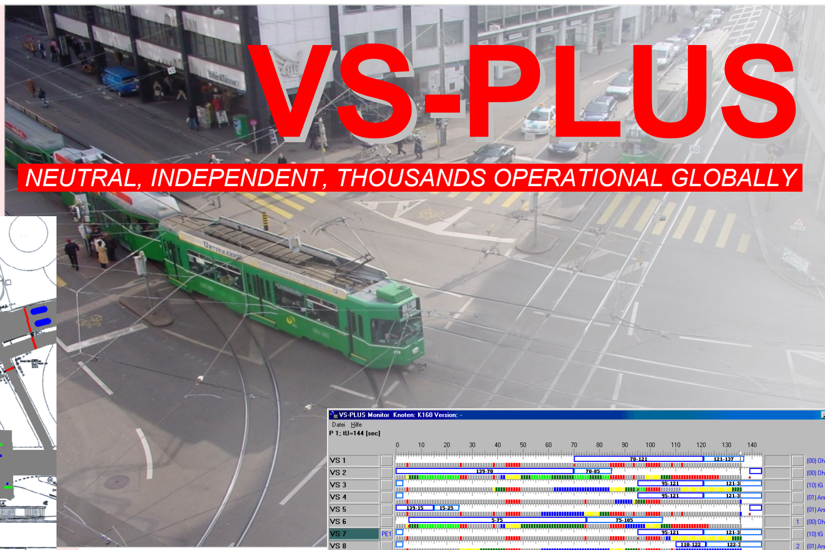

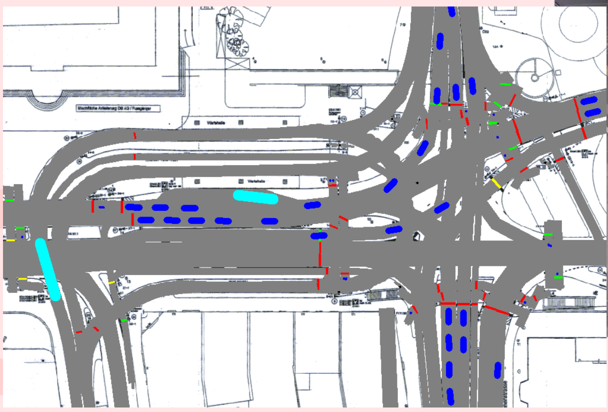

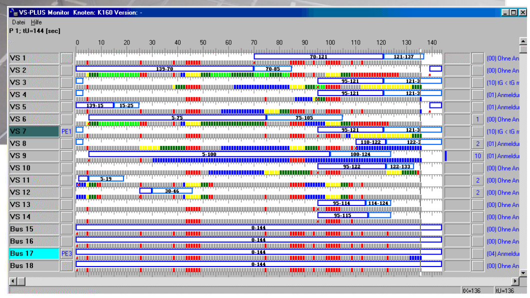

VS-PLUS

DETAILS

Understanding VS-PLUS

Version 0.9 - June 2004

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Contents

1 Introduction

Traffic-actuated, standardized and parameterized control programs pursue two goals: first, an **optimum and plausible traffic control**. Optimum here means low loss times to minimize the waiting times for all road users. This simultaneously means minimizing the impact on the environment. Plausible means a sequence, which is understood and accepted by all road users. This essentially means that a road user should be taken into account within a reasonable amount of time and should not be kept waiting for no apparent reason.

The second goal is the **simplest possible operation of a signal control system**. In towns and cities with a number of signalized intersections, an individual planning and programming of the systems is often not feasible, particularly with traffic-actuated controllers, for cost and time reasons. With standardized controllers the operator knows the sequence of a system on the basis of only a few parameter tables. The layout of the parameter tables is identical for all systems. Modifications can be performed with no programming skills by simply changing the parameter.

The standard control program described in the following contains the principles described above. VS-PLUS has been designed to enable the user to carry out all common types of control. It can be used for both fully traffic-actuated systems and partially traffic-actuated systems. The overall traffic dependency is defined with parameter. This means that the complete control sequence can be influenced at any time. With the corresponding software, these modifications can be easily carried out online in real time at the intersection.

Permissive signals serve as coordinating instruments. They are used as control instruments to switch phases and/or the corresponding signals. The permissive signal for each phase runs over the complete cycle time in fully traffic-actuated controls. There is no split into call and extension ranges.

During the cycle, phases that are not active can be added. However, they only receive green if they fit into the desired picture.

2 Terminology

In order to understand the following description of a traffic-actuated control, three terms have to be defined in addition to those commonly used.

- Phase
- Permissive signal
- Permissive period plan

2.1 Phase

This term is common in traffic engineering, though you should note that VS - PLUS has its own definition of the word.

Unlike normal technologies, VS-PLUS differentiates between the new traffic unit, the phase, and the display elements, which is assigned to the phase. The term display element is in this case a general term for all possible types of displays, which can be controlled by a controller with an I/O instruction. A display element typically corresponds to a signal group.

All descriptions and definitions relevant for traffic engineering can be found in the phase unit. In terms of control technology, the phase is a control loop with its own measuring elements (detectors) and actuators (display elements such as the signal groups) as well as control signals (permissive signal).

A phase is normally a vehicle-dependent phase, which generally has its own detectors and must always affect at least one display element.

It is quite possible for one phase to have a number of display elements assigned, or vice versa, two different phases have the same display element assigned. In the first case this may be a relationship between general-purpose traffic with two traffic signals or warning-flashing signal. In the second case this may be a bus moving along the general-purpose traffic lane. A phase can also have a functional meaning, e.g. if a phase is defined as a SPILLBACK (assigned to a spillback loop) which overrides a vehicle phase during a logon.

This phase technology allows the diversified control of a signal on the basis of different events.

2.2 Permissive Signal

Unlike the known signal times, the permissive signal is now used. A permissive signal is no longer interpreted as a switching instruction for a signal group, as is the case with signal times, but as a control signal for the traffic-actuated control of a phase, as briefly mentioned above. The permissive signal is defined for each phase. This means that every traffic-engineering unit can be directly influenced and/or controlled.

The permissive signal itself is split into a **call range** and an **extension range**. Calls are dealt with in the call range and forwarded to activation commands, whereas a phase must have green in the extension range and may only extend. However, in standard cases activation is no longer allowed.

The **permissive signal pointer** defines a time in the cycle at which the next phase to be processed (according to the main series in the priority class) is to be taken into account.

The total sum of all permissive signals for all phases produces the so-called permissive period plan.

2.3 Permissive Period Plan

The permissive period plan is the total sum of the permissive signals. Just as the signal times of signal groups form a signal time plan in conventional technology, the permissive signals of the phases form a permissive period plan. It is essential that the total sum of the permissive signals correspond to the total sum of all phases and not the total sum of all signal groups.

The permissive signals are generally planned on the basis of the signal times for the fixed time control. Splitting the permissive signal into a call and extension range avoids the danger of a signal group assigned to the respective phase from switching the green time outside the permissive signal.

The control principle is determined by constructing a permissive period plan. Either a control with a consistent coordination in the conventional sense or coordination with passive and active green band extension or even a fully traffic-actuated control can be determined.

3 The VS-PLUS principle

VS-PLUS has a modular structure. The sections are processed cyclically, i.e. at least once a second:

- Detector evaluation
- Phase evaluation
- Picture development
- Switching
- Interface

First the pending detector information has to be processed in the detector evaluation. Based on this information a check is carried out in the phase evaluation of whether the corresponding phase is to be kept on red or in case the extension conditions have been met with green. A number of adjustable parameters are available for this decision, these being the detector parameter for the detector evaluation and the phase parameter for the phase evaluation.

A detector call only results in a phase registration if the permissive signal of the corresponding phase is pending or the phase waiting time has reached its maximum. The phase waiting time is the time period since the first detector call was triggered. The maximum waiting time can be defined in the phase parameter for each phase. In the event of an extension, the dimensioning of the basic duration is also important alongside a practical recording of the overall traffic condition.

The results are saved in status values and attributes for each phase. A so-called priority value is thus calculated for each served phase.

The status values form the basis of the information for the control's core, the picture development. The picture development determines so-called main phases with their served minor phases.

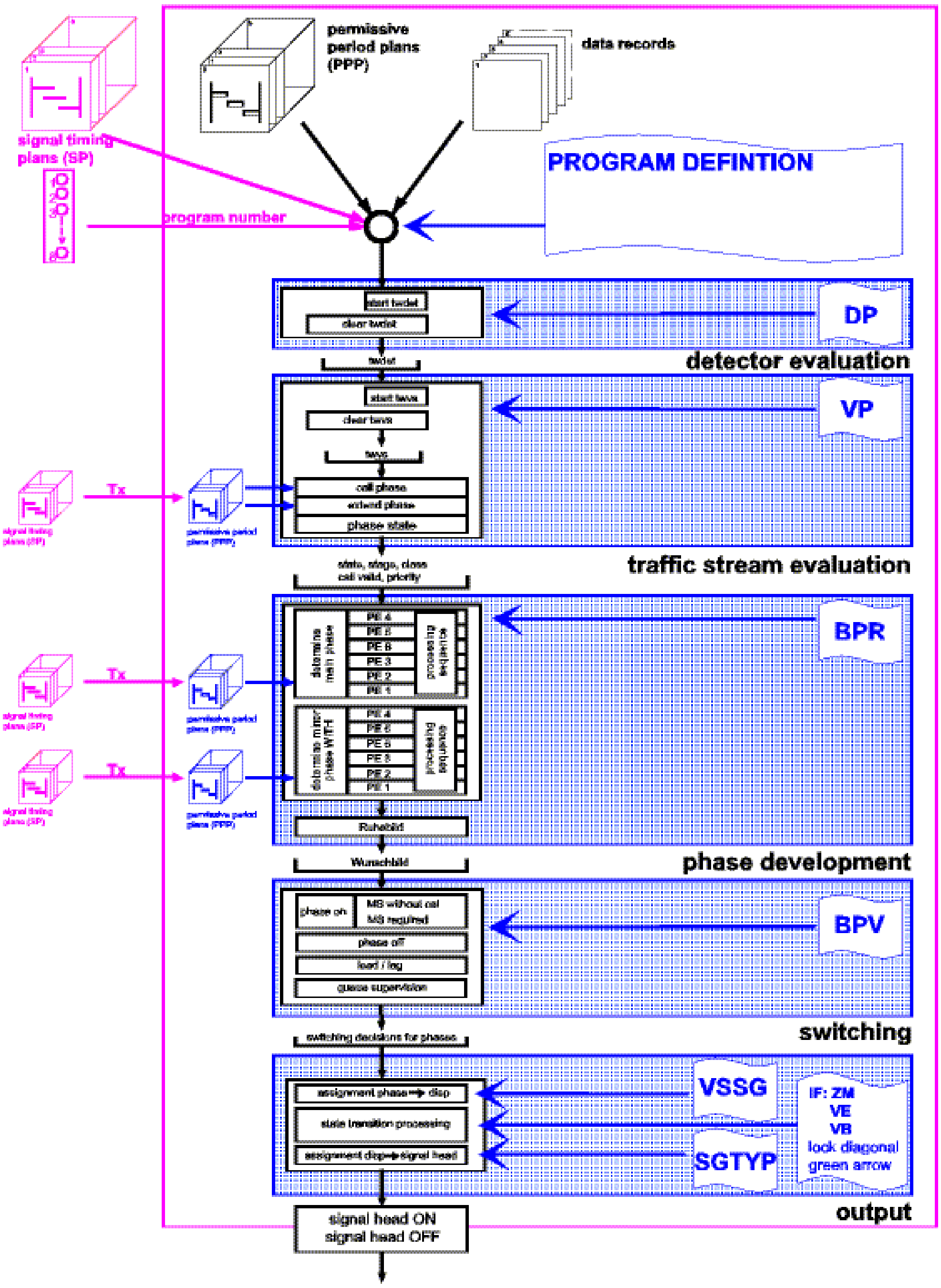
The result of the picture development is the target picture. This target picture lists all phases which will be the next to receive green and which are not conflicting in descending priority.

The target picture is processed in the switching section. In other words, the on and off commands are assigned for every phase. If only the served phases have been dealt with up to now, non-conflicting phases, which have not yet been served, can now also be handled. Consequently, all phases in conflict with the target picture are assigned an off command. Switching is carried out at a defined time.

The on and off commands for the phases are only converted into the corresponding on and off commands for the display elements in the VS-PLUS interface at the very end of this procedure, when it is determined which phases are to be activated. In this stage VS-PLUS calculates the phase change on the basis of the phase change time matrix as well as an offset time end and offset time start matrix.

At the end of the entire process, VS-PLUS sends the on and off commands for the corresponding signals of the display elements to the controller's operating system.

This briefly described sequence can take place every second. It goes without saying that the control logic is structured in such a way that the decisions taken every second are not constantly contradictory, which would lead to an uncontrolled phase.



The standard control program described in the following contains the principles described in the preceding chapter. VS-PLUS is designed in such a way that the user can perform all currently common control types. It can be used for both fully traffic-actuated and semi traffic-actuated systems. The overall traffic-actuation is defined in parameter. Thus, the complete control sequence can be influenced at all times. These modifications can be easily carried out on the spot at the intersection with the corresponding software.

Permissive signals serve as coordination instruments. They serve as control means to activate phases and the corresponding signals. In fully traffic-actuated controls the permissive signal runs throughout the entire cycle time for each phase. There is no split into call and extension section.

In order to supplement a phase during the sequence, uncalled phases can be added to the picture. However, these are only given green if they fit into the desired picture.

Summing up it can thus be said that a differentiation can be made between four graded control methods.

The following description is based on the general overview and goes into more details of the functions and parameter values necessary to set a traffic system. All existing parameter values are described in a separate part of the "Description of the parameter values".

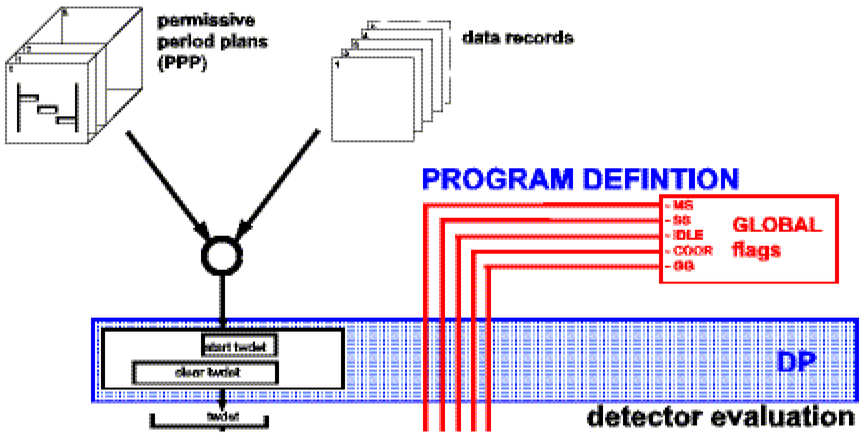
3.1 Control Methods

One can differentiate between four control methods.

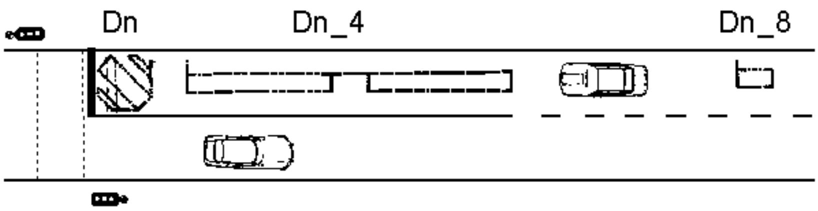
- **Control method I:**
  signal group for signal group fully traffic-actuated
- **Control method II:**
  phase for phase fully traffic-actuated
- **Control method III:**
  traffic-actuated coordinated with fixed cycle time (traffic-actuated control of small systems in one controller with up to 3 intersections)
- **Control method IV:**
  fixed time control

3.2 Detector Evaluation

The first task, detector evaluation, processes all detector inputs. A timer, the so-called detector waiting time (twdet) is assigned to each detector. This timer is always started with the first call and reset after a checkout signal or when the phase received green.



It is obvious that the design and positioning of the traffic recording devices are a prerequisite for an optimum traffic-actuated sequence. If the traffic recording devices are positioned incorrectly, even the best control logic will be unable to ensure an optimum control. The standard control takes into account a standard arrangement determined on the basis of experience:



These standard arrangements are not a precondition for the use of the standard control. Other arrangements can of course be used. However, in this case the extension criteria in particular cannot always be exactly adjusted.

3.2.1 Detector call

The standard control assumes that the detector evaluation provides the controller with the effective status of a loop (occupied - not occupied). The differentiation between the function types

- Impulse detector
- Occupancy detector

takes place in the logic.

The comparative value **occupancy time** is decisive for this determination. If the comparative value is 0, evaluation is by impulse, in every other case by occupancy.

Every detector is assigned a **detector waiting time**.

Impulse detector

The detector waiting time is started on a rising flank.

There is a great risk with impulse detectors that they may trigger a call if incorrectly activated. For example, a vehicle runs over a detector when changing lane or when passing and then does not wait at the corresponding stop line.

The **hold time** parameter can be used to avoid these incorrect messages. If the net gap for a detector is greater than the comparative value hold time, the detector waiting time is stopped and deleted. The detector cannot trigger a phase call. If the hold time comparative value is infinite (max. possible value) the waiting time will not be reset.

Occupancy detector

The occupancy time of a detector must be greater than the comparative value occupancy time before the detector waiting time is started. If the loop is not longer occupied after the detector waiting time has started the detector waiting time is deleted again.

It is known that vehicles cross the stop line during amber and sometimes even red. The standard logic enables a limitation of incorrect calls due to detector calls shortly after green end with the **reset time** parameter. The detector calls will be reset as long as the red time is smaller than the comparative value reset time. This function applies for both impulse and occupancy detectors.

3.2.2 Phase call

Every detector which has been assigned a phase can activate a phase call. A phase waiting time starts with the first call irrespective of the permissive signal. The green flag can also start it.

In order to call a phase the **delay time** (detector waiting time greater than comparative value delay time) must be exceeded first. Second, the **permissive signal** to call the corresponding phase must be set to green (phase enabled). A phase is only deemed to be called when both conditions have been met (phase called and permissive signal for call present).

If a phase is called due to a detector call outside the call permissive signal the phase will be called at the start of the next permissive signal.

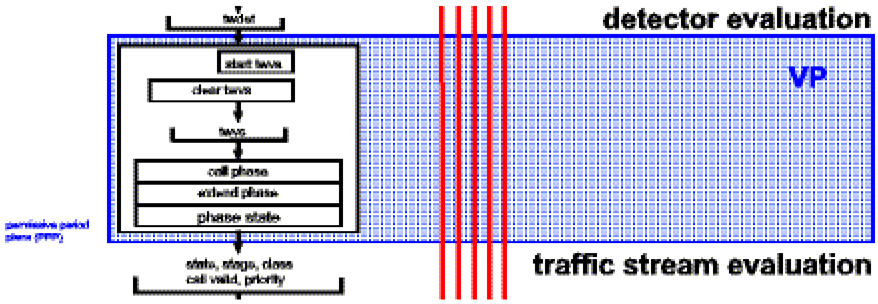
A call can also be triggered if the maximum waiting time (adjustable) for a phase is exceeded. (Phase set to priority level 2).

The phase will only be taken into account for the subsequent target picture development after a call.

If the detector waiting times are later reset, the phase waiting times are consequently also reset. The phase call is cancelled. The comparative value hold time can thus cancel a phase call provided a second detector does not maintain the corresponding phase call, or provided no reaction was yet triggered by the call.

3.3 Phase Evaluation

The second task, phase evaluation, prepares all detector and phase information for the following picture development. A timer, the so-called phase waiting time (twvs) is once again assigned for each phase. This timer corresponds to the waiting time for the phase since the first call. Various attributes are also managed for each phase along with this timer. The most important attribute is the status of the phase.



The phase evaluation checks each phase to see whether the corresponding phase is to be called with red or whether the extension conditions have been met with green. A number of adjustable parameters are available for this decision, namely

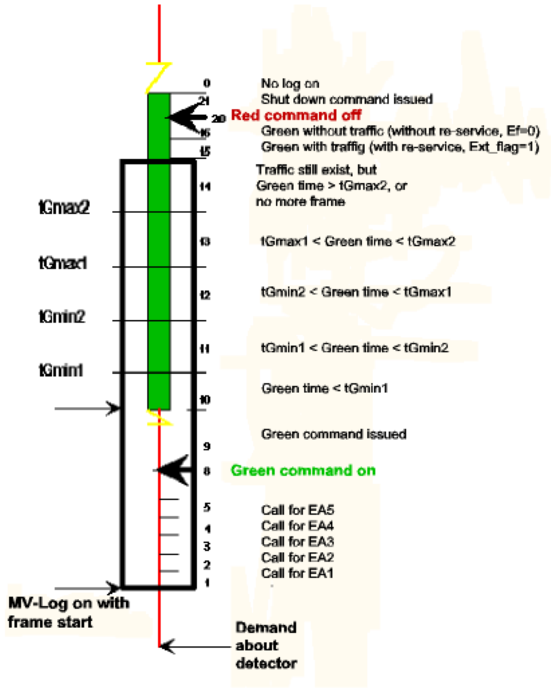
- Detector parameter for the detector evaluation and the
- Phase parameter for the phase evaluation.

3.3.1 Status values

The status of a phase is summarized in the so-called **status values**. The possible status values are shown in a figure.

These statuses are managed according to the following criteria.

- Color of assigned signal group
- Phase call
- Waiting time and control time
- Extension
- Green timer



3.3.2 Evaluation in red

If the phase waiting time is greater than 0 in red and its permissive signal is present or the maximum waiting time has been reached, the phase will be evaluated, i.e. the phase has been called and accepted for further processing in the picture development. The **intervention level** determines the green time for conflicting phases after which they may be set to red. The intervention level thus relates to the conflicting phases. The intervention level is dynamic. The intervention level can be changed with an increasing duration of the phase waiting time. The control recognizes five different intervention levels. If the phase waiting times exceed the control times the intervention level will be raised.

The intervention levels can be raised in the way shown in the next picture.

A differentiation is made in the intervention levels between "always protected" and "traffic-actuated protected". This means that in the second case information on the permissive signal and traffic must be included. An extension during green time greater than the minimum green time 2 (tg,min 2) is always dependent on the permissive signal. Shorter green times are independent of the permissive signal.

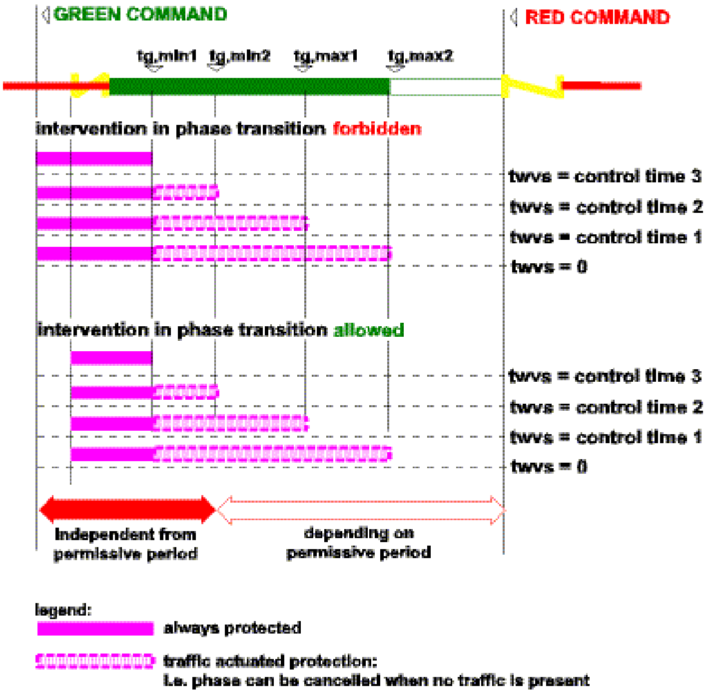
In a standard case, the control times are set to infinite, in other words the control works on intervention level 1, every pending green time can extend on the basis of the maximum green time or its permissive signal. The intervention levels are important in connection with PT priority and the consideration of special vehicles.

The priority level on which the phase is to be classified is determined on the basis of the comparative value maximum waiting time (Twmax). If the phase waiting time reaches the maximum waiting time the phase is upgraded into the upper priority level. The issue of a green command for a phase on the lower priority level depends on the permissive signal. Phases are called and switched to green irrespective of the permissive signal in the upper priority levels.

This permits different priority levels, particularly for public transport. In the first case the public transport is governed by coordination, on the upper pri-

priority level it can be given preference irrespective of the coordination. A green band can thus be protected whilst maintaining a maximum waiting time with respect to public transport.

Every phase can be called with a green flag, even if no detector has triggered a call.



3.3.3 Evaluation in green

The status values are set in green on the basis of the extension conditions. These depend on the traffic, permissive signal and the pre-set comparative values relative to the possible green time.

Net gap times on one hand and occupancies on the other can be used to record traffic. The net gap times must be smaller than the pre-set comparative value. All loops of a phase are hereby inquired. However, in certain cases it is practical to only take this into account during a certain green time. The active time specifies how long a detector is to be inquired during the green time. This is used in particular for loops on the stop line.

The extension criteria can be defined on the basis of the gap time, the occupancy or a combination of both evaluations.

If the gap time of the departing vehicle is still smaller than the pre-set comparative value, yet the occupancy is too small, no further extension will be granted.

Additional extension criteria can also be used in special cases to control the outflow. If spillback detectors are provided in the outflow area of the phase, the green for an assigned phase is terminated following a minimum green time 1 (tg,min1) after a spillback message. The spillback criterion uses the smoothened occupancy.

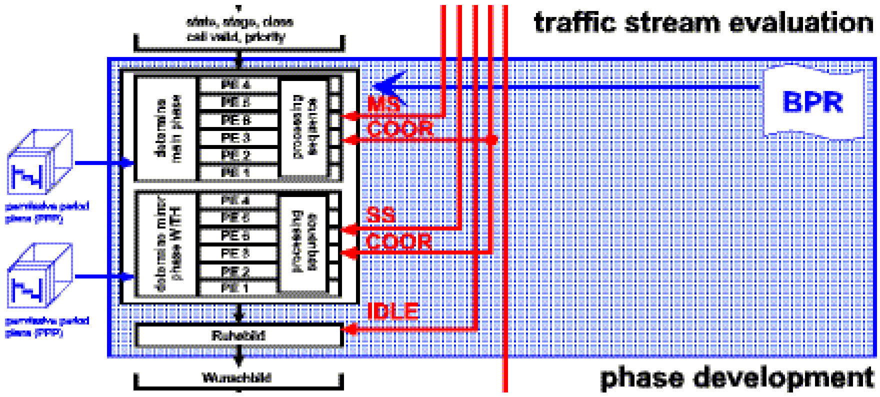
In some cases the outflow is not monitored with special spillback loops. A further extension of the green time with stopped traffic is nevertheless not desired. The flow can be controlled with short loops on the stop line by inquiring the occupancy and gap time.

The green time can be restricted on five levels corresponding to the intervention levels. The maximum is given by the comparative value **maximum**

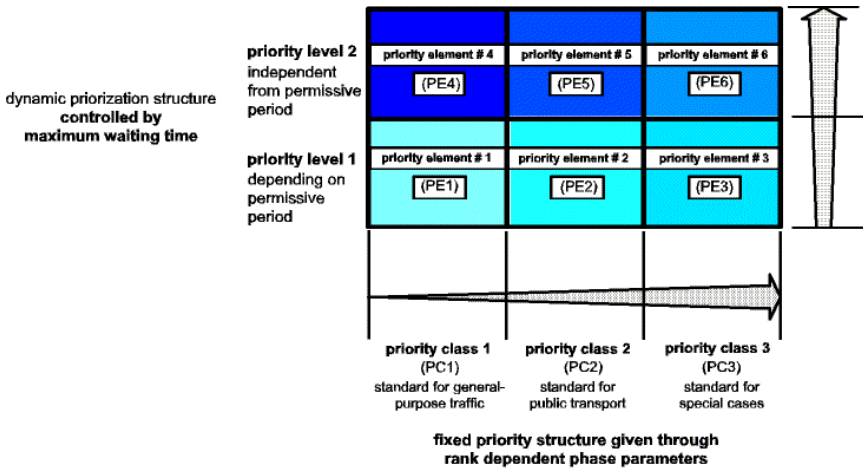
green time 2 (tg,max 2). This comparative value is obtained by calculating the necessary green time as a function of the phase condition.

3.4 Picture development

The third task, picture development, compiles the target picture on the basis of the prepared information. It works in a basic element, the so-called priority element. A priority element is created through the classification of the logged-in phases into priority classes on one hand and into a low or high priority level on the other. Picture development only processes served phases.



As already mentioned, the picture development works in its smallest element, the priority element (PE). Either one (minimum) or up to six priority elements (maximum) can be used depending on intersections and control philosophy. The basic structure is as follows:



The priority classes could be setup as follows:

- Priority class 1: normal sequence (general-purpose traffic, cyclists and pedestrians)
- Priority class 2: higher priority (public transport)
- Priority class 3: special interventions (emergency, heavy rail, etc.)

A phase may only appear as a main phase in one priority class.

Classification into upper and lower priority levels has the purpose of monitoring the maximum waiting times. A phase is classified on priority level 2 if its phase waiting time exceeds the maximum waiting time.

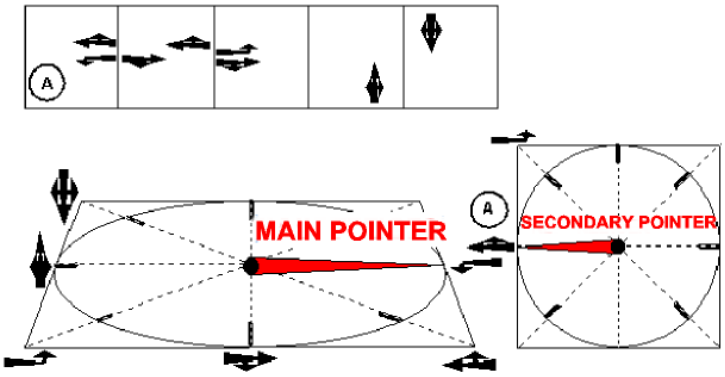
The standard logic is structured so that the processing of the various priority elements can be influenced depending on the control philosophy (priority and processing sequence).

Several intersections can be controlled with the 3 priority classes if required. This means that by assigning the phases to 3 classes, 3 independent intersections can be controlled with the software. However, further classifications into priority classes are then no longer possible. Priority conflicts then have to be solved with the remaining two priority levels per intersection.

In the first step, the picture development processes each priority element in a certain sequence. A main pointer hereby processes the called phases according to the main sequence. The pointer remains on the first called phase until it is served. During green, the pointer delay decides on the pointer increment. The main pointer remains on a rank until either the green time for the phase is higher than the comparative value *pointer delay* or the phase is no longer extended (no more traffic present).

The pointer moves to the next called phase at the latest when the comparative value pointer delay is reached. The selection procedure starts anew. The pointer delay can also be defined as a fixed time within the cycle. The **permissive signal pointer** defines a time within a cycle after which the pointer starts to run again.

The main phases selected by the main pointer in each priority element are now processed. If a main phase meets the intervention conditions and has a higher priority value, it is entered in the new target picture.



In the second step, further minor phases are added to the already determined main phases according to the minor sequence.

The minor sequence is rank-dependent. This means that the minor phases refer to the rank of the main sequence. There are two different types of minor sequences.

a) Minor phases with call (MiPh_with):

Phases that are only taken into account if they are called.

b/ Minor phases without call (MiPh_without):

Phases that are taken into account even without a call and without a pending permissive signal for a call to the selected main phase.

Phases under a) have precedence over phases under b).

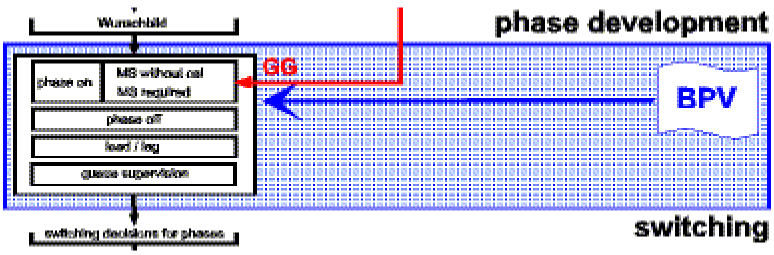
The current rank of the main pointer is decisive when determining the secondary sequence. As long as the main pointer points to the corresponding phase of the current rank, its minor sequence will also remain active. Phases with call can be added over the entire duration. Phases without call, on the other hand, are only added up to the issue of the green command and to the green start, up to the minimum green time 1. This description shows that a stage can be varied during the green of a determining phase by this selection procedure. Determination of the main and secondary sequence is thus decisive for the traffic-actuated flexible sequence.

The temporal limitation of the variation of a phase is controlled with the comparative value pointer delay. Fluctuations can be restricted. As already mentioned, the pointer delay determines how long the main pointer remains on a phase and keeps it in green. The incrementation of the pointer means that a different minor sequence has become decisive. The activated phase is held until expiration of the pointer delay. New green commands are only possible within the scope of the new active minor sequences. The pointer delay can also be controlled via the permissive signal pointer. The pointer is hereby incremented at a certain time within the cycle.

In times of little traffic, a previously determined minor sequence may be too restrictive under certain circumstances. All phases, which correspond to the main phase, should be allowed wherever possible. A parameter ("Minor series same as main series") can be set in the program definition that takes into account a fixed minor series for all ranks. This minor series can be determined in the form PPPh (Phase-dependent phase parameter). The minor series defined for each rank in PPR (Rank-dependent phase parameter) then becomes inactive.

3.5 Switching

In the fourth step, switching, the newly compiled phase for the picture development is supplemented by phases that are not yet served. The phases, which are now contained in the target picture issue on and off commands to the interface.



The result of the picture development is the target picture, a list of phases, which are to be switched to green and conflicting phases that are to be switched to red. The switching commands to the phases are converted to the green and red commands in the following module, **switching**. The standard behavior of VS-PLUS is such that only those phases are switched to red whose conflicting phases are switched.

During processing of the switching commands both minor phases without call (MiPh_without) and minor phases required (MiPh_obli) can be switched to each phase.

Minor phases without call only receive an activation command under certain conditions, namely if they do not conflict with a phase that has already been activated due to a call. Required minor phases on the other hand always receive a green command. This is why the required minor phases must have at most the same conflict as the decisive phase, which activates the minor phase.

However, there are often phases which have green but which are not affected by the standard behavior of VS-PLUS. A *red flag* enables phases to be set to red without these being set to red by conflicting phases according to the standard principle.

The *red flag* values have the following meanings:

0 Standard behavior:
The phase remains on green until switched to red by a conflicting phase.

1 The phase switches to red as soon as no more traffic is present. The permissive signal is hereby ignored.

2 The phase switches to red at the permissive signal end for extension.

5 as 2, though a conflicting call must also be pending.

3 If no traffic is present the phase switches to red as soon as a conflicting permissive signal is pending. It does so irrespective of whether the conflicting phase has been called.

6 as 3, though a conflicting call must also be pending in addition to the conflicting permissive signal.

4 The phase switches to red when the maximum green time 2 is reached irrespective of whether conflicting phases have called.

There are a number of special features that are described in the following sections.

3.5.1 Idle program

The idle program defines the status of the system when no more traffic has been checked in. In other words, it only becomes active if no further phase is called and no extension claim is present. A flag in the program definition controls the idle program.

- Value 0: No special conditions. The system remains in the last phase if no traffic is present.
- Value 1: The defined idle program is active. The idle program defined in VP (phase parameter) is active.
- Value 2: All red with no traffic.
- Value 3: The control works according to the permissive period plan. This means that the phases switch to green at the start of the permissive signal and back to red at the end of the permissive signal (alternating idle program).

3.5.2 Re-service flag

Each phase is identified when it changes from green to red on the basis of its re-service flag value. This so-called secondary flag is deleted when the main pointer of the corresponding priority element transgresses the rank defined as the cycle end. The re-service flag can also be reset at a fixed time in the cycle (in the program definition).

If a re-service flag is set it affects processing in the following ways:

- The phase can no longer be selected as a main phase,
- The phase can only extend up to a reduced green time.

This process ensures that the main sequences are processed quickly. Multiple activation of phases during a cycle is avoided.

3.5.3 Synchronization with permissive period plan (coordination)

Traffic-actuated coordination with prioritized public transit entails target conflicts, especially if errors due to interventions from higher priorities cannot be compensated by performance reserves.

On one hand, phases may be omitted and on the other the control may leave the coordinated permissive signal. This is why the control allows a choice of three strengths with respect to synchronization of the local control with the overriding permissive signal. The difference between the coordination types relates to the issue of green commands, but not to the green time. This is always dependent on the permissive signal and/or the minimum green time 2.

The coordination types can be determined for each phase:

- Weak coordination
- Medium coordination
- Strong coordination

3.5.4 Weak coordination

In this case not only the call but also the green command for the main phases depends on the permissive signal. This means that main phases can only receive green according to the permissive period plan. Minor phases can also receive green outside the permissive signal. The definition can also be reversed.

The risk of a fault due to interventions from a higher priority is lower with this coordination type. However, the probability of phases being "omitted" is higher.

3.5.5 Medium coordination

In this case not only the call but also the green command for the mains phases depends on the permissive signal. This means that main phases can only receive green according to the permissive period plan. Minor phases can also receive green outside the permissive signal. The definition can also be reversed.

The risk of a fault due to interventions from a higher priority is lower with this coordination type. However, the probability of phases being "omitted" is higher.

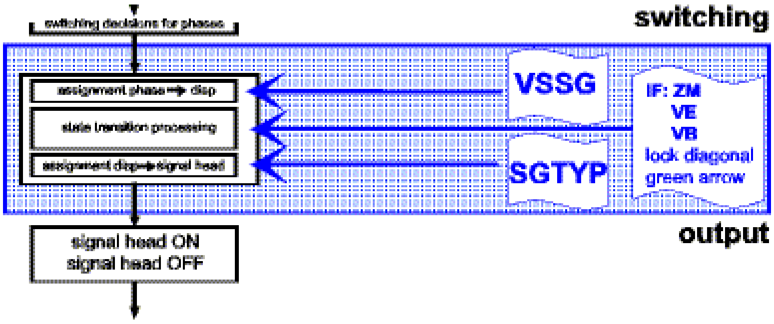
3.5.6 Strong coordination

In this case both main and minor phase are synchronized with the permissive signal.

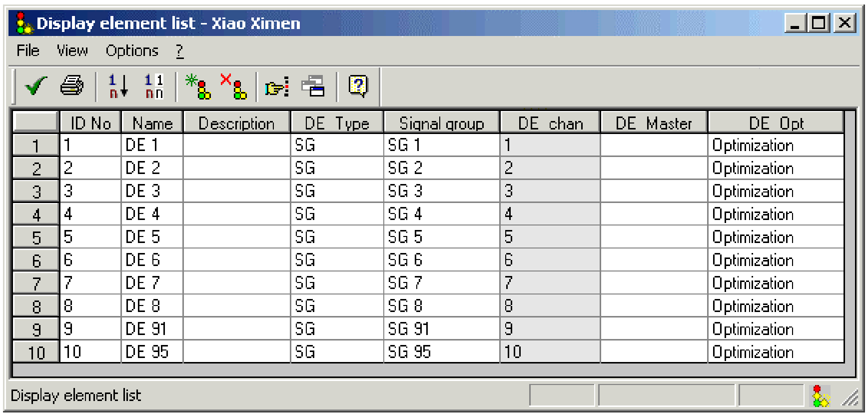
The risk of a fault due to interventions from a higher priority is lower with this coordination type. However, the probability of phases being "omitted" is higher, particularly if the phase permissive signals are short.

3.6 Interface

The interface assigns the phases to the corresponding display elements and issues these with the on and off commands. VS-PLUS then calculates the current phase change every second on the basis of the phase change and offset times. Special features such as flashing left turn signal are also controlled. Only the switching commands are sent to the signal groups, which are then implemented by the controller at the end of the interface.



4 Display elements



	ID No	Name	Description	DE Type	Signal group	DE chan	DE Master	DE Opt
1	1	DE 1		SG	SG 1	1		Optimization
2	2	DE 2		SG	SG 2	2		Optimization
3	3	DE 3		SG	SG 3	3		Optimization
4	4	DE 4		SG	SG 4	4		Optimization
5	5	DE 5		SG	SG 5	5		Optimization
6	6	DE 6		SG	SG 6	6		Optimization
7	7	DE 7		SG	SG 7	7		Optimization
8	8	DE 8		SG	SG 8	8		Optimization
9	9	DE 91		SG	SG 91	9		Optimization
10	10	DE 95		SG	SG 95	10		Optimization

VS-PLUS works with the traffic-technical unit ***phase (Ph)***. Each phase must have at least one ***display element (DE)*** assigned.

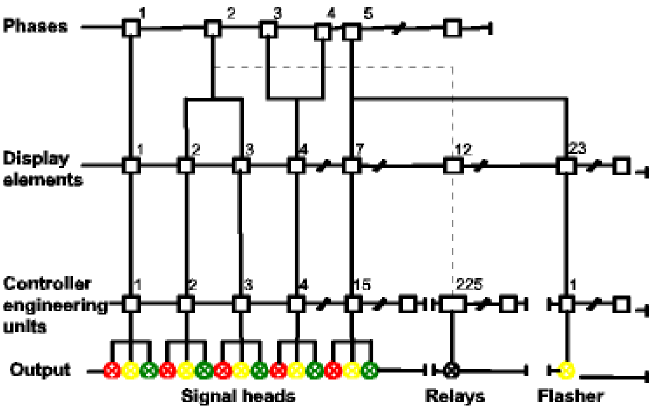
So-called "dummy phases" are excluded, which must exhibit only on and out condition and no temporal linkages with other display elements.

Additional UN, AND or OR-conditional display elements can be assigned. Hereunder the term display element applies as comprehensive term to all possible kinds of signals (regulating control device), as for example signal groups, Attention flashers etc.

One *unique numerical identifier*, a *channel number* and the *type of signal* define a display element. All properties must be assigned.

In the further characteristics can be defined, which determine the behavior of the display element in the phase change: the red optimizing, as well as a master display element.

The following illustration shows the hierarchy of the elements as they are used in VS-PLUS.

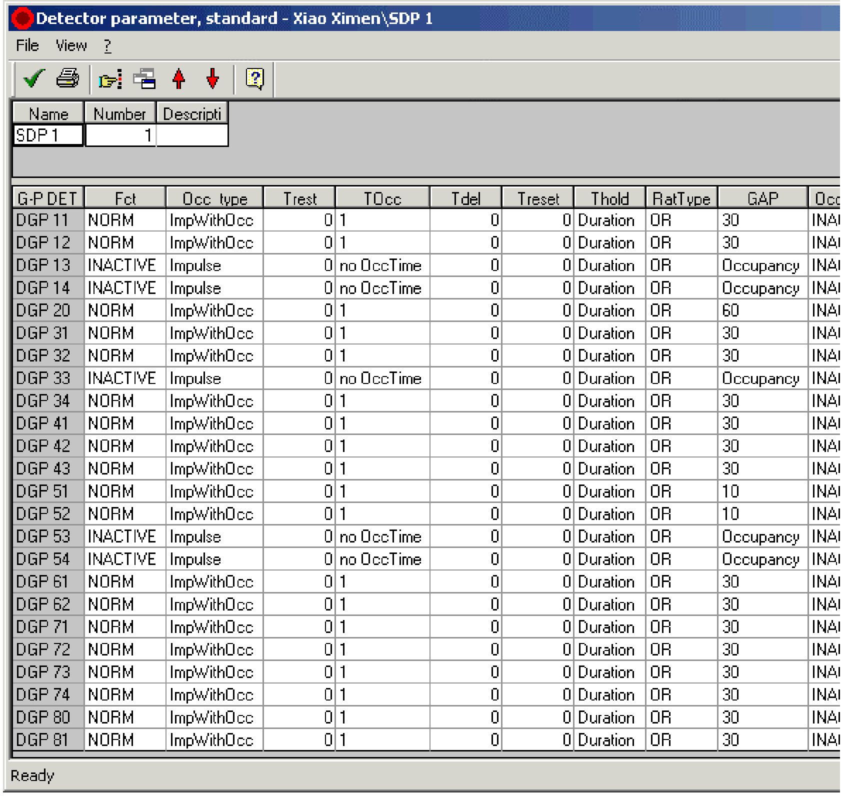


4.1 Red optimization

Specifying **optimization** will maximize the green time for the display element during the computation of the phase change. During the phase change these display elements get as much green as possible based on the phase change and offset times.

On the other hand with **immediate OUT** one does not optimize. This means that the display elements are switched off immediately (e.g. immediate termination of a streetcar phases after notice of departure). Therefore the phase change times to the display elements switching on in the phase change can be larger than necessary.

5 Detectors



Name	Number	Descripti
SDP 1	1	

G-P DET	Fct	Occ type	Trest	TOcc	Tdel	Treset	Thold	RatType	GAP	Occ
DGP 11	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 12	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 13	INACTIVE	Impulse	0	no OccTime	0	0	Duration	OR	Occupancy	INAI
DGP 14	INACTIVE	Impulse	0	no OccTime	0	0	Duration	OR	Occupancy	INAI
DGP 20	NORM	ImpWithOcc	0	1	0	0	Duration	OR	60	INAI
DGP 31	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 32	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 33	INACTIVE	Impulse	0	no OccTime	0	0	Duration	OR	Occupancy	INAI
DGP 34	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 41	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 42	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 43	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 51	NORM	ImpWithOcc	0	1	0	0	Duration	OR	10	INAI
DGP 52	NORM	ImpWithOcc	0	1	0	0	Duration	OR	10	INAI
DGP 53	INACTIVE	Impulse	0	no OccTime	0	0	Duration	OR	Occupancy	INAI
DGP 54	INACTIVE	Impulse	0	no OccTime	0	0	Duration	OR	Occupancy	INAI
DGP 61	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 62	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 71	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 72	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 73	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 74	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 80	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI
DGP 81	NORM	ImpWithOcc	0	1	0	0	Duration	OR	30	INAI

VS-PLUS differentiates between call and detection systems as well as check-in and checkout systems. The first one is intended for general-purpose traffic whereas the second one apples primarily to public traffic.

The following function groups can be differentiated:

- Detector functions general-purpose traffic
- Detector functions public transit
- Detector functions public transit in connection with PT-Memory

When creating an object of the type "detector" in visual VS-PLUS an assignment is made for the function group of " call and detection systems". Thus detector functions can only be specified for this function group.

Thereby the detector function determines the function mode of the detector concerned.

In terms of message points standard VS-PLUS differentiates two function sub-groups:

- Detector functions without counting
- Detector functions with counting

The detector functions **without counting** will only request on PT phase even if several calls (several impulses) are submitted. The checkout deletes this call. This function is to be used e.g. if calls by hand can be set and therefore must be assumed that the same PT vehicle can send several impulses (e.g. special radio keys).

Warning:

In case of **subsequent PT vehicles** it is to be noted that the first PT vehicle can likewise delete a subsequent course when checking out.

With the detector functions with counting several calls (several impulses) are detected separately. Up to three subsequent PT vehicles can be controlled.

Systems without line recognition can only conditionally recognize errors of the detection system!!!

5.1 Functions

- Detector not active (INACTIVE)
  The detector is switched off. It does not have any effect.
- Detector for call or detection (NORM)
  The detector does not have a special function other than normal detection. The effect of the detector depends on the detector parameter in the form standard detector parameter.
- Detector with continuous recall by software (SOFT)
  The detector function SOFT results in a continuous recall by the software.
  This continuous recall does not work in the green. Only calls are submitted. A continuous extension must be obtained with the movement flag "extension".
- Spillback detector (TerminatePhase)
  The movement is set on red.
  With the detector function "TerminatePhase" a spillback flow control is established. As soon as the detector concerned meets the conditions of spillback flow control the assigned movement is set on red.
  The minimum red time duration after spillback can be parameterized differently to the normal minimum red time.
  The detector function "TerminatePhase" assumes there is a downstream detector, i.e. after the stop bar. Detectors with the detector function "TerminatePhase" cannot be used for call or detection.
- Spillback detector (Det off)
  The detection is switched off.
  With the detector function "Det off" a spillback control is established. As soon as the detector concerned meets the conditions of spillback flow control the assigned movement is set on red.
  The detector function "Det off" assumes there is a downstream detector, i.e. after the stop bar. Detectors with the detector function "Det off" cannot be used for call or detection.

5.2 Type of call

It can be specified for each detector, which signal is considered as call.

The following types are possible:

- Positive flank (Impulse)
  The call of the detector takes place with the rising flank
- Negative flank (Gap)
  The call of the detector takes place with the falling flank.
- Positive flank with occupancy (Impulse with occupancy)
  The call of the detector takes place with the rising flank or if it is occupied.
- Occupancy (Presence)
  The call of the detector takes place after reaching the hold time.

5.3 Rest time

Detectors processing impulses can be set to rest. It means during the duration of the rest time no further impulses will be accepted after a valid impulse.

5.4 Occupancy time

The parameter *occupancy time* specifies after which time period the detector submits the call.

- 0 Presence of vehicles is not detected
- >0 This detector is evaluated on occupancy meaning it must be occupied at least during the adjusted length of time
- ∞ The criterion occupancy time is switched off

As soon as the criterion holding time is fulfilled, VS-PLUS starts a call timer [twdet] for the detector that records the time since the first call.

5.5 Delay time

With the parameter *delay time* the effect of a call can be delayed (after the criterion call was met). That is, VS-PLUS waits with a consideration of this call until the detector waiting time [twdet] is larger than the value delay time.

5.6 Hold time

The hold time indicates for how long the effect of a detector remains. As soon as the detector waiting time is larger than the value hold time the effect of the detector concerned is terminated.

In case of detectors detecting presence (type of call) with a hold time of 0s the effect remains only as long as the detector detects a vehicle.

Warning:

Particularly in case of PT vehicles the detector waiting time is deleted only if the PT vehicle received green at least once within the range of the expected arrival second.

5.7 Reset time

As long as the time after end of green is smaller than the reference *value reset time* a detector cannot cause a call. During the duration of the *reset time* the detector's calls are deleted.

For example: reset times as long as the amber time prevent calls for the next cycle by drivers crossing the stop bar during clearance (amber).

Except with PT vehicles additionally a resetting in green takes place.

- 0 No resetting
- >0 Resetting according to description

5.8 Extension: gap

The gap time indicates for how long a detector in the country can still extend after it is no more occupied and with its phase being in green.

This criterion can be combined with the parameter *occupancy*:

- 0 The occupancy alone is determining
- >0 The gap time is detected
- ∞ The gap time is inactive (the occupancy alone is determining)

5.9 Extension: occupancy start

VS-PLUS provides the possibility to detect the so-called "occupancy" of a detector. This is done using a hysteresis and the occupancy duration must rise over one determine threshold value (parameter *occupancy start*). Then the detector extends until the occupancy duration falls again below a second threshold value (parameter *occupancy end*).

The two values are to be entered in percent and lie between 1 and 100.

- 0 The occupancy is inactive (the gap time alone is determining)
- >0 The occupancy is

With a combination of both extension criteria (gap time and occupancy) the *type of detection* is to be considered.

5.10 Extension: occupancy end

VS-PLUS provides the possibility to detect the so-called "occupancy" of a detector. This is done using a hysteresis and the occupancy duration must rise over one determine threshold value (*parameter occupancy start*). Then the detector extends until the occupancy duration falls again below a second threshold value (parameter *occupancy end*).

The two values are to be entered **in percent** and lie between 1 and 100.

- 0 The occupancy is inactive (the gap time alone is determining)
- >0 The occupancy is

With a combination of both extension criteria (gap time and occupancy) the *type of detection* is to be considered.

5.11 Type of detection

VS-PLUS provides different parameter for detection such as gap time, presence, and occupancy. With the type of detection one specifies how these parameters are to be linked with one another:

- If the current time gap is equivalent the reference value and the allocation degree larger than the reference value, then this is considered as extension.
- If the current time gap is equivalent the reference value or the allocation degree larger than the reference value, this is considered as extension
- If the current gap time is smaller than or equivalent the reference value and the occupancy larger than the reference value, then this is considered as extension.
- If the current gap time is smaller than or equivalent the reference value or the allocation degree larger than the reference value, this is considered as extension

5.12 Active time

The active time indicates for how long a detector is evaluated with its phase in green in order to extend the phase.

With a green duration larger than the value "active time", the detector concerned is not considered anymore in the detection.

5.13 Spillback call: occupancy ON or OFF

In order to control the spillback on an approach VS-PLUS provides the possibility of a call in case of congestion. A so-called spillback detector detects the presence of vehicles. With the measured detector value (occupancy) a call can be submitted.

If this spillback detector is assigned to a special spillback movement (movement with higher priority and type of intervention) then a clearance phase can be forced into the cycle due to the spillback.

A threshold for the beginning and second threshold for the end to the spillback criterion must be set. If the smoothed occupancy rate of the spillback detectors is between the two threshold values "occupancy start" and "occupancy OFF" the criterion for the registration is met.

The values are to be indicated **in percent** and lie between 1 and 100.
- 0 The evaluation is inactive
- >0 The occupancy is considered

This criterion can be combined with the criterion occupancy time (**OR** combination).

5.14 Spillback discharge control

In order to control the discharge of a spillback VS-PLUS provides two possibilities:
- Flow control
- Discharge control

The **discharge control** takes place with a hysteresis based on the measured detector value "occupancy".

Thresholds for the beginning and second for the end control this criterion. If the smoothed occupancy rate of the indicated detectors lies between the two threshold values "occupancy ON" and "occupancy OFF" then the discharge control is active.

If the detector function is on "TerminatePhase" the assigned movement is set on red after the minimum green time 1 (tg,min1). It remains on red until either the spillback criterion disappears or the minimum red time is exceeded.

If the detector function is on *"Det off"* (spillback extension) the extension of the assigned movement is disabled. The movement's phase is terminated depending on other factors (red flag, permissive period plan, registration of conflicting movements); it cannot actively extend any longer.

The value is to be entered **in percent** and lies between 1 and 100.
- 0 The evaluation is inactive
- >0 The occupancy is considered

Warning:

If the parameter *detector function GP* is not particularly set on discharge control (detector function "TerminatePhase" or "Det off"), then flow control is active.

5.15 Spillback flow control: occupancy duration

The distinction of the two types of functions takes place via the parameterization of the detector's function.

For **flow control** no special detectors are used. A short loop at the stop bar examines whether vehicles are still present using the two parameter values. With the gap time it is checked when the last vehicle crossed the detector respectively the stop bar. With the **occupancy duration** it is examined whether vehicles are standing within the detector range and not being able to move.

If one of the two threshold values "Spillback flow control: occupancy gap" or "spillback flow control: occupancy gap " is exceeded the extension is disabled.

5.16 Spillback flow control: occupancy gap

With the parameter *spillback flow control*: occupancy gap is thus defined how long the detector at the stop bar may be unoccupied, until VS-PLUS assumes that the flow of traffic is disturbed (no vehicle flow). If the gap becomes larger than the entered value and the phase is still running, VS-PLUS disables the extension after the minimum green time tg,min2.

5.17 Increment red: time requirement

The time requirement (in 1/10 of seconds) per counted vehicle used for computation of green time.

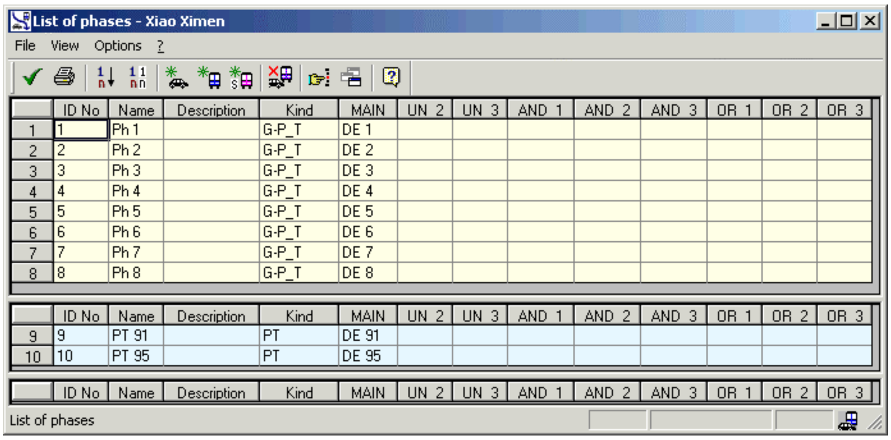
5.18 Increment red: occupancy

After reaching this value (occupancy rate in %) VS-PLUS assumes the detector is disturbed. No more vehicles are counted. The green time is set on the parameter value "Red_MaxGreen".

5.19 Increment red: maximum green

The maximum green time a movement can receive if its detector was announced as disturbed.

6 Phases



	ID No	Name	Description	Kind	MAIN	UN 2	UN 3	AND 1	AND 2	AND 3	OR 1	OR 2	OR 3
1	1	Ph 1		G-P_T	DE 1								
2	2	Ph 2		G-P_T	DE 2								
3	3	Ph 3		G-P_T	DE 3								
4	4	Ph 4		G-P_T	DE 4								
5	5	Ph 5		G-P_T	DE 5								
6	6	Ph 6		G-P_T	DE 6								
7	7	Ph 7		G-P_T	DE 7								
8	8	Ph 8		G-P_T	DE 8								

	ID No	Name	Description	Kind	MAIN	UN 2	UN 3	AND 1	AND 2	AND 3	OR 1	OR 2	OR 3
9	9	PT 91		PT	DE 91								
10	10	PT 95		PT	DE 95								

	ID No	Name	Description	Kind	MAIN	UN 2	UN 3	AND 1	AND 2	AND 3	OR 1	OR 2	OR 3

In the sense of the object-oriented approach different basis objects will be implemented in the phases depending on its type. The properties of the phases consists on the one hand of a general part (core properties) and a object-specific part:

- General-purpose traffic:
- Public transit with check-in / check-out systems:
- Public transit systems with serial radio communication:

In the general part a phase gets UN-conditional, AND-conditional or OR-conditional display elements assigned.

UN-conditional display elements:

The determining phase only controls the display elements in UN-conditional fields.

Using the PT-memory it is not necessary anymore to assign a main display element to each phase. This becomes determining for the recording when using the so-called PT-memory with devices.

AND-conditional display elements:

The display elements in the AND-conditional columns trigger additional checks. It is examined whether the same display element is also registered in the same column with further phases. An AND-conditional display element switches on only if all phases linked with it switches on. If a phase is switched off, then also the display element switches off.

Note:

Combinations of the same display element in different columns of the AND-conditional display elements are linked among themselves with the logical OR.

OR-conditional display elements:

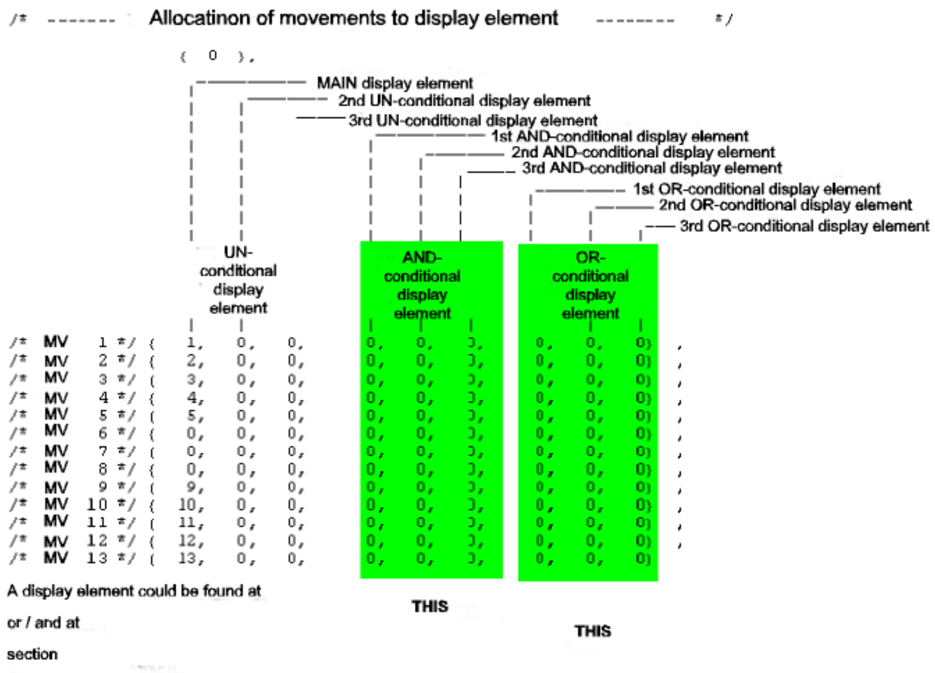
The display elements of the entries in the OR-conditional columns are switched on OR linked. A display element switches on if the assigned phase switches on.

Note:

Combinations of the same display element in different columns of the OR-conditional display elements are linked among themselves with the logical *AND.*

Combinations of AND-conditional with OR-conditional display elements:

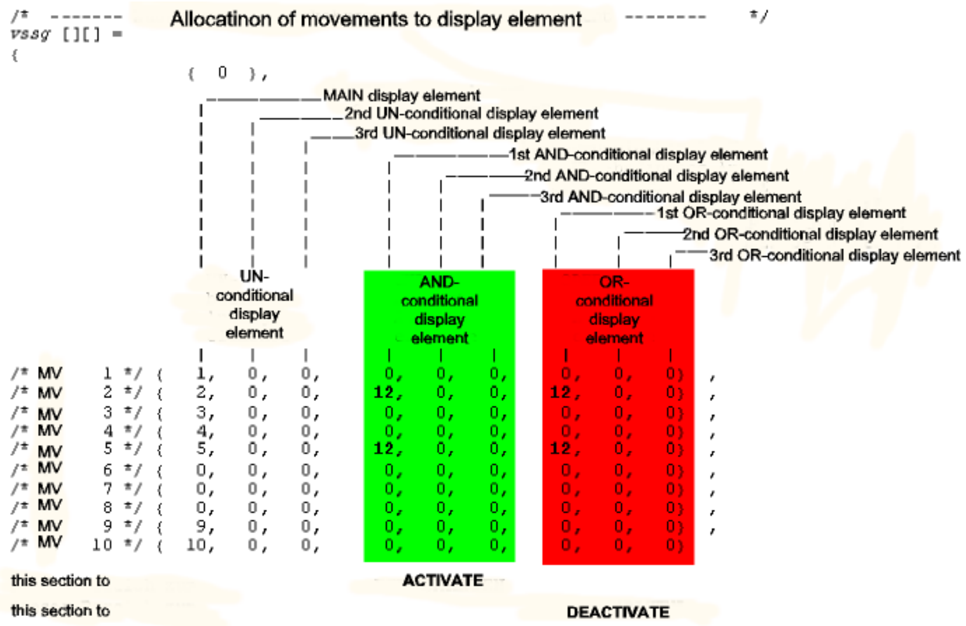
Often it is desired that on- and off switching off conditions are not the same. For example a protection turn signal must switch itself on only if the pedestrian **and** the car phase switch on. However the protection turn signal should only switch off when the pedestrian phase switches off. Therefore **VS-PLUS** permits to register a display element in the two columns **AND-conditional** and **OR-conditional**.



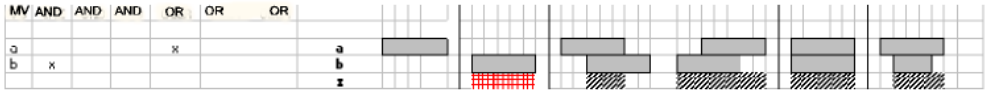
Definition:

If a display element is registered in the AND-conditional columns and in the OR-conditional columns, the AND-conditions are decisive for switching the display element on and the OR-conditions for switching the display element off.

A display element can occur in both or only in one of the ranges.

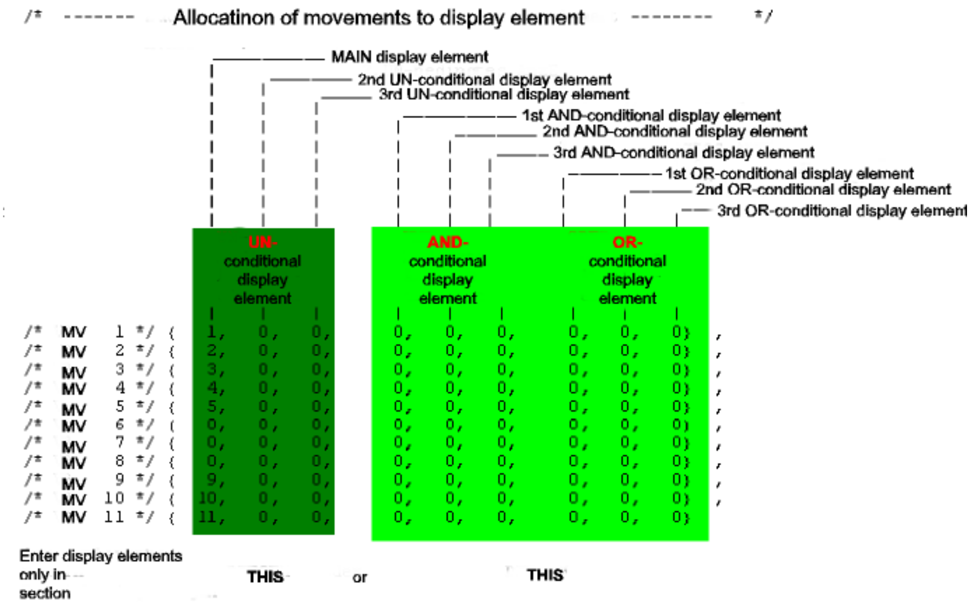


If a display element occurs within both ranges, AND-conditional and OR-conditional, then the following applies



Attention:

A combination with the **UN-conditional** range is not permissible.



6.1 MAIN display element

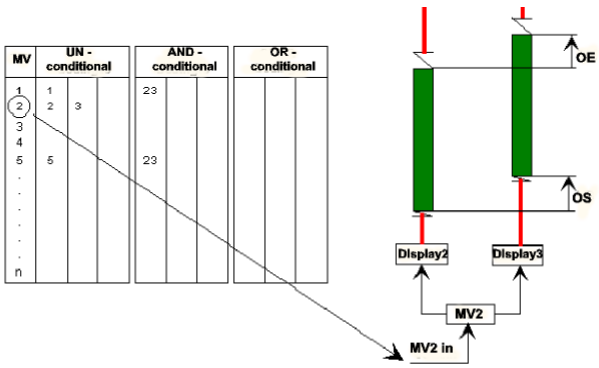
The main display element is an UN-conditional display element. This means that the main display element is activated by the ON command of the phase.

Attention:

With exception of so-called dummy phases a main display element has to be assigned to each phase.

6.2 UN-conditional display element

In case of an on or off command of the phase, UN-conditional display elements are switched in any case. UN conditioned display elements should be used only if two or more display elements are necessary, e.g. for signaling of a phase with multiple lanes and common stop line.



Attention:

In case of **UN-conditional display elements** it is to be noted that the status of the phase is formed by an OR linkage of signal statuses of the assigned display elements. That is, a phase is on green, as long as an assigned UN-conditional display element is green.

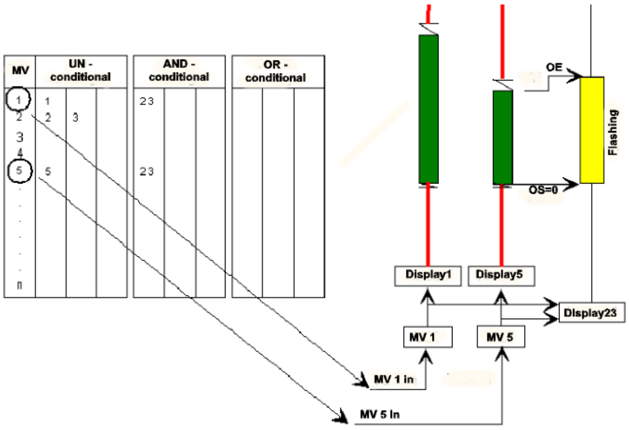
Therefore UN-conditional display elements should only be used if the phase change time of the combined display elements match!!

Assigned AND- or OR-conditional display elements do not have an influence on the condition of the phase.

6.3 AND-conditional display element

AND-conditional display elements only receive green if both phases, which are assigned to the same display element, receive an on command. As soon as one of the two phases switches to red, the assigned AND-conditional display element also switches to red.

Typical examples for AND-conditional display elements are protection turn signals, which e.g. only flash if the pedestrian and the parallel general-purpose traffic are on green.

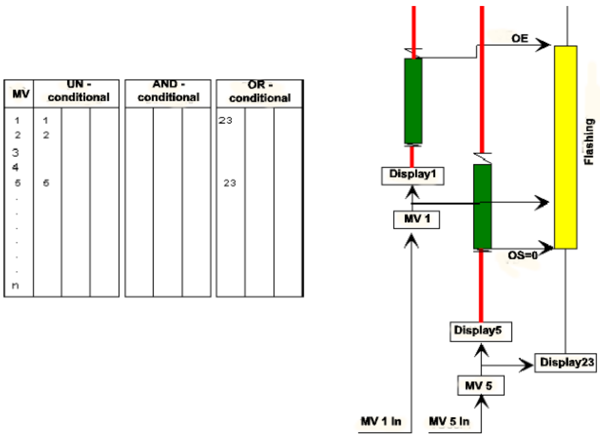


Attention:

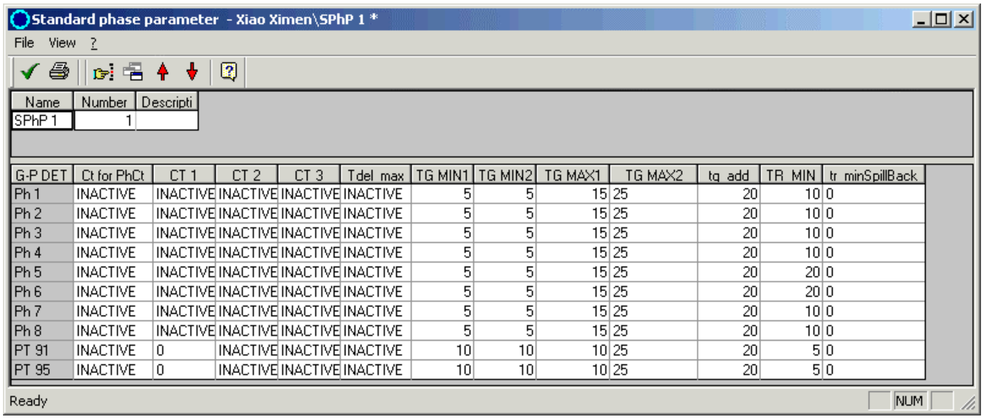
If a display element is specified in several columns, then the columns are linked with a logical OR.

6.4 OR-conditional display element

OR-conditional display elements receive green as soon as a phase, which is assigned the same display elements, receives an on command.



7 Standard phases parameters



Name	Number	Descripti
SPhP 1	1	

G-P DET	Ct for PhCt	CT 1	CT 2	CT 3	Tdel max	TG MIN1	TG MIN2	TG MAX1	TG MAX2	tq add	TR MIN	tr minSpillBack
Ph 1	INACTIVE	INACTIVE	INACTIVE	INACTIVE	INACTIVE	5	5	15	25	20	10	0
Ph 2	INACTIVE	INACTIVE	INACTIVE	INACTIVE	INACTIVE	5	5	15	25	20	10	0
Ph 3	INACTIVE	INACTIVE	INACTIVE	INACTIVE	INACTIVE	5	5	15	25	20	10	0
Ph 4	INACTIVE	INACTIVE	INACTIVE	INACTIVE	INACTIVE	5	5	15	25	20	10	0
Ph 5	INACTIVE	INACTIVE	INACTIVE	INACTIVE	INACTIVE	5	5	15	25	20	20	0
Ph 6	INACTIVE	INACTIVE	INACTIVE	INACTIVE	INACTIVE	5	5	15	25	20	20	0
Ph 7	INACTIVE	INACTIVE	INACTIVE	INACTIVE	INACTIVE	5	5	15	25	20	10	0
Ph 8	INACTIVE	INACTIVE	INACTIVE	INACTIVE	INACTIVE	5	5	15	25	20	10	0
PT 91	INACTIVE	0	INACTIVE	INACTIVE	INACTIVE	10	10	10	25	20	5	0
PT 95	INACTIVE	0	INACTIVE	INACTIVE	INACTIVE	10	10	10	25	20	5	0

Properties:

- Control time for phase change
- Control time 1 (intervention after tg max 1)
- Control time 2 (intervention after tg min 2)
- Control time 3 (intervention after tg min 1)
- Maximum waiting time
- Minimum green time 1
- Minimum green time2
- Maximum green time1
- Maximum green time 2
- max green detector malfunction
- Minimum red time
- Red time in spillback

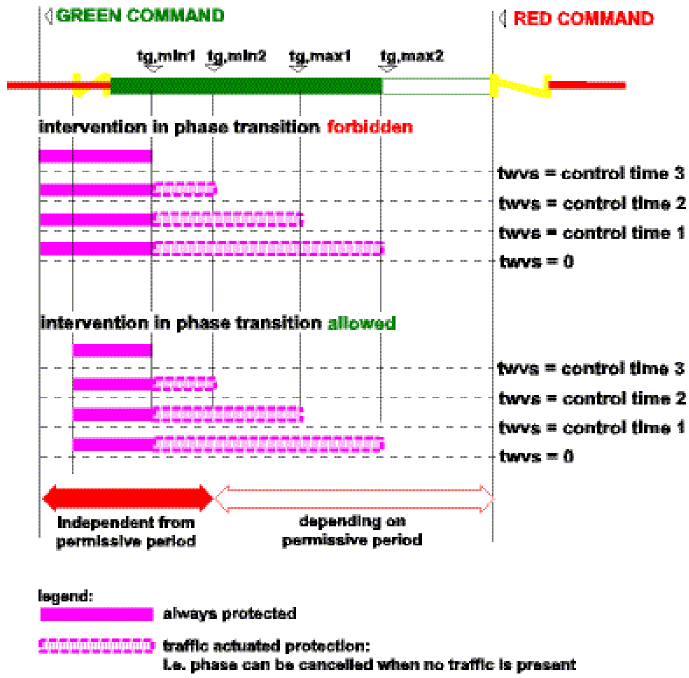
7.1 Control time for phase change

This parameter defines, after what time a termination of a phase change is possible.

- Abort in the phase change is not permitted:
- The phase change is protected. The earliest intervention is possible after the minimum green time 1 (tg,min1).
- Abort in the phase change after control time is larger than the permitted value:
- The phase change is not protected. An intervention is possible up to the engagement of the conflicting phase (no longer permitted from first second of green).

7.2 Control time 1 (intervention after tg max 1)

VS-PLUS knows up to eight different kinds of intervention. These depend on the parameter *control time* as well as the parameter *control time for phase change*.



If the phase waiting time exceeds a reference value "control time" while still on red the type of intervention is upgraded by one level. This means that the phase concerned can set conflicting phases to red more rapidly.

If the phase waiting period exceeds the *control time 1* while still on red, only the maximum green time 1 (tg,max1) will be allowed for conflicting phases.

Note:

A control time 1 of ∞ means the phase concerned can never cause a reduction of the green duration to tg,max1 of the conflicting phases.

7.3 Control time 2 (intervention after tg min 2)

If the phase waiting period exceeds the *control time 2* while still on red, only the maximum green time 2 (tg,max2) will be allowed for conflicting phases.

Note:

A control time 2 of ∞ means the phase concerned can never cause a reduction of the green duration to tg,max2 of the conflicting phases.

7.4 Control time 3 (intervention after tg min 1)

If the phase waiting period exceeds the *control time 3* while still on red, only the minimum green time 1 (tg,min1) will be allowed for conflicting phases.

Note:

A control time 3 of ∞ means the phase concerned can never cause a reduction of the green duration to tg,min1 of the conflicting phases.

7.5 Maximum waiting time

If the phase waiting time achieved the maximum waiting time, the phase is shifted from priority level 1 to priority level 2.

7.6 Minimum green time 1

The minimum green time 1 (tg,min1) can be regarded as redundant minimum time to the controller's minimum time.

In order to prevent VS-PLUS from sending switch-on / switch-off commands, which then have to be corrected by the safety level of the controller, the minimum green time 1 must be at least as large, as the controller minimum time.

Note:

The minimum green time 1 is protected by VS-PLUS under all circumstances. That is, it is set independently from the frame signal.

7.7 Minimum green time 2

The minimum green time 2 (tg,min2) is considered as traffic engineering meaningful minimum green (limited minimum green duration).

The green is held, if the extension conditions (traffic present) are met.

Note:

The minimum green time 2 (tg,min2) is set independently from the frame signal.

7.8 Maximum green time 1

The maximum green time 1 is the first reduction level under the maximum green time 2.

Conflicting phases which reached their control time 1, can interrupt phases after tg,max 1.

7.9 Maximum green time 2

The maximum green time 2 (tg,max2) corresponds to the traffic-engineering maximum according to the capacity calculation.

A continuous allocation of all loops should result in a cycle time not violating any of the tg,max2 of all phases. This cycle time has to meet the load (utilization 100%).

Note:

If a phase achieves the maximum green time 2 and a conflicting phase is about to be activated, then it will be interrupted, even if its frame signal end was not yet reached.

7.10 Maximum green detector disturbance

The time requirement (in 1/10 seconds) that is used per counted vehicle for the calculation of the green time.

7.11 Minimum red time

The minimum red ensures that a phase does not receive green again immediately after green end.

The minimum red time is independent from congestion.

Attention:

The minimum red time refers to the red duration of the phase and not to the red duration of the display element (signal group).

The minimum period of the color red is to be entered.

7.12 Red time in spillback

With the detector function "*TerminatePhase*" a phase with down phase congestion (discharge control) is set to red.

Thus a new switch-on command is not obstructed. VS-PLUS can also switch a phase with congestion again to green in accordance with the rules of the picture compilation.

The red time in spillback keeps a phase with a red command due to congestion from becoming green again immediately after end of green. The assigned value corresponds to a minimum red time after the congestion.

8 Phase flags

PhP DE	REQU	green flag	prio flag	Coord	Coord	Coord	Ext flag	Red flag 1	Red flag 2	Red flag 3	Red flag 4	Rep fla	Rep flag	PI	PreStIdlPr	IdlePr
Ph 1	Immediate	Duration	INACTIVE	Hard	Hard	Hard	DET stat	No red flag	No red flag	No red flag	No red flag	immer	immer	SI_No. 1	without freeze	Idle progr
Ph 2	Immediate	Duration	INACTIVE	Hard	Hard	Hard	DET stat	No red flag	No red flag	No red flag	No red flag	immer	immer	SI_No. 1	without freeze	Idle progr
Ph 3	Immediate	Duration	INACTIVE	Hard	Hard	Hard	DET stat	No red flag	No red flag	No red flag	No red flag	immer	immer	SI_No. 1	without freeze	Idle progr
Ph 4	Immediate	Duration	INACTIVE	Hard	Hard	Hard	DET stat	No red flag	No red flag	No red flag	No red flag	immer	immer	SI_No. 1	without freeze	Idle progr
Ph 5	Immediate	Duration	INACTIVE	Hard	Hard	Hard	DET stat	No red flag	No red flag	No red flag	No red flag	immer	immer	SI_No. 1	without freeze	Idle progr
Ph 6	Immediate	Duration	INACTIVE	Hard	Hard	Hard	DET stat	No red flag	No red flag	No red flag	No red flag	immer	immer	SI_No. 1	without freeze	Idle progr
Ph 7	Immediate	Duration	INACTIVE	Hard	Hard	Hard	DET stat	No red flag	No red flag	No red flag	No red flag	immer	immer	SI_No. 1	without freeze	Idle progr
Ph 8	Immediate	Duration	INACTIVE	Hard	Hard	Hard	DET stat	No red flag	No red flag	No red flag	No red flag	immer	immer	SI_No. 1	without freeze	Idle progr
PT 91	Immediate	INACTIVE	INACTIVE	Hard	Hard	Hard	DET stat	No extension	No red flag	No red flag	No red flag	immer	immer	SI_No. 1	without freeze	Idle progr
PT 95	Immediate	INACTIVE	INACTIVE	Hard	Hard	Hard	DET stat	No extension	No red flag	No red flag	No red flag	immer	immer	SI_No. 1	without freeze	Idle progr

Properties:

- Type of call
- Green flag
- Priority flag
- Partial-intersection

Coordination flags:

- Coordination flag for main phase
- Coordination flag for minor phase WITH call
- Coordination flag minor phase WITHOUT call
- Extension flag

Red flags:

- Red flag

Re-service flags:

- Re-service flag for main phase
- Re-service flag for minor phase

Idle program flags:

- Idle program
- Preliminary stage - idle program
- Idle program - controller off

8.1 Type of call

The type of call defines when the phase waiting period is started:

- Immediately
- The phase waiting time [twts] is started at the same time as the first detector waiting period [twdet].
- With PP

The phase waiting time [twts] starts with the beginning of the frame plan.

8.2 Green flag

VS-PLUS Principle:

Phases switch to green only if they are called!

Thus the standard behavior of VS-PLUS is to switch only those phases to green, which are called by their detectors.

With the green flag phases can be requested, even if the assigned detectors did not submit a call. The following possibilities are available:

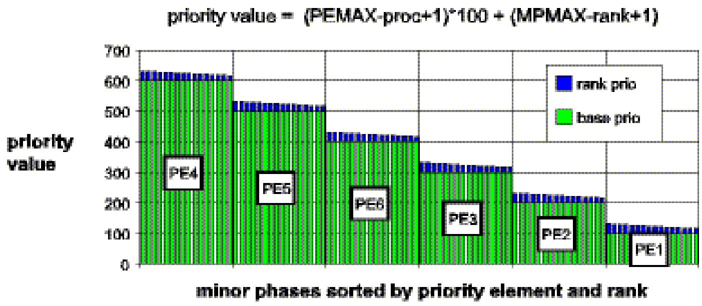
- INAC (green flag 0)
- Standard behavior:
- A phase can be called with detectors only.
- Duration (green flag 1)
- A call for green takes place directly with red (continuous call of the phase).
- BeginPP (green flag 2)
  A call for green takes place, as soon as its frame signal started, even if no detector call is present.

```
Pha      =========================
Phb  (conflict with Pha)     ========================
                             ^                       ^
                             |<--------------------->|
                           Call of phase Phb
```

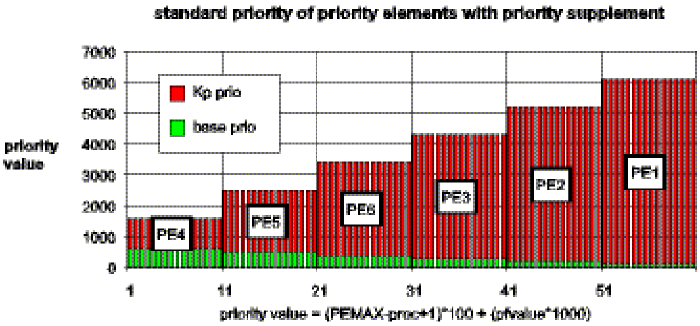
8.3 Priority flag

As a standard procedure VS-PLUS assigns a priority value to each phase. This value depends on the priority of the priority element, in which the phase is located, as well as the rank of the phase within the priority element.

The priority value is determining in the picture composition. During simultaneous call the phases are considered in accordance with the priority value.



With the priority identification the standard priority value can be affected, as a priority addition is added to a phase depending on its level of intervention.



The weight of the addition is determined, depending on the priority element, by the parameter *weight of the priority identification*.

With a priority addition according to standard, a total priority is developed, which is inverse to the standard prioritization.

The parameter initialization takes place with a time value equal to the maximum waiting time. As soon as this time value is exceeded (phase waiting time larger than time value), the priority addition is initiated.

8.4 Coordination flag

(for main phases and minor phases WITH and WITHOUT call)

VS-PLUS permits to select between four different degrees of coordination. These determine how strong the synchronization of the green commands with the framework signal plan is.

These degrees of coordination refer on one hand to main phases and on the other hand to minor phases. It can be determined whether only main or only minor or both shall be with synchronized the frame signals

A **hard coordination** follows strictly the frame signal plan. It means, a phase can only receive green, if its call and its on command take place within the frame signal. Thus the calling range of the frame signal is absolutely kept. Also the main pointer can point to this phase only as long as the frame signal is applied.

It is to be noted that with a hard coordination phases, which cannot be switched to green within their frame signal for call, e.g. due to an intervention of a higher priority, can be omitted.

A **soft coordination** follows the frame signal less strictly. In this case only the call is synchronized with the frame signal. The green command can then also take place outside of the frame signals. Therefore the main pointer can also point to this phase outside of its frame signal.

With the soft coordination omitting of phases is prevented. Phases, which could not be switched within the framework signal e.g. due to an intervention of a priority, will be served later. It is to be noted that the coordination can be disturbed substantially (green no longer within the target range).

The coordination flag can be set differently to **SOFT** or **HARD** for both the main phases and for the minor phases with and without call:

- Coordination flag main phases
- Coordination flag minor phases without call
- Coordination flag minor phases with call
- All combination options are possible e.g.:
- soft coordination for MSt, MiSt-with and MiSt-without
- hard coordination MSt, soft coordination for MiSt-with and MiSt-without

- hard coordination MSt and MSt-with, soft coordination for MiSt-without
- hard coordination for MSt, MiSt-with and MiSt-without

Attention:

However the coordination flags for each phase are only active if the appropriate global flags in the program definition are set to "in accordance with definition phase"

8.5 Extension flag

VS-PLUS normally starts green time detection after minimum green 1. The extension is thus dependent on the extension flag. The extension flag recognizes three effective groups:

- Static detection: detection cancelled after gaps.

  The detection is cancelled in the event of gaps in traffic even if sufficient traffic is subsequently available.

  Two variants are possible:

  a) The detection is cancelled when **all loops** stopped detecting. A "swinging" between individual loops (alternate detection of the loops) is possible.

  b) The detection is cancelled loop for loop. In other words a loop that is no longer detecting is ignored. This prevents "swinging" between the loops.
- **Dynamic detection**: temporary gaps are ignored.
- A phase can be detected up to maximum green even if temporary gaps occur in traffic and no conflicting phases can intervene.
- **Permanent detection**: extension by software

  This extension flag generates a permanent extension independent of traffic (like permanent occupancy of a loop). This can also be set if no loops are present.

8.6 Extension flag static detection

The static detection knows the following possibilities

8.6.1 Static detection by phase

A phase can only actively extend a green phase once. If **all loops** are no longer detecting, meaning no traffic is present anymore, the phase is terminated as soon as possible even if traffic is then present again.

Note:

Contrary to "DET_stat" the termination takes place only if **all loops** do not detect any longer.

8.6.2 Static detection by phase with conflicting permissive signal

This extension flag is a combination of static and dynamic detection:

As long as no conflicting permissive signal is pending dynamic detection is active (temporary gaps are ignored). As soon as a conflicting permissive signal is pending static detection applies (detection cancelled after first gap).

This basically means that detection only starts when a conflicting permissive signal is pending.

Note:

The detection is cancelled if no more loop measures.

8.6.3 Static detection by phase during conflicting permissive signal and call

"Ph_stat with Call_conf"

This extension flag is a combination of static and dynamic detection:

The dynamic detection (temporary gaps are ignored) is active, as long as no conflicting permissive signal is activated. As soon as a conflicting permissive signal and a conflicting call (twdet larger than zero) are pending, the static detection (detection terminated after first gap) applies.

This means the detection begins with the activation of a conflicting call.

Note:

The detection is cancelled if **no loop** is detecting anymore.

8.6.4 Loop wise static detection

loop wise static detection "DET_stat"

A phase can actively extend only once for each green phase. If **all loops** do not detect any longer, i.e. no traffic present, the phase is terminated at the earliest time possible, even if then traffic is present again.

Note:

Contrary to "Ph_stat " the termination takes place **loop for loop (loop wise)**.

8.6.5 Loop wise static detection with conflicting permissive signal

"DET_stat with PS_conf"

This extension flag is a combination of static and dynamic detection:

As long as no conflicting permissive signal is pending, the dynamic detection (temporary gaps ignored) applies. As soon as a conflicting permissive signal is pending, the static detection (detection cancelled after first gap) applies.

This means that the detection begins only with the activation of a conflicting permissive signal.

Note:

The detection is cancelled if **all loops** do not detect any longer. The canceling takes place **loop for loop**.

8.6.6 Loop wise static detection with conflicting permissive signal and call

"DET_stat with Call_conf"

This extension identification is a combination of static and dynamic detection:

As long as no conflicting permissive signal is pending, the dynamic detection (temporary gaps ignored) applies. As soon as a conflicting permissive signal and a conflicting call (twdet larger zero) are pending, the static detection (detection terminated after first gap) applies.

This means that the detection begins only with the activation of a conflicting call.

Note:

The detection is cancelled if **all loops** do not detect any longer. The canceling takes place **loop for loop**.

8.7 Red flag

VS-PLUS' standard behavior is such that only those phases that are deactivated by conflicting phases are switched to red.

VS-PLUS principle: Phases remain green until switched to red through the activation of conflicting phases!

The reasons for a deactivation are given by the various rules:

- No traffic present
- Higher intervention level
- Maximum green reached
- End of permissive period

You will often find phases that have green but which are not affected by the standard behavior of VS-PLUS and thus retain green.

A **red flag** allows to selectively switching these phases to red. These phases can then set to red even if they were not to be set to red according to the standard behavior.

The possibilities are as follows:

- No red flag
- No traffic
- Extension up to permissive signal
- Extension up to permissive signal end
- Extension up to tg min 1
- Extension up to tg min 2
- Extension up to tg max 1
- Extension up to tg max 2
- Extension up to conflicting call
- Extension up to conflicting activation
- Extension up to conflicting permissive period

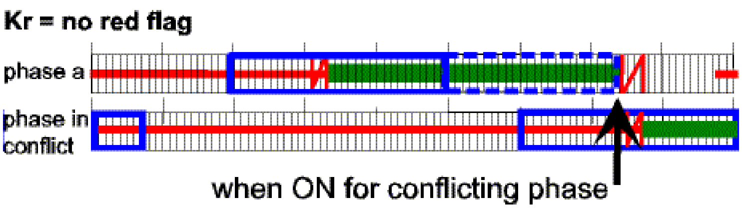
The effect of the individual red flag parameters can be combined logically:

- (RF1 or RF2) and (RF3 or RF4)

8.7.1 No red flag

Red flag 0 "No red flag": Standard behavior.

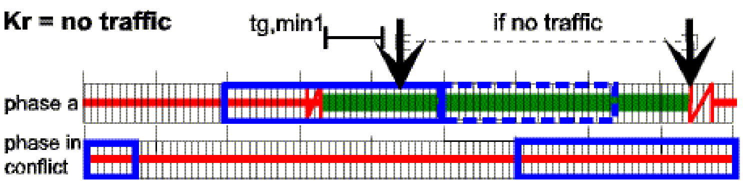
- The phase retains green until switched to red by a conflicting phase.



8.7.2 No traffic

Red flag 1 "no traffic"

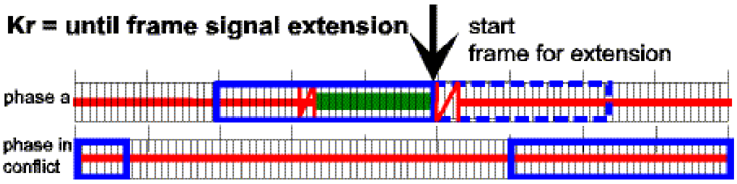
- The phase switches to red as soon as no further traffic is present. The frame signal is ignored.



8.7.3 Extension up to permissive signal

Red flag 2 "up to PS"

- The phase switches to red at the end of the (red) extension frame the latest.



Note:

With overlaid phases (several phases are assigned to the same display element) VS-PLUS examines whether the red flag of the other phases can be implemented likewise. If this is not the case, the red flag does not work.

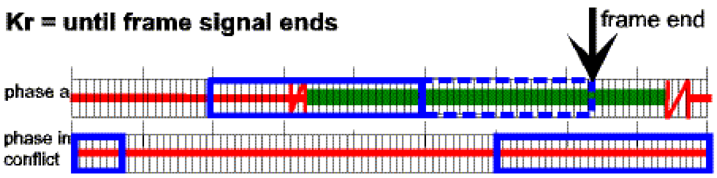
Attention:

The red flag works not within the range "early green" but only at the end of the permissive period for extension.

8.7.4 Up to end of permissive period

Red flag "PS end"

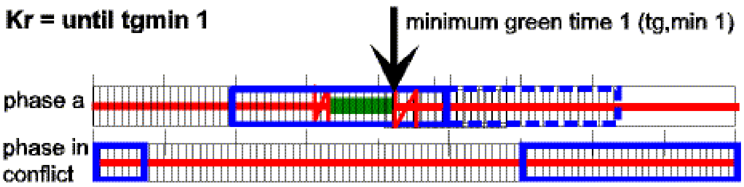
- The phase switches to red at the end of the permissive period extension the latest.



8.7.5 Up to tg min 1

Red flag "up to tg min 1"

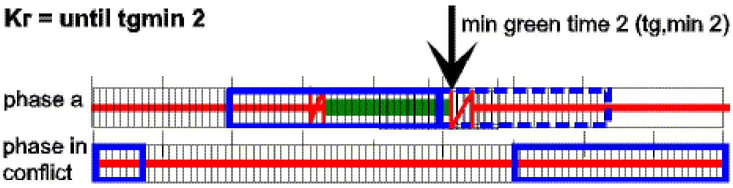
- The phase switches to red on reaching the minimum green time 1 (tg,min1).



8.7.6 Up to tg min 2

Red flag "up to tg min 2"

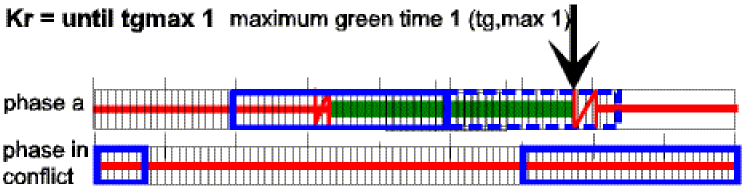
- The phase switches to on reaching after the minimum green time 2 (tg,min2).



8.7.7 Up to tg max 1

Red flag "up to tag max 1"

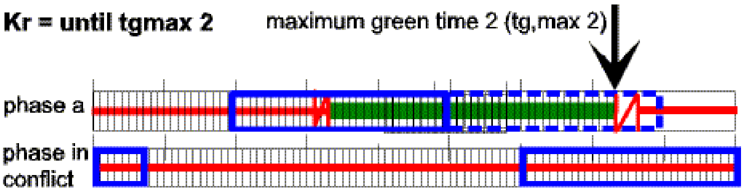
- The phase switches to red on reaching the maximum green time 1 (tg,max1).



8.7.8 Up to tg max 2

Red flag "up to tag max 2"

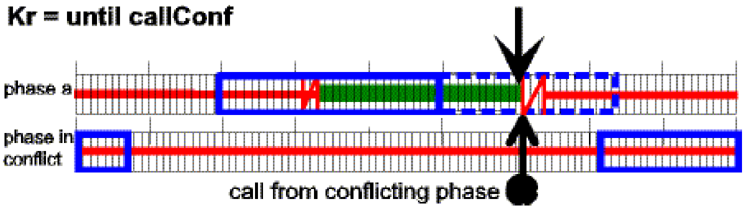
- The phase switches to red on reaching maximum green time 2 (tg,max1).



8.7.9 Up to conflicting call

Red flag "up to conflicting call"

- The phase switches to red, as soon as a conflicting call is present.

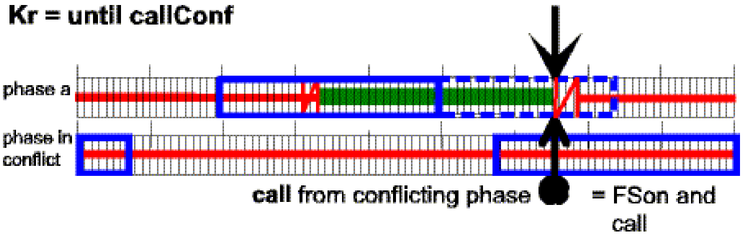


The registration is valid if a call timer (tweet) assigned to the phase is larger than zero.

8.7.10 Up to conflicting activation

Red flag "up to conf active"

The phase switches to red, as soon as a conflicting phase is activated.

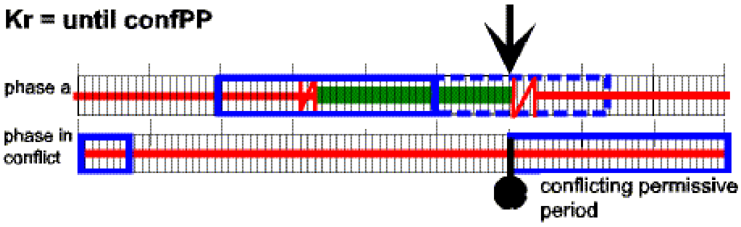


The registration is valid if its phase waiting period (twos) is larger than zero. The condition for it is that the phase's assigned call timer (tweet) is larger than zero and the permissive period for registration is present

8.7.11 Up to conflicting permissive period

Red flag "up to conf PP"

- The phase switches to red, as soon as a conflicting permissive signal is about to start. This happens independently of whether the conflicting phase was called or is activated.



8.8 Re-service flag

(for main and minor phases)

If a phase switches to green, VS-PLUS sets an internal marker. This marker is used in the event of a second call to decide on the basis of the parameter *re-service flag* whether or not the phase in question can receive green again. This internal marker is deleted at the end of the cycle.

If minor phases wish to switch into an active phase, a subsequent detection should not delay indexing to the next phase. Starting with version 3.0 VS-PLUS thus provides a so-called **remaining green calculation**. The remaining green calculation determines the expected green end of the current assigned phases and only activates a minor phase if the remaining green meets the requirements of the re-service flag.

The remaining green calculation initially searches for the assigned phase, which has had green for the longest time. The main phases already determined and their intervention levels are taken into account. In a second step this **remaining green** is compared to the conditions of the re-service flag. If the remaining green is smaller than the required value the minor phase is **not** activated.

The re-service flag can be set differently for both the main phases and minor phases.

The effect of the re-service flag depends on the control principle.

- With a cyclic control the re-service flag controls a re-service of the main phases and green conditions for minor phases.
- With a non-cyclic control it controls the green condition for a minor phase.

8.8.1 Re-service flags for main phase with cyclic control

- No special conditions. Main phase may re-service freely.
- re-service with tg,min1 allowed
- re-service with tg,min2 allowed
- re-service with tg,max1 allowed
- re-service with tg,max2 allowed
- restricted, main phase must not re-service

8.8.2 Re-service flags for main phase with non-cyclic control

- no meaning

8.8.3 Re-service flag for minor phase with cyclic control

- No special conditions, free re-service. The allowed green time is set to tg,max2.:
  - minor phase may re-serve freely
- The following conditions apply for both the first green as well as re-service as minor phase:
  - Minor phase may be served, if remaining tag ≥ tg,min1
  - Minor phase may be served, if remaining tag ≥ tg,min2
  - Minor phase may be served, if remaining tag ≥ tg,max1
  - Minor phase may be served, if remaining tag ≥ tg,max2
  - Minor phase may re-serve, if remaining tag ≥ tg,min1
- The first green is given with no further conditions. The green time allowed is tg,max2. The following conditions apply for the re-service:
  - Minor phase may re-serve, if remaining tag ≥ tg,min2
  - Minor phase may re-serve, if remaining tag ≥ tg,max1
  - Minor phase may re-serve, if remaining tag ≥ tg,max2
  - Minor phase must not re-serve

8.8.4 Re-service flag for minor phase with non-cyclic control

- No special conditions. Minor phase may re-service freely.
  the allowed green time is set to tg,max2.
- Remaining green must be larger than tg,min1;
  the allowed green time is set to tg,min2.
- Remaining green must be larger than tg,min2
  the allowed green time is set to tg,max1 genets.
- Remaining green must be larger than tg,max1
  the allowed green time is set to tg,max2.
- Remaining green must be larger than tg,max2
  the allowed green time is set to tg,max2.
- Not allowed as a minor phase.

8.9 Control modes

8.9.1 Cyclic control

Main phases first receive green according to the standard behavior condition tg,max2 and intervention level of new phases. A re-service as main phase depends on the x-value of the re-service flag

The permitted green duration for **minor phases**, including the first green, is always determined by the remaining green condition. This depends on the y-value of the re-service flag

8.9.2 Acyclic control

Main phases first receive green according to the standard behavior condition tg,max2 and intervention level of new phases. A re-service as main phase depends on the x-value of the re-service flag

The permitted green duration for **minor phases**, including the first green, is always determined by the remaining green condition. This depends on the y-value of the re-service flag

8.9.3 Re-service for main phase with cyclic control

Re-service as main phase is allowed

- No special conditions. Main phase may re-service freely.
- re-service with tg,min1 allowed

- re-service with tg,min2 allowed
- re-service with tg,max1 allowed
- re-service with tg,max2 allowed

Re-service as main phase is forbidden

- restricted, main phase must not re-service

8.9.4 Re-service for minor phase with cyclic control

- No special conditions, free re-service. The allowed green time is set to tg,max2:
  - minor phase may re-serve freely
- The following conditions apply for both the first green as well as re-service as minor phase:
  - Minor phase may be served, if remaining tag ≥ tg,min1
  - Minor phase may be served, if remaining tag ≥ tg,min2
  - Minor phase may be served, if remaining tag ≥ tg,max1
  - Minor phase may be served, if remaining tag ≥ tg,max2
  - Minor phase may re-serve, if remaining tag larger or equal tg,min1
- The first green is given with no further conditions with an allowed green time tg,max2. The following conditions apply for the re-service:
  - Minor phase may re-serve, if remaining tag ≥ tg,min2
  - Minor phase may re-serve, if remaining tag ≥ tg,max1
  - Minor phase may re-serve, if remaining tag ≥ tg,max2
  - Minor phase must not re-serve

8.9.5 Re-service for minor phase with non-cyclic control

The permitted green duration for **minor phases** is determined in each case by the remaining green condition. This depends on the re-service flag:

Re-service as minor phase is allowed

- No special conditions, minor phase may re-service freely.
  the allowed green time is set to tg,max2.
- Remaining green must be larger than tg,min1;
  the allowed green time is set to tg,min2.
- Remaining green must be larger than tg,min2
  the allowed green time is set to tg,max1.
- Remaining green must be larger than tg,max1
  the allowed green time is set to tg,max2.
- Remaining green must be larger than tg,max2
  the allowed green time is set to tg,max2.

Re-service as minor phase is prohibited

- Not allowed as a minor phase.

8.10 Partial-intersection

VS-PLUS can control up to three intersections. In that case different idle programs can be active or even idle programs for each partial-intersection can be set. This possibility depends on the type of controller used.

The flag *partial-intersection* handles the allocation of a phase to the partial-intersection # 1, 2 or 3.

8.11 Idle program

An idle program can be determined with the idle program definition.

The idle program is activated at the earliest when no further calls are received. The extensions of phases that are not part of the idle program are taken into account depending on the following flag.

The idle program is switched on in three stages:

• Preliminary stage idle program	Variable "active" set to value 1
• Idle program	Variable "active" set to value 2
• Idle program – off condition	Variable "active" set to value 3

In the stage "preliminary stage idle program" no more activation requests are present. The served phases however still have traffic (detection loops still active).

Using the parameter *preliminary stage idle program* the decision can be made mow whether the green time is frozen (value = with freezing) or continue counting (value = without freezing). In the case of freezing the green duration is held at the minimum green time 2 (tg,min2).

In the stage idle program the predefined idle picture is set. Here the following possibilities are available:

• INAC	Phase actively not affected
• Red	Phase set to red
• Green	Phase set to green

The stage "Idle program – off condition" is currently not available. It is intended to switch phases to a basic state "dark" or "flashing". At present this parameter is set by default on "No off IP ".

Note:

If only activation of phases are present with a predefined idle program and no phases with green extend anymore, the idle program is switched on immediately. VS-PLUS does not waited until the permissive period plan permits a switching to the new picture.

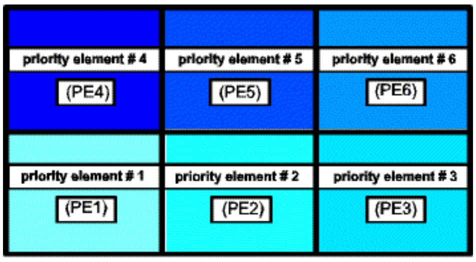
Attention:

However the idle program is only activated if in the parameter rest is set to "idle program according to definition" (IP_acc_DEF) in the parameter field program definition.

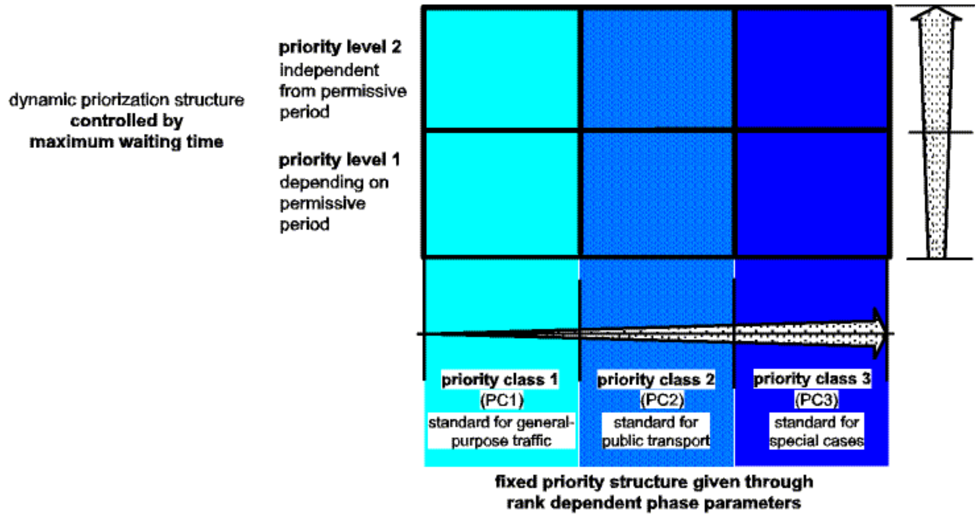
9 Phase parameters

9.1 Picture control

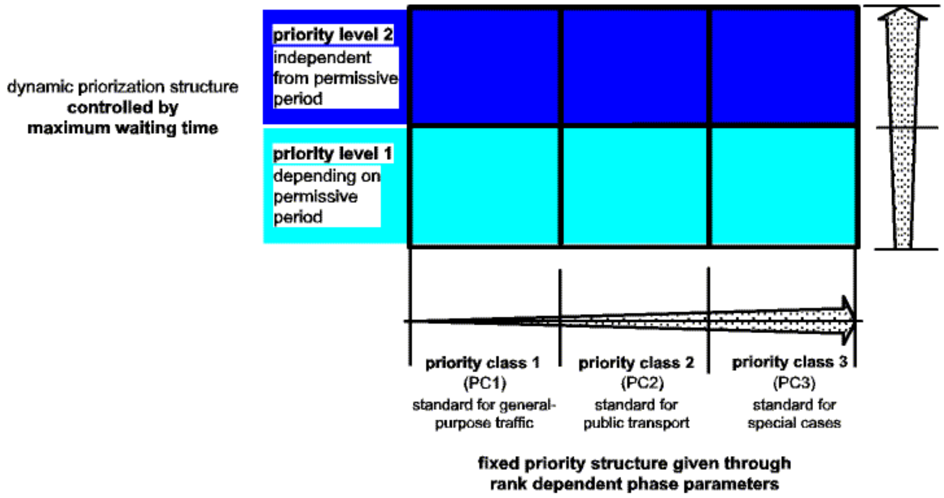
VS-PLUS works with three priority classes:



and two priority levels:

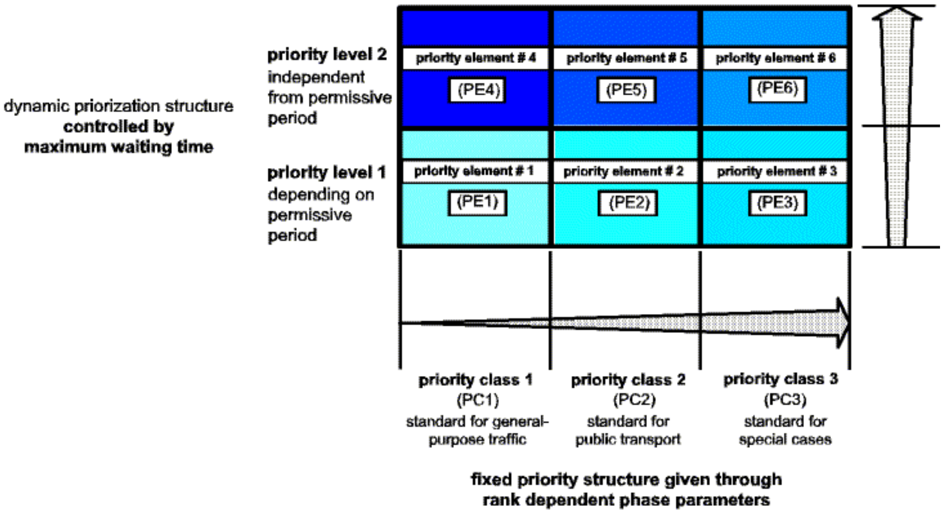


An overlay of the three priority classes and the two priority levels results in a prioritization structure with six priority elements

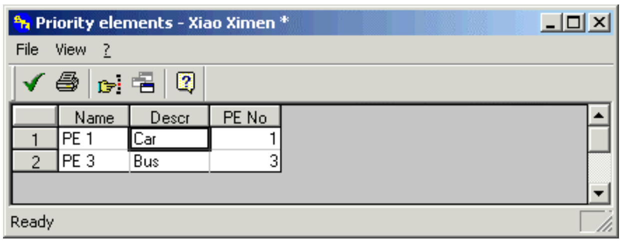


The picture compilation assigns one of these six priority elements to each registered phase. In addition each phase must be assigned to one of the three priority classes, by registering the phase into the main series of the respective priority class.

This means that first the priority elements are used according to the priority classes 1 to 3. The use of the priority elements 4 to 6 depends on the fact whether the priority level is activated by setting a maximum waiting time [Tw max].

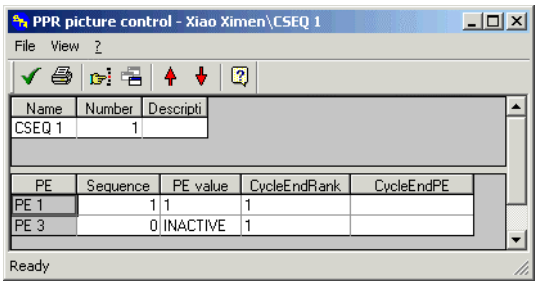


9.1.1 Number to priority element



To indicate the number of the priority element is in accordance with the representation:

9.1.2 Picture parameter control picture parameter



Properties:

- Processing sequence
- Priority value
- Cycle end according to rank
- Cycle end according to priority element

The priority supplement value can be set for each priority element individually.

With the processing sequence the individual priority elements are arranged for the treatment in the picture composition.

VS-PLUS determines with an internal flag whether a phase was on green once within the cycle. The cycle is defined by the main series in the priority classes. The main series must to be processes completely during a cycle. As soon as such an internal flag is set, a re-service of green depends on the parameter *re-service flag*.

After a cycle, at the end of the main series processing, these internal flags must be deleted for a new cycle can begin.

A cycle end can be defined for each priority element. All internal flags are deleted at the end of this cycle.

Note:

Apart from the above-mentioned possibility for the deletion of the internal flags exists another method. All flags can be deleted at one predefined time during the cycle. This time is adjusted using the parameter *global flag: cycle end* in the parameter field "program definition".

9.1.3 Priority value

Depending on the priority flag an additional value can be added to a phase's standard priority value. The size of this supplement depends on the weight of the priority flag. A priority flag can be set for each priority element separately. Thus a phase in a lower ranking priority element can receive a higher weighting than a phase in a higher-ranking priority element.

The standard weighting is in reverse order of the processing sequence. The first priority element in the processing sequence receives the smallest, the last priority element in the processing sequence receives the highest weight.

As soon as the higher weighted phase is selected by the picture composition as the main phase, it blocks the lower weighted phases.

Warning:

The activation of a supplement is controlled with the parameter priority flag. The higher priority weight can only become effective when the phase concerned is selected as main phase.

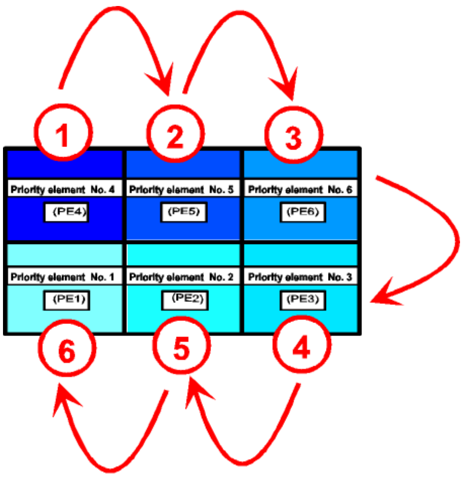
Example: Priority supplement

- The intersection works with the priority classes 1 and 2 and the priority elements 1 and 2 as well as 4 and 5.
- Thus the standard processing sequence reads 4,5,2,1.
- Derived from it the standard weight reads:
- Priority flag 1 for priority element 4,
- Priority flag 2 for priority element 5,
- Priority flag 3 for priority element 2,
- Priority flag 4 for priority element 1,

9.1.4 Processing sequence

To indicate is the sequence, in which the priority elements are to be considered during the picture composition. Thus the sequence and the priority are specified, with which the phases are selected for a new picture.

The standard processing sequence corresponds to the sequence: PE4, PE5, PE6, PE3, PE2; PE1



The intersection works with the priority classes 1 and 2 and the priority elements No. 1 and 2 as well as 4 and 5.

Therefore to register is: 4.5.2.1

Now PE 4 is processed first, then PE 5, PE 2 and finally PE 1.

9.1.5 Cycle end according to priority element

If the cycle end of another priority element is valid for the priority element concerned, then the *cycle end according to priority element* must reference the determining priority element.

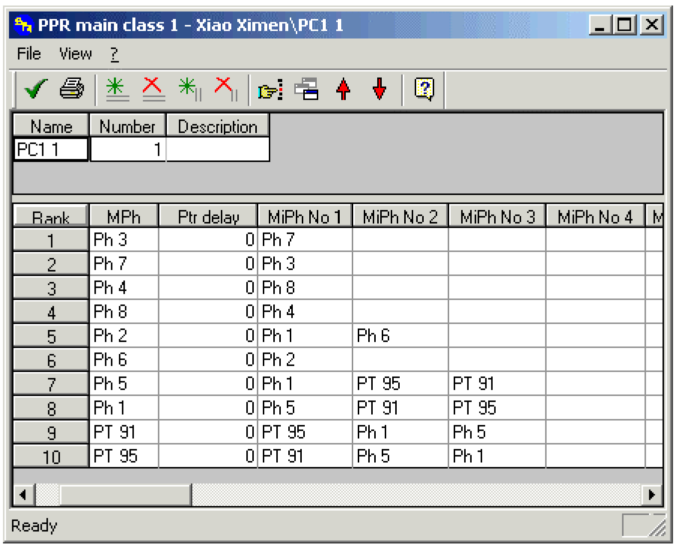
If the rank of the priority element concerned is to be effective instead of another priority element, then the parameter *cycle end according to priority element* is to be left empty. But the parameter *cycle end according to rank* must be specified.

9.1.6 Cycle end according to rank

The parameter *cycle end according to rank* must be set to a rank of the priority element. Once the priority element concerned reached the specified rank in the sequence the internal flags are deleted.

If another priority element is to be effective instead of the rank of the priority element concerned, then the parameter *cycle end according to rank* is to be left empty. But the parameter *cycle end according to priority element* must be specified.

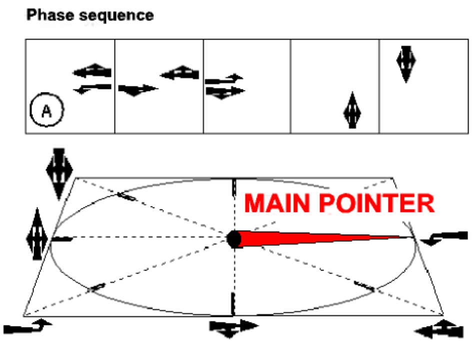
9.2 Main series



Rank	MPh	Ptr delay	MiPh No 1	MiPh No 2	MiPh No 3	MiPh No 4
1	Ph 3	0	Ph 7			
2	Ph 7	0	Ph 3			
3	Ph 4	0	Ph 8			
4	Ph 8	0	Ph 4			
5	Ph 2	0	Ph 1	Ph 6		
6	Ph 6	0	Ph 2			
7	Ph 5	0	Ph 1	PT 95	PT 91	
8	Ph 1	0	Ph 5	PT 91	PT 95	
9	PT 91	0	PT 95	Ph 1	Ph 5	
10	PT 95	0	PT 91	Ph 5	Ph 1	

9.2.1 Main phase

Each priority class has its own main series. The main pointer follows this main series cyclically under normal conditions (standard setting of *global flag: definition principle main series* = MS_cyclic). That is, the pictures are developed cyclically phase by phase in accordance with the table main series.



- In principle all phases are assigned to the class 1 if they are not in a main series. If a PT phase is divided into the class 0 in the Siemens VS-PLUS it remains in this class and is not arranged in the class 1.
- The pointer remains on phases that are at getting switched on (condition 9) if the permissive period and the coordination flag permit this. It will also remain on these phases if the phase concerned is in the stage 2.

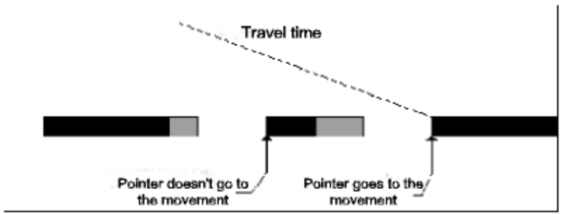
Warning:

Each phase is registered in the appropriate priority class. Each phase may occur as main phase only in one priority class. However repetitions within a priority class are permitted.

Phases of the type PT form an exception, if these phases are processed with the so-called prioritization module.

9.2.2 Pointer delay

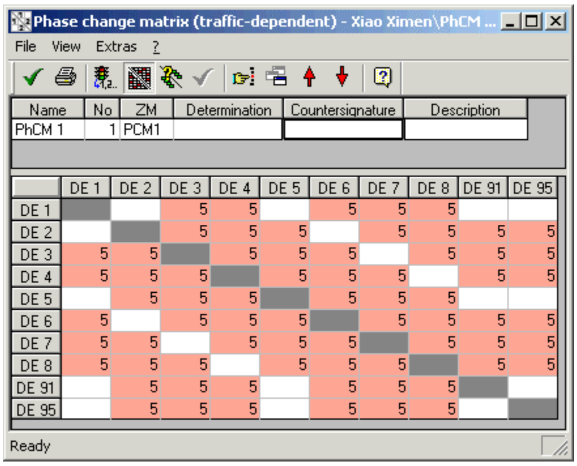
The pointer delay specifies the degree of freedom permitted when adding non-conflicting phases during a phase (pointer is pointing on a certain rank). As long as a main pointer is fixed on a certain rank the appropriate minor series is also active.



The main pointer can be held on each rank. The pointer delay is active during green, if the extension criterion is met. The main pointer only points to the next rank after it reached reference value set in the *pointer delay* field.

- The pointer remains on phases that are at getting switched on (condition 9) if the permissive period and the coordination flag permit this. It will also remain on these phases if the phase concerned is in the stage 2.
- If the travel time of a PT vehicle exceeds its phase permissive period, the pointer will ignore this permissive period and only point to the phase once it reaches the "correct", permissive period.

10 Phase change matrix



	DE 1	DE 2	DE 3	DE 4	DE 5	DE 6	DE 7	DE 8	DE 91	DE 95
DE 1			5	5		5	5	5		
DE 2			5	5	5		5	5	5	5
DE 3	5	5		5	5	5		5	5	5
DE 4	5	5	5		5	5	5		5	5
DE 5		5	5	5		5	5	5		
DE 6	5		5	5	5		5	5	5	5
DE 7	5	5		5	5	5		5	5	5
DE 8	5	5	5		5	5	5		5	5
DE 91		5	5	5		5	5	5		
DE 95		5	5	5		5	5	5		

VS-PLUS calculates phase changes on the basis of the display elements using the phase change and offset times. With the computation of a phase change VS-PLUS tries to switch the display elements on **as soon as possible**.

Therefore VS-PLUS requires a phase change matrix. The phase change times specified in the phase change matrix can be larger, than the controller's default values.

If a display element does not have to be switched off due to shorter phase change times, then this additional green is given to it during the phase change. Exceptions are display elements of the type "without optimization".

VS-PLUS is able, to work with two different phase change matrices in one data record. In principle VS-PLUS uses the values defined in the matrix phase change traffic related (VS-PLUS).

In case of PT phases however phase change times can be shorter. If VS-PLUS determines that a PT phase checked out correctly at the checkout detector, the shorter phase change time is used. In case of a checkout by obligation notice of checkout, the phase change time entered in the phase change matrix is used.

The 'global flag phase change time defines weather or not the shorter phase change time will be used.

- PC normal: No shorter phase change time will be used.
- PC shorter: Shorter phase change time will be used.

Due to safety reasons the phase change time, which is supplied in the controller, cannot be undercut. If thus VS-PLUS switches a ‚shortened' phase change time it is the time supplied in the controller's basis. Thus the traffic-technical phase change time must be larger, so that shortening is obtained.

If the functionality is to be tested in the simulation, a second phase change matrix must be provided (phase change time standard). This second matrix must contain the controller's phase change time. These values are then used in the simulation as ‚shortened' phase change times.

Attention:

If VS-PLUS recognizes during the phase change that two conflicting display elements are to be switched to green, it will only switch the one, which is first in the sequence. The conflicting display element will be suppressed. Since this case can occur only with an incorrect parameter setting, an error message will appear.