

USER REQUIREMENT SPECIFICATION

FOR

**ELECTRONIC INTERLOCKING INTERFACE TO A
SIEMENS KEY RELEASE INSTRUMENT**

FOR THE USE IN

**PASSANGER RAIL AGENCY OF SOUTH AFRICA
(PRASA)**

<i>URS for EI Interface to a Siemens Key Release Instrument for the use IN PRASA</i>				<i>Doc No. & Version</i>
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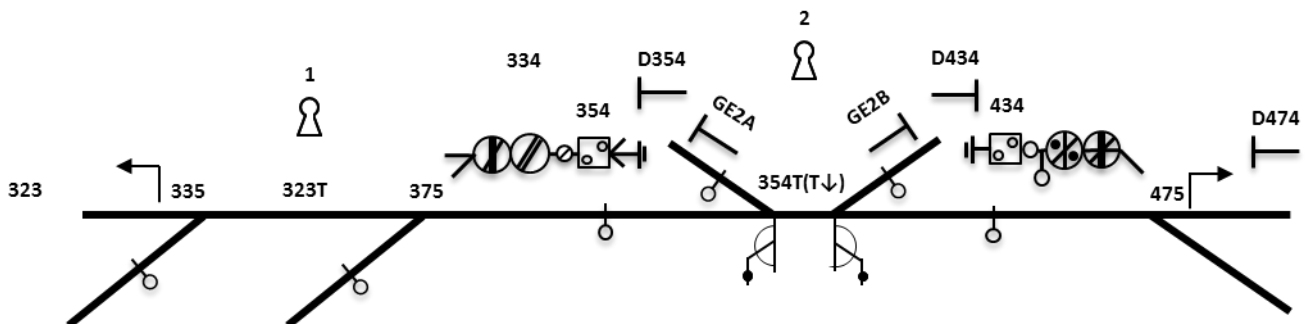
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1. SCOPE:

The detailed requirements for the Logical I/O software block/program in EI to interface to a Siemens key release instrument. This is required in PRASA in two major categories of key release instrument applications:

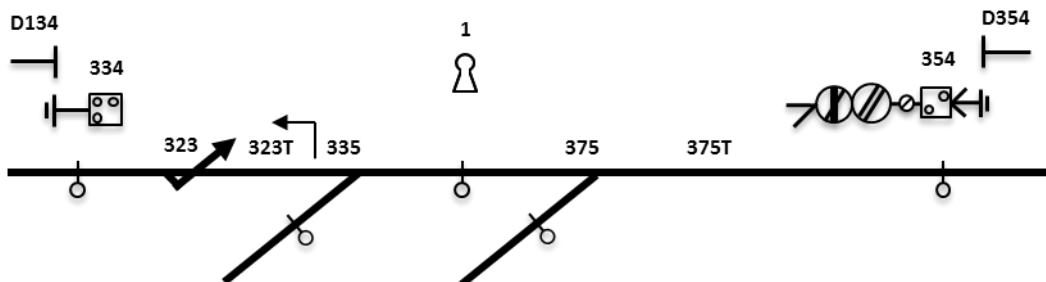
- 1.1. **Releasing a/ key/s for unlocking of manually thrown key points-set/s and/or other switching gear, for example switching gear to switch on overhead power in sidings, etc. See Diagram 1.1 below for layout part of validation model for this application.**

Diagram 1.1:



- 1.2. **Releasing a key as permission to take local control and the removal of the key to deactivate CTC control and activate local control as required, for auto shunting or limited control from a local control panel, etc. See Diagram 1.2 below for layout part of validation model for this application.**

Diagram 1.2:



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2. APPLICABLE DOCUMENTS:

The following specifications, standards and drawings of the exact issue shown form a part of this specification to the extent shown herein. In the event of conflict between the referenced document and this specification, the contents of this specification shall be considered a superseding requirement.

2.1. PRASA/Transnet documents.

Symbol Catalogue for the SATCOS User Interface Doc – ID 150P_30059-PRJ-SPN-0107; Version E of 2014-02-27.

2.2. Drawings.

BBB3803 Version 3 Sheet 1 to 4.

BBB3812 Version 1 Sheet 1

2.3. Interface Control Documents ICDs.

Not applicable.

2.4. Standards.

UIC Code 736i for type N and C signalling safety relays.

CENELEC standards:

EN 50121-4 Railway applications – Electromagnetic compatibility (EMC)
– Signalling and communications.

EN 50125-3 Railway applications – Environmental conditions for equipment
– Signalling and communications.

EN 50126 Railway applications – The specification and demonstration of
Reliability, Availability, Maintainability and Safety (RAMS).

EN 50128 Railway applications – Software for railway control and
protection systems.

EN 50129 Railway applications – Safety related electronic systems for
signalling.

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EN 50159-1 Railway applications – Signalling and communications – Safety-related communication in closed transmission systems.

EN 50159-2 Railway applications – Signalling and communications – Safety-related communication in open transmission systems.

2.5. Other documents.

Not applicable.

3. GENERAL REQUIREMENTS:

3.1. Safety approval.

- 3.1.1. The EI must be approved by a reputable railway safety authority such as the “Deutsche Bundes Ampt” as complying with a Safety Integrity Level 4 (SIL4) as described in the CENELEC EN50126 Standard.
- 3.1.2. Generic interlocking core software, after approval, must not be able to be modified during application configuration by unauthorised persons.
- 3.1.3. The safety approval of this interface to the “Key Release instrument” is included in the safety approval of EI. The functional and application safety validation approval is by PRASA Strategy Asset Development. The software safety validation is done by a CENELEC approved independent safety accessor.

3.2. Reliability approval.

- 3.2.1. Reliability approval part of the EI reliability approval.

3.3. System definition.

This interface will be required for the key release instruments on the PRASA re-signalling projects of the three metro poles: Gauteng, Durban and Cape Town.

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4.2. The Key release function. See 4.1 Diagram of Siemens Key Release Instrument Interface.

4.2.1. Key release request applies for both - Applications 1.1 and 1.2:

4.2.1.1 The request from the CTC VDU (SATCOS) for a key release is received via remote control to the interface program (electronic interlocking COMMAND).

An emergency key release request can also be received directly from the key instrument to the interface program in the case of a CTC failure energising the EPBR and marking a non-vital input “Emergency Key Release request” to the interface program (activating the same electronic interlocking COMMAND as from CTC).

4.2.1.2 A new “Key” element must be created with a EI physical interface program interfacing the instrument with a track circuit logical element or other element part of the spoor/channel functions. When the logical track circuit element is used it is the one containing the key release points-set in application 1.1 above. New COMMAND “Key release” acting on this element must be created in the EI. In application 1.2 a logical element part of the spoor/channel functions must be created

4.2.2. Key Normal detection applies for both - Applications 1.1 and 1.2:

4.2.2.1 The Key normal detection will be a vital input (SIL4) when a primary safety relay (UIC Code 736i type N) is used, two out of two inputs over its front contacts equivalent must be used (CR↑).

4.2.2.2 This input will be normally active (CR↑), proving that the key in the key instrument is normal not released (SL relay in instrument down/de-activated). This is the case when there is no key release in progress – no release timer running (power on SL relay coil) or the key was not removed (SL relay mechanically stuck up).

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- 4.2.2.3 A version of the Siemens key instrument has a contact: KEY IN (SK) on the key that makes when the key is normal (in SL locked position) and breaks when the key is turned and removed. **This version is the preferred one.**

When this applicable contact makes (KEY IN makes – not turned) it must be fed back separately to the interface program as a vital input (SIL4) when a primary safety relay (UIC Code 736i type N) is used, two out of two inputs over its front contacts equivalent must be used (KEY IN[↑]).

When this contact not making (KEY IN[↑] not energised) but the CR[↑] still normal (no release given) it is considered as a wrong-side failure that has occurred and the key interface must be passivated.

- 4.2.2.4 The “Key normal” state in the interface program will therefore depend on both primary relays CR[↑] and KEY IN[↑] energised or in other words both vital inputs TRUE: CR[↑] AND KEY IN[↑].
- 4.2.2.5 Because of the infrequent use of some key release functions when primary relays are used to proof: the key not released (CR[↑]), the key normal in (KEY IN[↑]) the integrity of these relays must be scheduled tested (not only with giving a release).

The preferred option is that the integrity of these relays must be proven every-time a route is set and locked over the key-points-set/s or logical software element that the key instrument interface program is interfaced to. When this integrity test fails the points-set/s must be passivated, the key interface or both must be passivated according to the application.

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4.2.3. The Normal key points-set/s detection/s for the main line - Application 1.1:

- 4.2.3.1 The key points-set/s detection/s for the main line must be fed back per points-set separately (E1KR↑; E2KR↑).

A key-points-set/s losing main line detection/s without a release given (CR↑) on the key unlocking the key-points-set/s is considered a wrong-side failure that has occurred and the points-set/s must be passivated or the key interface or both must be passivated according to the application.

- 4.2.3.2 Because of the infrequent use of some key points-sets when primary relays are used to proof the main line key points detection (E1KR↑; E2KR↑) the integrity of these relays must be scheduled tested (not only with giving a release).

The preferred option is that the integrity of these relays must be proven every-time a route is set and locked over the key-points-set/s. When this integrity test fails the specific points-set must be passivated, the key interface or both must be passivated according to the application.

4.2.4. Release function for - Application 1.1:

- 4.2.4.1 The “Key Release” command must be rejected when:
- There is an existing route set, in the locked or final defined state over the associated logical track circuit element containing the Key-points – independent of being occupied or vacant.
This is any route with G354 and G434 as destination signal set over, locked or in final defined state of T354 in the test model – see diagram 1.1.
 - There is an existing route set, in the locked or final defined state with the logical track circuit element containing the Key-points as occupied track down shunting track section.
Routes with D354 and D434 dummy track down shunting signals as destination signals in the test model – see diagram 1.1.
 - The logical track circuit element containing the Key-points is the destination track and the overlap 90 second train-normalisation time is still running (train has not come to a standstill on this applicable destination track).
 - The logical track circuit element containing the Key-points is locked

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in the final defined state in route or overlap.

- e) The associated logical “spur” track circuit element is transferring flank/head-protection.
- f) The associated logical “spur” track circuit element forms part of an overlap set, in a locked or final defined state.
- g) Route has already been set from a starter signal with a berth track circuit element containing the Key-points.

Signals: AG354 and G434 in the test model see diagram 1.1.

4.2.4.2 The “Key Release” function:

- a) When a “Key Release request” either from the CTC or EPBR (button on key release instrument pushed), the vital output energising the RR must be raised if none of the above mentioned condition exist and the logical track circuit element containing the Key-points is unlocked.

This RR vital output must energise the SL relay in the Key release instrument enabling the key to be turned and removed – the release must be maintained for a configurable time between 10 and 60 seconds to allow the key to be removed.

- b) The RR relay “Key Release” function is sending out a vital output to the instrument.
- c) The “RR relay” output must be kept active with the “Key Release” (RR-relay) output until the configured “Key Release” time has elapsed.
- d) If the key was not removed during the configured “Key Release” time, the “Key Normal” detection will again become active.
- e) If the key was removed during the configured “Key Release” time, the “Key Normal” detection will stay inactive.
- f) After the release time has elapsed two back contacts of the “Key Release” (RR-relay) must be fed to vital inputs to proof that the relay has de-energised. When this relay is stuck up the key release object must be passivated.

4.2.4.3 The train normalisation of a destination track section containing Key-points/manual points unlocked to enable the key to be released:

- a) When a shunt/B-signal is cleared to the destination track the destination track section (TC-object) will be conditionally configured as passive for train normalisation purposes. When the last lockable element before the opposing signal of the shunt signal cleared into the passive track section has normalise the track section containing the Key-points will normalise.
- b) When a main/A-signal is cleared into the track section containing the Key-points the track section will be conditionally configured as

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active for train normalisation purposes – sequential train normalisation or reverse cancellation will then normalise this track section. The release of the key will not be allowed.

- c) The key release is only possible when this track section is unlocked – will be the case with a B-signal cleared into track section and train gone past opposing signal and the 90 seconds overlap release time has elapsed. When train then disappears into siding track section will not be locked.
- d) When a main/A-signal was cleared into the track section and the key release must still be activated, an emergency route cancellation will have to be done on the route containing the applicable track section to unlock it after time delay so that the key release will still be possible.

4.2.5. When the “Key” has been removed AND/OR the key points-sets detection for the main line has been lost - Application 1.1:

4.2.5.1 The setting of the following routes/overlaps must be prevented:

- a) The setting of a route or overlap over the associated logical track circuit element containing the Key-points – independent of being occupied or vacant must not be allowed.
This is any route with G354 and G434 as destination signal set over T354 in the test model – see diagram 1.1.
- b) The setting of any route with the logical track circuit element containing the Key-points as occupied track down shunting track section must not be allowed.
Routes with D354 and D434 dummy track down shunting signals as destination signals in the test model – see diagram 1.1.
- c) The setting of any route from a starter signal with a berth track circuit element containing the Key-points must not be allowed.
Signals: AG354 and G434 in the test model see diagram 1.1.

4.2.5.2 The seeking and transferring of flank protection over the logical track circuit element containing the Key-points-set/s must be terminated.

4.2.6. When the “Key Release” interface has been passivated AND/OR the key points-sets detection for the main line has been passivated - Application 1.1:

- 4.2.6.1 The “Key Release” interface object/element can be passivated when a wrong side failure occurs in the key instrument or hardware interface of the EI:
 - a) When KEY IN (SK) contact not making (KEY IN[↑] not energised) but the CR[↑] still normal (no release given) it is considered as a wrong-side failure that has occurred (Key was removed without a release given) and the key interface must be passivated.

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- b) When KEY IN (SK) contact making (KEY IN[↑] energised) but the CR[↑] still de-energised while no release given, it is considered as a wrong-side failure that has occurred (Key can be removed without a release given – key not locked.) and the key interface must be passivated.
- c) When the integrity test of the primary relays KEY IN[↑] AND/OR CR[↑], done when setting a route over applicable track object/element, fails.
- d) When the area object controller/object controller/vital I/O that is monitoring the state of KEY IN[↑] AND/OR CR[↑] fail.

4.2.6.2 The Key points-set/s detection object/element can be passivated when a wrong side failure occurs in the Detection or hardware interface of the EI:

- a) When detection is lost E1KR[↑] OR/AND E2KR[↑] de-energised but key not removed - KEY IN[↑] still energised and no release given CR[↑] still normal it is considered as a wrong-side failure that has occurred (The manual key points-set/s was/were thrown without unlocking it/them with the key) and the key points-set/s detection object/element must be passivated.
- b) When the integrity test of the primary relays E1KR[↑] OR/AND E2KR[↑], done when setting a route over applicable track object/element, fails/.
- c) When the area object controller/object controller/vital I/O that is monitoring the state of E1KR[↑] OR/AND E2KR[↑] fails.

4.2.6.3 The setting of the following routes must be allowed again:

- a) The setting of a route over the associated logical track circuit element containing the Key-points – independent of being occupied or vacant must be allowed.
The clearing/calling of A or B signals must be prevented.
The calling and clearing of emergency signals for these routes must be allowed.
The emergency signal will only clear when none of the key points-set's detection object/elements passivated.
This is any route with G354 and G434 as destination signal set over T354 in the test model.
None of E1KR[↑] OR E2KR[↑] passivated to clear emergency signal – see diagram 1.1.
- b) The setting of any route with the logical track circuit element containing the Key-points as occupied track down shunting track section must be allowed.
The clearing/calling of the B signals must be prevented.
Routes with D354 and D434 dummy track down shunting signals as destination signals in the test model – see diagram 1.1.

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- c) The setting of any route from a starter signal with a berth track circuit element containing the Key-points must be allowed.
The clearing/calling of A or B signals must be allowed.
The calling and clearing of emergency signals for these routes must be allowed.
Signals: AG354 and G434 in the test model see diagram 1.1.

4.2.6.4 The seeking and transferring of flank protection over the logical track circuit element containing the Key-points-set/s must be terminated.

4.2.7. Release function for - Application 1.2 – see diagram 1.2 above:

- 4.2.7.1 The “Key Release” command must be rejected when:
- The pre-conditions for transfer of control to auto-shunting or a local control panel has not been put in place.
 - In the validation model the condition to allow auto-shunting is that G354 has been cleared to shunt aspect.
- 4.2.7.2 Auto shunting functionality between G334 ground shunt and signal G354:
- Signal G354 must be cleared to a shunt aspect (berth track must be validly occupied to remove derailer W323 off the rail). A shunt aspect on G354 will allow a release on key 1.
 - With auto shunting the key release must not be automatic when signal G354 is first cleared to a shunt aspect.
Must be a request to the TCO to auto shunt and he must give the release.
 - When the release on the key is still running before the key is removed (only the instrument with contact KEY IN (SK) detecting the key normal must be used in this application) the cancellation on destination signal D314 is still possible and the train normalisation must still be functionally active.
 - When a cancellation is initiated on D314 or the train normalisation starts with track T375 becomes occupied (Whenever the shunt aspect on G354 signal is replaced) – the release on the key must be immediately withdrawn.
- 4.2.7.3 When the “Key Release” command has been completed and the key removed:
- When key 1 is removed signal G334 must clear to a shunt aspect while the shunt aspect on G354 is retained.
 - Normal and emergency cancellation must be inhibited (rejected by interlocking) on D314 – no inhibition (refusal) of normal or emergency cancellation on G354.

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- c) The train normalisation must be inhibited when T375 becomes occupied. When T375 OR/AND T323 is occupied both the signals G334 and G354 must be replaced to danger.
- d) When both T375 AND T323 becomes unoccupied again both signals must clear to a shunt aspect again.
- e) When in auto-shunting mode D434 must not be allowed to be a track down dummy destination signal to prevent opposing track down shunting moves towards G354.
- f) When in auto-shunting mode G354 must not be allowed to be a destination signal to prevent opposing shunting moves towards G354.

4.2.7.4 When the key1 is replaced and Key Release is detected normal:

- a) Signal G334 must replace to danger while retaining G354 shunt aspect – when key 1 replaced while T375 and T323 vacant.
- b) With the key 1 normal again cancellation on D314 must be allowed again and when train traversed passed G354 the train normalisation must take place again.

4.2.7.5 When key 1 passivated because of a hardware fault inside interlocking (Hardware monitoring key in key instrument faulty, etc.) or wrong side failure in instrument (key not normal without a release, etc.):

- a) When this happens when key was normal auto shunting is no longer possible and G354 and G334 function normally with no inhibition of D314's cancellation or train normalisation passed G354.
- b) When this happens in auto-shunting mode G334 is replaced to danger, cancellation on D314 becomes active and train normalisation passed G354 active again – (auto shunting mode immediately terminated).
Auto-shunting not possible anymore until passivation cause fixed. G354 and G334 function normally with no inhibition of D314's cancellation or train normalisation passed G354.

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4.3. Indications.

- 4.3.1. The indications applicable to the key release is fully illustrated in the specification:
Symbol Catalogue for the SATCOS User Interface Doc – ID 150P_30059-PRJ-
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5. QUALITY ASSURANCE PROVISIONS:

- 5.1.1. The functionality and safety case of this interface must be proven on a physical
model by PRASA Strategy Asset Development: Technology Management.

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