coming from small values.

667

668 Please observe that **tuning bgBrake\_ISF\_weight must strictly be done with types of meals for**  
669 **which there is insulin need at de-celerating but still rising bg.**

670 bgBrake\_ISF is totally irrelevant for hi carb meals where your loop shot over iobTH already  
671 by the time your rising towards the bg peak slows down!

672 Likewise, if your initial bgAccel\_weight is set so strong that your first SMBs catapult you  
673 over the iobTH, no matter what type of meal: Then you must **first** find a reasonable setting  
674 for this parameter, one that works “good enough” to control your carb loaded meals, and  
675 then see whether there is “room” (and need) for milder loop response at low carb meals.

676

677 In case you cannot quite get all the ISF\_weights “right” so the occasional low carb meal will not get  
678 over-treated: Avenues to adapt your loop aggressiveness are discussed in [section 5](#).

679 For instance you will be able to (if needed):

680

- 681 • use a temp. reduced %profile
- 682 • temp. lower iobTH or bgAccel\_ISF\_weight
- 683 • construct for yourself a “DIY cockpit” with an extra “snack” or “low carb” button with an  
684 underlying suitable Automation

685

686 In the **late stage of still rising (!) glucose**, the Full Closed Loop typically sharply reduces  
687 SMBs already because it is “painfully aware” of the following principal conflict:

688

- 689 • iob (like formerly given in HCL via your bolus) must go high quickly, in order to limit the high
- 690 • However, if there is too much insulin in the system, a **hypoglycemia can happen later**  
691 within the DIA time window, because the loop can, later, only correct to a very limited extent  
692 (namely, only to the extent that it can set basal to zero).

693 Therefore, the core problem is that the Full Closed Loop must build up iob very quickly, **but**  
694 **not too much**, in the initial phase of a meal, and high bg values (out of range, >180 mg/dl)  
695 can not always be avoided.

696

697

## 4.5 Sluggish rise into a bg plateau, or late plateauing at high bg: dura\_ISF and bg\_ISF

Depending how your personal diet spectrum looks, you need to tune-in your dura\_ISF primarily with large hi-FPU meals, and/or for meals at the low carb end of your diet

### 4.5.1 dura\_ISF for sluggish rise into a bg plateau

A (in that case, often not very high) plateau can form in **low carb meals**, when, basically, carb and insulin “burn rates” might keep a balance over an hour or longer, requiring occasional moderate size SMBs.(See an example in [case study 4.2](#))

### 4.5.2 dura\_ISF for late/high bg plateaus

With **large or high fat/protein meals**, often a long high bg plateau is encountered (sometimes associated with 2nd “late, long stretched hill” forming for this, in the bg curve). For such situations, autoISF features the modulation of ISF depending on bg level and on duration of **plateau** formation.

### 4.5.3 “One size fits all” -dura\_ISF

Absolute “pros” could primarily calibrate their dura\_ISF for low carb.

Dura\_ISF has in-built amplification at higher bg levels. So, effects will automatically be boosted in case much higher plateaus develop after greasy feasts.

Should that not per se be sufficient, there is more the DIY “pro” can do:

- by adding an Automation that gives an extra boost “against” the temporary insulin resistance associated with fats (via increasing the baseline, in terms of a temp.130% profile switch, for instance. Compare at:  
<https://androidaps.readthedocs.io/en/latest/Usage/FullClosedLoop.html#stagnation-at-high-bg-values> ),
- or by making additional use of the bg\_ISF (or dynamicISF) (-> Tune it in parallel.)

The author’s preference would be to go via Automation, but only in case the in-built differentiation via bg level make it necessary.

### 4.5.4 Options to limit iob delivered from dura\_ISF

736 Rather than relying on your initial tuning to keep you safe from hypos also in the future, there are  
737 some extra precautions you could take. Some were discussed in Discord [or in dev circles](#),  
738 regarding what could be done:

739

740 1) To limit the danger of going low, it can make sense to  
741 design an **Automation** which pauses the delivery of more  
742 insulin.

743

744 This one was suggested by Alex999

745

746 If a glucose plateau built under 140 mg/dl, do not treat via  
747 dura\_ISF (because the defined Action is to set an elevated  
748 TT to a level that will not require more correction insulin.

749

750 An alternative Action would be to set, near the actual  
751 glucose target, an odd-numbered TT (which blocks any  
752 SMB be given, while valid).

753

754 2) In an autoISF update, the **duration** in which iob is added up could be **capped** after max. 1.5  
755 hours of any “stubborn high”.

756 3) Instead of 2), or additionally, the total **iob accrued** in that “**dura phase**” could be **capped** by  
757 a new related safety setting. It would probably be anchored on iobTH, and could also become a  
758 tuneable setting, maybe even a new parameter useable in Automations, too.

759

#### 760 4.5.5 How dura\_ISF works

761

762 Conditions for dura\_ISF to become active:

- 763 1) glucose is varying within a **+/- 5% interval** only;
- 764 2) the average glucose (*dura\_ISF\_average*) within that interval is **above target**;
- 765 3) this situation lasted **at least for the last 10 minutes** (*dura\_ISF\_minutes*)

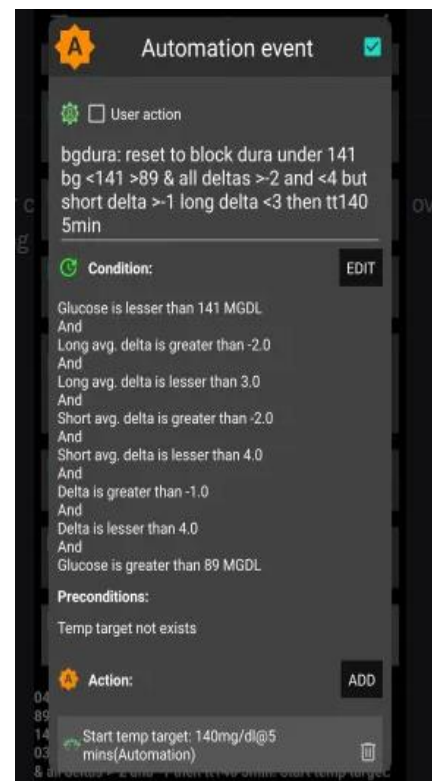
766

767 Effect:

768 4) The strengthening of ISF is stronger the longer the situation lasts, and **the higher** the aver-  
769 age glucose is above target:

770 5) This can be individually tuned by the **duraISF\_weight to automatically manage** high plat-  
771 eaus in bg values.

772





773 The formula looks like (this, and more, see page 6 of the Quick guide at [Github/ga-zelle/autoISF](https://github.com/ga-zelle/autoISF)):

$$\text{dura\_ISF} = 1 + \frac{\text{avg05-target\_bg}}{\text{target\_bg}} * \frac{\text{dura05}}{60} * \text{dura\_ISF\_weight}$$

where

avg05 = dura\_ISF\_average

dura05 = dura\_ISF\_minutes

774

775

776 *Off topic:* dura\_ISF is also very useful in Hybrid Closed Loop. It can be used to elegantly manage,  
777 fully automatically, a temporary insulin resistance from fatty acids. Please refer to other papers for  
778 details (for instance, sections on FPU and persistent high bg in “Meal Mgt.3...,pdf”, available here:  
779 <https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings> ).

780

#### 781 4.5.6 Set your dura\_ISF

782

783 Set a **start value of 0.2** for your dura\_ISF\_weight, and increase only cautiously with an eye on  
784 hypo prevention 2-3 hours later.

785

786 Caution: Fine tuning this parameter only makes sense **after** you tuned your bgAccel\_ISF and  
787 pp\_ISF well (so your thin yellow insulin activity curve shifts *as far to the left*, towards meal start,  
788 *as possible*, which will lower bg peaks and ease the job for dura\_ISF).

789

790

#### 791 4.5.7 Set your bg\_ISF

792

793 Since in Full Closed Loop we make our loop give us the maximum SMB size it can, at the  
794 beginning of a rise, it is crucial to **resist the temptation to continue** with a particularly **strong ISF**  
795 in the meal phase with the **highest glucose** values .

796 This is a reason why in Full Closed Loop we do not make much use of the **bg\_ISF** component of  
797 autoISF.

- 798 • Wanting to get most of our insulin from SMBs delivered at fairly low (but beginning-to-rise)  
799 bg implies that we do **not** make ISF weaker at low bg. Under preferences/OpenAPS  
800 SMB/autoISF/bg\_ISF settings you could set **lower ISF\_range\_weight** = 0.0.

801 If you want to analyze in your data, whether you might benefit from a milder ISF at low bg  
802 values (e.g. if you often go below target after correction of only mildly elevated bg in the  
803 preceding hours), you may want to try lower ISF\_range\_weight = 0.1 or 0.2. Study the  
804 effects from bgISF, and increase, or decrease, the bgISF\_weight to fine tune the sought-  
805 after affect.

- The **higher\_ISF\_range\_weight** is used when bg is above target, It then strengthens ISF the more the higher the set weight is. 0 disables this contribution, i.e. ISF is constant in the whole range above target.

In FCL, this factor should be fairly irrelevant: Near glucose peak, zero-tempering usually prevails anyway, so the settings we try might often not be used really by the loop. Very likely, you can live with setting the weight to = 0.0 here, too.

If you want to analyze in your data, whether you might benefit from a stronger ISF at high bg values (e.g. if you often remain above target after correction of elevated bg in the preceding hours), you may want to try higher ISF\_range\_weight = 0.1 or 0.2. Study the effects from bg\_ISF, and increase, or decrease, the higher\_ISF\_range\_weight to fine tune the sought-after affect.

#### 4.5.8 “Quality control” on your tuning for the later half of your meal time

The later stages of meal management (both, in HCL and in FCL) struggle with the problem that there is a **hypo danger** from the “tail” of insulin activity from earlier SMBs that were needed to fight high bg or plateaus associated with temporary insulin resistance.

Once your bg sits high, neither you, nor a hybrid closed loop with all the carb info, nor your FCL can work wonders.

Very important:

- Iterate between **2 or 3 kinds of meals** (from your typical spectrum) to find **one** set of settings that works *good-enough for all*. That should be possible.
- If you can’t make it work for certain meal types, see [sections 4.7](#) and [5](#), what you can do then.

Observe hypo trends after meals, and

- resist the temptation to elevate the **dura\_ISF\_weight** very high.
- try to stay away from **bg\_ISF** or dynamicISF in Full Closed Loop:
  - In FCL you probably can afford to shut bg\_ISF entirely off via setting both related \_weights to 0.0.
  - At least be careful, use small ISF\_range\_weights and check whether you are happy with the contributions to the effectively used ISFs

839                   ○ *Off topic:* If, coming from dynamicISF usage, you stay in **Hybrid** Closed Loop, but now with  
840                   autoISF, you probably can use the bg\_ISF parameter with higher \_weights to emulate what  
841                   you like to replicate from your dynamicISF experience.

842

843 bg highs will take time to resolve.

844 Interestingly, an after-dinner walk can work wonders sometimes (take glucose tablets along).

845 Zero-tempering and too tightly set safety limits can be **stumbling blocks in your tuning** project

846 Investigating effects of set ISF\_weights is not really possible in periods of zero-tempering.

847 Too aggressive settings might not come into play most of the time.

848 However, some *other* time they might come into play, and *then* produce a hypo 1-2 hours later.

849

850 Therefore, **carefully study the SMB tab** (or better yet, do an **emulator** based analysis, see  
851 [sections 10-11](#)) to see

852                   • what the selected weights **would** do, **if** there was **no zero-tempering** at the time, and

853                   • whether you bump into a **set limit** already (if your bgAccel\_ISF\_weight makes you exceed  
854                   allowed max. SMB size, then further tuning your settings only makes sense with either  
855                   allowing bigger SMBs, or limiting bgAccel\_ISF\_weight to a lower number at which you will  
856                   not frequently bounce into the SMB limit)

857                   • at which **other** times (rather than the one you currently look at and try to improve) that  
858                   selected setting might backfire

859

860

#### 861 4.5.9 How your “UAM” concludes insulin need for your un-declared carbs former 4.5.3 quoted elsewhere!

862

863 The UAM Full Closed Loop doesn't get any information from you as to how many grams of carbs  
864 will be there, for absorption.

865

#### 866 Looking back

867

868 For the recent 5-minute segments, the UAM oref(1) loops can precisely calculate how many grams  
869 of carb “must have been digested” based on the CGM values seen, and your IC and ISF profile  
870 parameters

871 For more detail see chapter 1.2 on how dynamic carb absorption is calculated, in “IC (carb  
872 ratio)...pdf” at: <https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings>.

873

#### 874 Looking into the next minutes, hour

875

876 However, *here* we worry about the *late meal stage*, and our FCL has gotten no information from us  
877 about how many grams **in total** were eaten, and certainly we do not bother to give eCarbs with  
878 estimated **absorption times** (that are so essential in iOS Loop).

879

880 So, in FCL you leave your loop without knowledge when your steady-state max carb absorption  
881 phase...

882     ○ the earlier mentioned 30g/h, or

883     ○ with gastroparesis, or if on GLP-1 drug treatment, probably on a lower g/h level

884     ○ sometimes prolonged (“faked”) by a brief episode of insulin resistance to fats

885 ...might end. Nor, whether extra carbs were added, later, or “FPU’s are lurking”.

886

887 The FCL now needs to provide desired amounts of insulin, while facing potentially induced hypo  
888 danger later (considering the DIA of all insulin in use).

889

890 Fortunately, the UAM Full Closed Loop is *not completely clueless* regarding how carb absorption  
891 *will continue*:

892

893 It will work with a **prediction** of *further* carb absorption, building on the **carb deviations**

894 (=calculation of how much got absorbed in the *past* 5 minute segments), and phase out further

895 *expected* carb decay in the course of the next 1 to max 3 hours.

896

897

898 For more detail see

- 899 • <https://openaps.readthedocs.io/en/latest/docs/While%20You%20Wait%20For%20Gear/Understand-determine-basal.html#understanding-the-basic-logic-written-version>
- 901 • *or do a real-time study* with (screenshots from) your SMB tab info.

902

## 903 Discussion

904

905 **This UAM prediction** about further carb absorption can be worse, but **can also be better than a**  
906 **prediction based on the user's „e-Carb“ input in Hybrid Closed Loop.**

907

908 In any case, and even when having perfect knowledge about how exactly the carbs fade out in the  
909 next hours, there would still be a principal problem for the loop: Heavy insulin „fire“ against highs  
910 will not work immediately (depending on the insulin's time-to-peak), and notably it comes with a  
911 significant hypo danger from the „tail“ of insulin activity.

912 A big bolus, or also a series of boli, will rarely work exactly for several hours matching the  
913 absorption of carbs (from what, how much and and how fast the user ate).

914

915 *Off topic closing remark:* With meticulous attention to all carb-related profile parameters, and daily  
916 inputs on amounts and absorption times, plus some “mindfulness” as to which diet habits disturb the  
917 possible balance, there are “pro” loopers (notably on iOS Loop) who achieve impressive %TIR  
918 (and % in tight range) performance. – The author consciously chose the other way, to put substantial  
919 effort into a personalized upfront system calibration, and work with a `oref(1)` algo system that allows  
920 (nearly) every day hands-off FCL.

921

## 922 4.6 Tuning your initial settings

923

924 Be pro-active: **The earlier large SMBs come** (driven by `bgAccel_ISF` and `pp_ISF`) ...

925 Note: Also your CGM smoothing may play a role here, that you may want to look into !

926 ...the **less high** the overall increase in BG will be, and (provided you set a proper `iobTH`)  
927 the **lesser** the **risk** will be **for a hypo** after the meal.

928

929 Therefore, **put most of your FCL tuning effort into determining suitable weights for**  
930 **`bgAccel_` and for `pp_ISF`, and for finding a suitable `iobTH_percent`.**

931

932 Low carbers probably should pay more attention on **`dura_ISF`**, besides seeing to it that  
933 `bgAccel_ISF` is not too aggressive (see above, [section 4.2.5](#) and [case study 4.2](#)).

934

935 Later, your “FCL cockpit” will give you access to **temporarily modulate** these essential  
936 parameters (see [section 5.2.](#)), providing you an opportunity

- 937 • in your tuning phase, for more research on the fly, so to speak
- 938 • everyday, for temp. adaptations to altered insulin sensitivity, or to special  
939 disturbances (should you, occasionally, see a need).

940

941 After you tuned your **initial settings** well, there should rarely arise a need for “fine tuning” later,  
942 see [section 8](#) and [case study 8.2!](#)

943

944 The experience of the author is that it is possible to tune the above mentioned weights for very  
945 different meals in such a way that the glucose almost always remains acceptably in range.

946

947 However, if you come to the conclusion that **differentiated settings** (for different meals or meal  
948 time clusters) would be easier to establish, and/or work better for you, the following sections  
949 suggest many options you could try and use.

950

## 951 [4.7 Maneuvering through more complex scenarios](#)

952

953 You now can move on, to accommodate more complex scenarios.

954

### 955 [4.7.1 Complex meal spectrum](#)

956

- 957 • Especially if you are a bit shy of using the Emulator ([section 10](#) and [11](#)) for really detailed  
958 analysis, it can well be that you will not hit *one* real good system calibration ([section 4](#)) for your  
959 *entire range* of diets (meal spectrum)..
- 960 • In that case you will occasionally run out of range (bg =70...180 mg/dl), and your options to  
961 prevent, react, or improve are:
  - 962 ○ accepting a few % higher time outside of range for that day (and, if feasible, in the  
963 future avoiding what seemed to have caused it)
  - 964 ○ taking a snack (whenever you tend to go low from the “tails” of insulin activity that was  
965 required to fight a peak)
  - 966 ○ doing a manual “tweak” (if you can think of one in time), to manage the problem  
967 manually. For example, briefly going into an odd TT (=temp. blocking more SMBs) can  
968 be a very easy-to-handle remedy, sometimes

- 969           ○ define a User Action Automation, and provide an extra “cockpit button” to announce a  
970 meal *outside of your usual spectrum*, so it will automatically be treated differently by  
971 your FCL (as you defined in your Automation; example: [Case study 5.2](#)).
- 972           ○ temporarily resorting to “your old” hybrid closed loop.

973

974 Instead of accepting such instances, you could launch “improvement projects”, that refine your  
975 initial tuning ([section 4](#). and [sections 8](#) and [9](#))

976 Note, though, that it could be near-impossible to fine-tune *if your basics never were “right”* and you  
977 got lost in a maze of errors and counter-errors. In that case, **only a fresh start might**  
978 **convincingly help**.

979

#### 980 4.7.2 Complex tasks aside from managing meals

981

982 To deal with *different* disturbances than presented by your meal spectrum (that you were  
983 calibrating for in this section 4), there will be **other** instances where **temporary modulations** of  
984 your FCL will be needed.

985

986 You have a variety of options to deal with that, and this will be the topic in [section 5](#).

987

988 It is suggested to do **major exercise** still *in your hybrid closed loop* setting, *until* you have your  
989 FCL up and running for meals on normal days with no or only moderate exercise.

990 Later, implement extras as discussed in [section 6](#) to fully implement your FCL.

991

992

993

994



## 4.8 Profile helper

**DRAFT** by John Kitching/edited

For general loop settings for FCL with autoISF, please consult [sections 2.1 – 2.6](#)

The following table gives a comprehensive approach how to tune your autoISF FCL better, when you see any of the problems as in *column A*.

Make sure to work through the problems in the order given in this table.

	A	B	C	D
1	Notes: 1. if not entering carbs then "several hours after eating" can be applied instead of "with zero COB"			
2	<b>The problem</b> (follow <u>in order</u> )	Y/N	Possible solution	Based on what logic
3	Are you having periods with zero COB and negative IOB?	Yes	Decrease basal a bit over these periods, wait a couple of days to evaluate and return here	Oref is backing off your basal to try and hold your BG steady so basal is probably too high
4		No	Continue with this sheet	
5	Are you having periods with zero COB and positive IOB?	Yes	Increase basal a bit over these periods, wait a couple of days to evaluate and return here	Oref is increasing your basal to try and hold your BG steady so basal is probably too low
6		No	Continue with this sheet	
7	Do you get roller coaster BGs?	Yes	Increase profile ISF a bit (make weaker). Also, check your set iobTH%. Reevaluate over a couple of days, return here	BG goes over target -> with too-strong ISF, too much insulin is dosed resulting in BG below target. Long zero-temping required, but resulting in high BG next ...
8		No	Continue with this sheet	
9	After your BG went high, do you get a hypo later (from remaining insulin "tail" at zero COB)?	Yes	Reduce autoISF "weights" a bit, reevaluate over a couple of days, return here	ISF is reduced (strengthened) too much by autoISF as you move away from target. Reducing the proper ISF_weight will reduce that impact. Use the <b>autoISF history table</b> for more information about <b>which one</b> is causing the issue: Preferably, "shave of late", at DURA or BG; PP or ACCEL weights might need reducing, too.
10		No	Continue with this sheet	
13	When you start eating with BG around target and iob near zero, do you get a hypo (in the first 2 hours)?	Yes	Check whether you can reduce your set iobTH%, or SMB range extension, or autoISFmax. Decrease PP (and maybe also ACCEL) "weight", and increase profile carb ratio a bit (make it weaker, so you see the insulin needed relate well to the g of carbs digested by the time you see a hypo tendency). Reevaluate over a couple of days, return here	You're getting too much insulin to cope with the bg rises from the carbs you've eaten. Taming the loop can be done in several ways: Weakening profile carb ratio and ISF would work in all situations. Lowering ACCEL and/or PP autoISF "weights" would exactly weaken loop over-response in early stage of BG rise. And the 3 first-mentioned safety settings just limit excesses.
14		No	Continue with this sheet	
17	When you eat, is iob building up too slow, with a lot of it added at bg peak or even still when BG reduces?	Yes	Check whether you must increase your set iobTH%, or SMB range extension, or autoISFmax. Increase PP "weight", and decrease profile carb ratio a bit (make it stronger, so you see the insulin needed relate well to the g of carbs digested). Reevaluate over a couple of days, return here	You're not getting enough insulin to cope with the bg rises from the carbs you've eaten. If your loop bounces into any of the 3 first-mentioned limits, "tuning more aggressive" might simply not work. Making the loop more aggressive can be done in several ways: Strengthening (lowering) profile carb ratio and ISF would work in all situations. Elevating autoISF "weights" (notably PP) could exactly strengthen loop response in instances where needed (where the respective "weight" is playing a role).
18		No	Continue with this sheet	
19	Does BG stay high for long periods?	Yes	Increase DURA "weight" a bit. Reevaluate over a couple of days, return here	DURA reduces ISF (makes it stronger) if BG stays high for longer periods than it should. Reminder: Follow this sheet <u>in order</u> ! This "last job", dealing with persistent highs via DURA, is much easier after you sorted out how to build-up iob faster, so not to go super high in the first place.
20		No	Have a short holiday with lots of carbs	
22	<b>Further reading:</b>			
23	Ga-zelle's quick start guide		<a href="https://github.com/ga-zelle/autoISF/blob/A3.2.0.4_ai3.0.1/autoISF3.0.1_Quick_Guide.pdf">https://github.com/ga-zelle/autoISF/blob/A3.2.0.4_ai3.0.1/autoISF3.0.1_Quick_Guide.pdf</a>	
	FCL e-Book, Trouble Shooting		<a href="https://github.com/bernie4375/FCL-potential-autoISF/blob/FCL-e-book/09_Trouble.Shooting_FCL-">https://github.com/bernie4375/FCL-potential-autoISF/blob/FCL-e-book/09_Trouble.Shooting_FCL-</a>	