# A chapter entitled “The F3 layer”

## Context – guidance for authors.

This chapter is intended to form part of a supplement to UAG-23 / UAG-23A to provide rules and guidance on the interpretation of ionograms containing a F3 layer.

Before reading this chapter we expect any reader to be familiar with at least chapters 0 to 3 of UAG-23A. Hence there is no need to repeat any of that information in this chapter. Rather we are focusing on adding a chapter that covers one discrete phenomenon.

The goal is to present a Final Proposed Draft text[[1]](#footnote-1) to the 2026 GASS[[2]](#footnote-2) meeting.

## 0.2 Contributors

As soon as you make a contribution add your name to the table below. Please don’t be shy or humble as we want to credit everyone who contributes to this chapter. Please add your affiliation – no matter how long or short it might be. Please add the country in which you are working to give a flavour of just how wide spread the contributions have been.

| Name | Affiliation | Country |
| --- | --- | --- |
| Dr Samuel Ritchie | Commission for Communications Regulation | Ireland |
| Paulo Fagundes |  | Brazil |
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## How this process will work

I am co-ordinating this work and the work only progresses as I receive contributions.

This is the master document which will become the chapter dealing with the F3 layer.

I will make the latest master available for download from my website[[3]](#footnote-3). Feel free to take a copy from there to work on. If you are going to add text make sure to download the latest version to work on.

Add what you can and email the document back to me[[4]](#footnote-4) . It does not matter how much or how little you have done. You can always download the latest master when you are ready to contribute some more.

Revision marks should not be turned off – I need to see what you have done by following the revision marks in order to update the master document.

Please send me high definition graphics of any ionograms you insert which I will store – this is in case we go for a high quality printing, or if I am annotating graphics.

No doubt we will need to explain things by annotating graphics, i.e. mark up the ionogram. I would prefer to make all those annotations myself so that all the annotations in the chapter use the same colour, style, font, size, etc. As long as you have sent me the high definition graphic you could just write the annotations on a copy, scan it and email it to me.

Do not forget to add full references if you reference anything – just write them into the body of the text and I will sort them out when we approach the end.

I will regularly update the master on my website and we repeat the process until we have a stable version.

A stable version has the following characteristics:

* Contributions of new material has dried up;
* Comments[[5]](#footnote-5) on other people’s work have stopped; and
* It is clear why some headings are not required.

In that stable version I do not expect that we will agree on everything so there maybe be two or more different text options on a number of issues or on some examples. But, once we have a stable version we can have a ZOOM call to agree/compromise on matters or we hopefully will have the option to come to Dublin for a face-to-face meeting to finalise the document before we send it up for consideration.

I may have put in headings below that are simply not required[[6]](#footnote-6) and I will delete the unwanted when we have a stable document.

## 0.4 Work to be done

The chapter starts on the next page.

The text in blue defines what needs to be drafted/found/inserted by contributors/authors.

The text in black is my comments, guidance, examples.

Revision marks are always on – this will help me keep the master document updated when many different contributions arrive.

# The F3 layer

## General Description.

Insert a real-life example of a real ionogram showing a well-defined F3 layer.

Provide a general description if what the example ionogram is showing.

Talk, in a general manner, about the occurrence of the F3 layer at low, mid and high latitudes.

At low-latitudes the F3 layer is …….

At mid-latitudes the F3 layer is often …….

However at high-latitudes the F3 Layer has never been identified as occurring.

## Definition.

As exampled in paragraph 3.30 (page 99 of UAG-23A) we need a definition

Some commentary might be inserted here to reflect current practise (if applicable), point to difficulties or reflect on what you as an expert in this area have noticed.

## Proposed parameters.

To avoid confusion, examples of parameters are: foF2, h’F, M(3000)F2, etc.

Here we need to detail the parameters that we want to scale to make use of the data provided by ionosondes.

As detailed in 0.23 (page 3 of UAG-23A) we can propose parameters based on:

* Parameters required for worldwide studies – we can have one example ionogram showing these.
* Parameters required for regional studies (different latitudes) - we can have one example ionogram showing these for one region.
* Parameters required for local studies - we can have one example ionogram showing these for a specific location.

## Types.

If there are different types of F3 layer then we need to present an example of each type, provide comment on the type and assign a lower case letter to each type.

The exemplar is paragraph 4.83 (page 125 of UAG-23A).

## Proposed scaling rules for each parameter

As exampled in paragraph 3.32 (page 102 of UAG-23A), here we want to propose the rules applicable to scaling the F3 layer.

## 5.1 Guidance notes for scaling

Notes to guide those doing the hard work of scaling.

Include a note on how we have retained backward compatibility (if necessary).

## Proposed scaling accuracy for each parameter

Example text:

FoF3 should be scaled with an accuracy of 0.1 MHz. Therefore the last digit of the scaled value is always in the range 0 – 9.

h’F3 should be scaled with an accuracy ………..

## Proposed use of qualifying and descriptive letters.

Example text:

FoF3 is indicted by a numerical value in units of 0.1 MHz with or without letters or by a letter only.

If we need to use qualifying and descriptive letters then we must ensure we align with the current list of qualifying and descriptive letters. These are found in section 2.3 (pages 34 -35) and a detailed explanation is in section 2 (pages 65 – 98) of UAG-23A).

We can have real life examples of the use of qualifying and descriptive letters in the next section.

## Examples of scaling the F3 layer.

We can present as many real-life examples of scaling ionograms, in colour, as we deem necessary to give the reader a good handle on scaling F3 layers.

We can have simple to complex.

We can have examples from all latitudes.

We can demonstrate the use of all the descriptive and qualitative letters.

We can have special cases if there are any.

For each example the framework to use when describing the example is[[7]](#footnote-7):

Observation:

The trace below 3.2 MHz fades away due to the high absorption present as evidenced by fmin.

Interpretation:

Frequencies below fmin are affected by absorption. Therefore, the numerical value should be accompanied by the qualifying letter E and the descriptive letter B.

Comment:

Absorption of this magnitude is rarely observed between 01:00 and 04:00 local time at all low-latitude ionosondes.

## References.

We can add citations to papers that deal with the E2 layer here. BUT… they be useful for interpreting ionograms, this is not be a history lesson, a survey of everything we know, etc.

Fagundes, P. R., V. Klausner, Y. Sahai, V. G. Pillat, F. Becker-Guedes, F. C. P. Bertoni, M. J. A. Bolzan, and J. R. Abalde (2007), Observations of daytime F2-layer stratification under the southern crest of the equatorial ionization anomaly region, J. Geophys. Res., 112, A04302, doi:10.1029/2006JA011888.  
  
Fagundes, PR; Klausner, V; Bittencourt, JA; Sahai, Y; Abalde, JR (2011), Seasonal and solar cycle dependence of F3-layer near the southern crest of the equatorial ionospheric anomaly. J. Adv. Space Res., DOI:10.1016/j.asr.

Tardelli, A., P. R. Fagundes, M. Pezzopane, K. Venkatesh, and V. G. Pillat (2016), Seasonal and solar activity variations of F3 layer and quadruple stratification (StF-4) near the equatorial region, J. Geophys. Res. Space Physics,121, doi:10.1002/2016JA023580.

Tardelli, A., Pezzopane, M., Fagundes, P. R., Venkatesh, K., Pillat, V. G., Cabrera, M. A., & Ezquer, R. G. (2018). Study of the F3 and StF4 layers at Tucumán near the southern crest of the equatorial ionization anomaly in western South America. Journal of Geophysical Research: Space Physics, 123. <https://doi.org/10.1002/2017JA024539>.

Venkatesh, K., Patra, A. K., Balan, N., Fagundes, P. R., Tulasi Ram, S., Batista,  
S., & Reinisch, B. W. (2019). Superfountain effect linked with 17 March 2015 geomagnetic storm manifesting distinct F3 layer. Journal of Geophysical Research: Space Physics,124, 6127–6137, <https://doi.org/10.1029/2019JA026721>.

Tardelli, A; Fagundes, PR; Pezzopane, M; Pillat, VG (2022) Longitudinal variations of the occurrence of F3 and F4 layers within the southern EIA and their dependence on solar cycle. ADVANCES IN SPACE RESEARCH.69, 1, 59-70, DOI:10.1016/j.asr.2021.08.011.

Ends …./

1. This is ITU terminology for a document that is ready for approval by a plenipotentiary meeting – which for URSI is GASS. [↑](#footnote-ref-1)
2. Scheduled for 15 – 22 August in Krakow, Poland. [↑](#footnote-ref-2)
3. [www.samuelritchie.com/ionogram](http://www.samuelritchie.com/ionogram) [↑](#footnote-ref-3)
4. Use [samuel.ritchie@comreg.ie](mailto:samuel.ritchie@comreg.ie) [↑](#footnote-ref-4)
5. Always polite comments of course. [↑](#footnote-ref-5)
6. Which we recognise as there have been no contributions made under these headings. [↑](#footnote-ref-6)
7. Text below is completely made-up. [↑](#footnote-ref-7)