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1. An historical survey of sequence descriptions

Things haven’t always been as they are today. Previously, in the so-called good old days, there were fewer rules and regulations. Why was that? There were only a few small, and thus clearly arranged machines and systems. For many of them there was no documentation. Machines were seldom developed at the drawing board. “R&D” was usually carried out directly at the production location by tinkering, step by step, from strictly manual work towards automation. The line of approach was clear-cut, and quite simple:

Try it out and see if it works!
- If it does, that’s great!
- If not, try again!

Any lack of documentation was no problem at all, because the machines and systems were intended exclusively for the use of developers. Furthermore, in the good old days people rarely changed jobs. Knowledge regarding the functions and any peculiarities of the machine was thus always readily accessible.

But times have changed! People started building machines that were no longer intended for their own use, and began buying machines from other sources. Suddenly there was a problem: Machines had to be maintained, repaired and optimised by people who had never seen them before! And thus the need arose for a description of the functions of any given system, i.e. for a circuit diagram and uniform documentation.

Standards appeared regarding circuit symbols for the devices that existed at that time, as well as a standard for function diagrams. This standard covered the state-of-the-art in the field of automation technology in its entirety at that time. In those days the sequences were linear, and there were no time functions, counting functions or program variants.
But time didn't stand still. On the contrary, things began happening faster and faster. Although the time function was quite easy to represent in sequence diagrams, loop counters and program variants, for example, presented practically insurmountable obstacles despite improvements to the standard. Automation technology demanded new possibilities for the graphic representation of sequences. In the meantime, the “sequential function chart” had come into being as a response to these requirements. But of course it too had its defects, inconsistencies and weak points at first. When the sequential function chart was significantly improved and accepted by industry at the beginning of 1992, the function diagram admitted defeat.

But automation technology continued developing further and further, and the good was sacrificed in favour of the better. This, incidentally, is nothing new. It's been a valid concept since the invention of the hand axe.

Moreover, this has also been the fate of the sequential function. Its successor is known as GRAFCET, which is valid all over Europe. At first glance, GRAFCET may appear confusing in comparison with the sequential function chart. But after taking a closer look, it becomes apparent that many things have been more clearly defined and simplified. The lack of structuring, right up to the various operating modes, has now been clearly standardised.

And so once again we have reached the point at which we bid the familiar farewell and must tackle the current state-of-the-art in the field of automation technology, because he who remains at today's level will tomorrow be living in the past.
2. Why a new standard?

Nobody would go to the trouble of writing a new standard just for fun. There are at least three important reasons for revising standards, or for creating new ones:
1. Unclear, confusing or even contradictory texts within the valid standard
2. Missing, non-standardised content
3. Internationalisation of the scope of validity

With the change from DIN 40719, part 6, “Sequential function charts”, to DIN EN 60848, “GRAFCET”, one thing alone becomes immediately apparent – as a result of the designation: the standard’s scope of validity. The function chart was a German standard, but GRAFCET is valid all over Europe. It’s European origin is also made apparent by the name. GRAFCET is an abbreviation for the French term: **GRAphique Fonctionnel de Commande Etape Transition**.

Translated into English, this means: step transition function charts.

When comparing the old and the new standards it becomes evident, for example, that just a few arrows are used instead of a maze of letters for the actions. The broad range of identifying letters has thus been eliminated. This is also the case for letters used to identify responses with all of their designations. The general “save command” is now precisely described in a simple fashion as well, and is a significant step closer to the PLC program. Simplification has thus been clearly achieved.

Hierarchical levels required for precisely defining coarse-fine structures, as well as for all operating modes right up to emergency stop, were sought after in vain in DIN 40719, part 6. But these are also included in GRAFCET. This is not the result of negligence on the part of earlier standards authors, but rather the substantiation of further advances in the field of automation technology. As demonstrated in actual practice, the further advanced the machine, the more important the operating modes and their hierarchies. And thus the standardisation gaps have been closed.
2. Why a new standard?
3. Structure of GRAFCET

Essentially, GRAFCET describes two aspects of a control process in accordance with fixed rules:

- The actions to be executed (commands)
- The sequence in which they are executed

A GRAFCET – which is also referred to as a GRAFCET plan – is subdivided into two parts for this reason. The structure depicts the process sequence in time, and the process is broken down into consecutive steps.

GRAFCET for a process which separates workpieces and feeds them to a production sequence
3. Structure of GRAFCET

The structure does not define in particular which actions are to be executed. These are included in the action section. In the example shown above, these are the blocks to the right of the steps, as well as the transition conditions between the steps.

**The basic principle of GRAFCET**

1. Sequences are subdivided into alternating
   - steps and
   - transitions.
2. Only one step is active at any given time.
3. Any desired number of actions can be linked to the steps.
4. Sequences can be branched out and merged back together as
   - alternative branchings or
   - parallel branchings.

Step one must be observed in this case!