

User Manual for GCOR-Union Pacific Signal Scripts

Installation

The signaling package is compressed within the Gcor.zip file. Extract this archive into a dedicated folder. This directory must be set as the "Signal path" under the Environment tab within the Edit | Preferences menu of Train Director.

Gcor Folder Contents

The Gcor folder contains:

- .tds files containing the signal logic scripts.
- .xpm graphics files for the signal aspect icons.
- _Segnalamento GCOR.pdf and _GCOR signalling.pdf files, provided for an in-depth theoretical understanding of the North American signaling system.
- _Istruzioni.pdf and _Instructions.pdf files, covering the simulation mechanics of the GCOR system within Train Director (TD).
- The Segnali UP.trk layout file, which demonstrates a practical example of all signal aspects in the Eastbound direction.
- The Gibbon folder, which contains an example layout utilizing Union Pacific signaling rules.

Technical Constraints of the GCOR System in Train Director

When simulating the GCOR system within Train Director, several European signaling paradigms do not apply:

- No Isolated Distant Signals: The standalone distant signals common in European layouts are absent. Instead, lines use exclusively Absolute Signals (which convey a "Stop" indication that cannot be passed without dispatcher authority, similar to home signals) and Intermediate/Automatic Signals (which convey a "Stop and Proceed" indication).
- No Dedicated Switching Signals: There are no specific shunting indicators or European-style ground "marmotta" signals. Yards utilize low-profile Dwarf Signals that display the exact same aspects and operational logic as high mast, bridge, or cantilever signals.
- Implicitly Bi-directional Lines: Because old-style single-direction permissive signals are not used—replaced instead by bi-directional automatic intermediate signals—all mainline tracks in the simulation are implicitly signaled for bi-directional running.

Simulation Note: A true Stop and Proceed rule (stopping at a red automatic signal and immediately advancing at Restricted Speed into an occupied block) cannot be accurately processed by Train Director's train AI. Consequently, within the simulator, a Red aspect acts as an absolute stop until the block clears or a manual override is given.

GCOR-Union Pacific Signals

Physical Structure

The GCOR system is utilized by numerous railroad administrations across the Central and Western United States, each possessing distinct structural traditions. This simulation strictly models the physical equipment configurations of the Union Pacific Railroad (UP).

UP traditionally employs high mast signals with one, two, or three signal heads. Each head houses three separate color optical units (Red, Green, and Yellow) arranged vertically, meaning a three-head signal physically contains nine individual lights. Because this footprint is too large for Train Director's layout display panels and limits on-screen visibility, this package utilizes Searchlight-style multi-color single-lens heads, displaying one variable color per head.

Software Automation

In Train Director, any signal configured as an "Intermediate" (Edit | Signal Properties | Intermediate Signal) allows AI trains to automatically resume their march as soon as the block ahead clears. Conversely, an "Absolute" signal permanently holds a train at Stop until a route is lined or an operator command is issued.

The architectural logic of the signal types is structured as follows:

- 3-Head High Signals: These operate predominantly as Absolute Signals protecting junctions, stations, or crossovers (Interlockings). In this setup, the mast lacks a numerical plate and a red aspect dictates an absolute stop. On high-speed or heavy-grade territories, three-head masts can be configured as Intermediate (Automatic) Signals to spread the braking distance of heavy tonnage manifest freights across 4 or 5 blocks using advanced approach braking aspects (approach_fourth and approach_third). In this scenario, they carry a Mile Post (MP) number plate.
- 1-Head and 2-Head High Signals: These can function as either absolute or intermediate units; when acting as intermediates, they visually display a white MP number plate.

- 1-Head and 2-Head Dwarf Signals: These function exclusively as absolute yard/interlocking units and are never configured as intermediates.

Block rule: A block section governed by an Intermediate signal must not contain any turnouts/switches.

Operational Speeds

The following standard speeds (converted to km/h) have been hardcoded into the headers of the signal scripts for Train Director's speed limit enforcement:

Name	Speed (km/h)	Operational Meaning
MAS	—	Maximum Authorized Speed permitted by the timetable or equipment.
limited	110	Limited Speed: For long turnouts on high-density passenger corridors.
medium	50	Medium Speed: For standard interlocking turnouts and station routes.
slow	25	Slow Speed: For movements within freight yards and secondary tracks.
restricting	15	Restricted Speed: For shunting, yard movements, and sight-restricted running.

Approach Aspects vs. Attained Speed Aspects

Under GCOR / Union Pacific operating rules, signal indications are divided into two distinct functional categories based on the locomotive engineer's required handling:

1. Approach Aspects (Braking Orders): Require the engineer to initiate a reduction in speed only after passing the signal, ensuring the train drops to the target velocity before reaching the next signal.
2. Attained Speed Aspects (Point-of-Passage Limits): Dictate that the train must already be traveling at or below the specified speed restriction at the exact moment the locomotive passes the physical location of the signal.

KEY ATTAINED SPEED ASPECTS (POINT-OF-PASSAGE):

- restricting (15 km/h): Used for entering yard tracks, spurs, or occupied blocks. The train must cross the signal location at a maximum of 15 km/h, prepared to stop within half the range of vision short of equipment, misaligned switches, or track breaks.
- slow_clear (25 km/h): Proceed at Slow Speed through the turnout structure until the entire train clears the interlocking limits.
- medium_clear (50 km/h): Proceed at Medium Speed through the turnout structure.

The Principle of Speed Signaling: European-style standalone distant signals are absent because North American railroading relies on Speed Signaling. All intermediate signals utilize a cascading, continuous logic loop. A single signal face simultaneously communicates the authorized speed for the current block and acts as a dynamic distant warning for the upcoming signal.

Block Sizing and Critical Distance Management

The braking physics of Union Pacific freight trains—with total weights regularly exceeding thousands of tons and lengths stretching up to 2,500 meters—requires a strict safety overlay based on physical block spacing.

When a terminal interlocking signal is at Stop (Red), the script calculates the layout geometry ahead by comparing absolute distance to the danger point (.redDistance) and the length of intermediate blocks (.nextLength) across three critical thresholds:

1. CRITICAL BLOCK THRESHOLD (DISTANCE < 800M) - CHECKED VIA .REDDISTANCE

Typically found on approaches to junctions, siding entrances, or yard leads. If the distance to the absolute stop signal is under 800 meters, speed must be shed immediately:

- On Mainline Signals (2 or 3-Head Intermediates): To prevent a heavy train from overshooting the stop canvas, the script forces a **double_approach** aspect (two stacked steady yellows), preceded on the previous mast by an **approach_third** aspect (yf-y-r or yf-y). This spreads the active braking zone across four full blocks.
- On Absolute Interlocking Signals (2 or 3-Head): If an interlocking signal leads to a yard track with less than 800 meters of headroom before a stop point, the signal forces a **slow_approach** aspect (r-y or r-r-y), dropping the train to 25 km/h immediately at the point of passage.

2. SHORT BLOCK THRESHOLD (DISTANCE < 1,500M) - CHECKED VIA .REDDISTANCE

Where the distance between a steady Yellow (approach) aspect and the following Red (stop) is under 1,500 meters, standard single-block braking is insufficient. The system triggers Cascading Aspects: the upstream signal, which would normally display a flashing yellow (advance_approach), is automatically downgraded to a steady yellow (approach). This expands the visual braking footprint across three consecutive blocks.

3. REDUCED BLOCK THRESHOLD (LENGTH < 2,400M) - CHECKED VIA .NEXTLENGTH

The 2,400-meter marker (1.5 miles) represents the safety limit for heavy tonnage trains running at full track speed. Because Train Director does not natively handle progressive mid-block deceleration profiles after passing a mast, this package introduces custom _short aspects. These aspects force an immediate point-of-passage speed restriction (speedLimit 30/50/60). This compromise maintains track speeds on standard blocks while safely tightening the flow over condensed layout geometries.

Train Director Code Limitation: If a signal script outputs a speed limit higher than the train's current actual velocity, Train Director will not automatically accelerate the train. Acceleration will only occur once a track speed override command (MAS) is explicitly fed to the line. Furthermore, Train Director uses a fixed deceleration constant for all rolling stock: a 2,500-meter heavy unit coal train stops at the exact same rate as a lightweight high-speed Amtrak passenger consist.

Signal Aspects

Icon Color Key (.xpm files):

- r → Red
- l → Lunar (Ice-white/Light Blue)
- g → Green
- y → Yellow
- b → Black (Blank lens color used to create flashing animations)
- f → Flashing light modifier (e.g., yf = Flashing Yellow)

ASPECT NOMENCLATURE.

The only intentional deviation from official Union Pacific rulebooks is the elimination of the generic term "Diverging". This documentation replaces it with exact speed definitions (Medium, Limited, Slow) for clarity within the simulator. While the prototype rulebook uses Diverging Approach to denote any turnout movement, it does not explicitly label the turnout speed. By renaming the aspect to medium_approach or slow_approach, the simulator operator receives an instantaneous, unambiguous indication of the exact speed limit enforced through the switch points.

HIGH MAST SIGNALS

1. ONE-HEAD HIGH SIGNALS

Primarily utilized as mainline intermediate automatic signals. On older territories, they can occasionally be found at the exit of controlled sidings leading onto the main track.

Aspect Name	Light Profile	Description
clear	g	Proceed at Maximum Authorized Speed. Intermediate use only.
approach	y	Route to next signal is clear; expect next signal at Stop. Max 50 km/h.
approach_short	y	Approach warning for a short block geometry. Max 25 km/h.
advance_approach	yf	Expect second signal ahead to be displaying a Stop indication. Line only.
advance_approach_short	yf	Used on intermediates protecting blocks < 2400m. Max 50 km/h.
restricting	l	Proceed at Restricted Speed / Shunting movement (15 km/h).
red	r	Stop. Absolute or Permissive depending on the presence of an MP plate.

Note: The steady y and flashing yf profiles are shared across different physical block configurations. In accordance with prototype operations, the engineer must know the specific line restrictions via the timetable or track profile sheets.

2. TWO-HEAD HIGH SIGNALS

Configurable as either Absolute Interlocking or Intermediate Automatic units.

Top Head Green or Yellow Main Route / Timetable Track Speed			
Aspect Name	Light Profile	Diverging	Description
clear	g-r	No	Proceed at Maximum Authorized Speed. Mainline/Intermediate only.
approach	y-r	No	Expect next signal at Stop. Enforces speedLimit 50.
approach_clear_sixty	y-gf	No	Expect next signal to display a clear diverging route at 60 km/h.
advance_approach	yf-r	No	Advance warning; second signal ahead is at Stop. Mainline only.

approach_vermillion	yf-y	No	Reduce speed for short block; shares graphics with approach_third.
advance_approach_medium	yf-g	No	Expect next signal to require Medium Speed (50 km/h).
double_approach	y-y	No	Expect next signal to display an Approach aspect on a short block.
approach_medium	y-g	No	Expect next signal to require a maximum speed of 50 km/h.
approach_slow	y-y	No	Expect next signal to require a maximum speed of 25 km/h.
approach_restricting	y-l	No	Expect next signal to display a Restricting aspect (Marcia a vista).
stop	r-r	—	Stop.

Top Head Red Diverging Routes at Medium Speed - 50 km/h			
Aspect Name	Light Profile	Diverging	Description
medium_clear	r-g	Yes	Proceed through turnout at 50 km/h, then resume track speed.
medium_approach	r-y	Yes	Proceed through turnout at 50 km/h, prepared to stop at next signal.
medium_approach_medium	r-gf	Yes	Proceed at 50 km/h; expect next signal to require max 50 km/h.
medium_advance_approach	r-yf	Yes	Proceed at 50 km/h; advance warning of a Stop signal two blocks away.

Top Head Red Diverging Routes at Slow Speed 25 km/h / Restricted Speed 15 km/h			
Aspect Name	Light Profile	Diverging	Description
slow_clear	r-g	Yes	Proceed through turnout at 25 km/h, then resume track speed.
slow_approach_medium	r-gf	Yes	Proceed at 25 km/h; expect next signal to display a Medium aspect.
slow_approach	r-y	Yes	Proceed at 25 km/h, prepared to stop at the next signal.
restricting	r-l	Yes/No	Proceed at Restricted Speed (15 km/h) into yards or occupied tracks.

3. THREE-HEAD HIGH SIGNALS

Configurable as Absolute Interlocking or Intermediate Automatic units.

Top Head Yellow or Green Main Route / Timetable Track Speed			
Aspect Name	Light Profile	Diverging	Description
clear	g-r-r	No	Proceed at Maximum Authorized Speed.
approach	y-r-r	No	Expect next signal at Stop. One block section ahead is clear.
approach_clear_sixty	y-gf-r	No	Expect next signal to require a maximum speed of 60 km/h.
advance_approach	yf-r-r	No	Advance warning; second signal ahead is at Stop (Two clear blocks).
approach_third	yf-y-r	No	Third advance warning before Stop (Three clear blocks).
approach_fourth	yf-g-r	No	Fourth advance warning before Stop; starts the braking chain (Four clear blocks).
approach_medium	y-g-r	No	Expect next signal to require a maximum speed of 50 km/h.
approach_slow	y-r-y	No	Expect next signal to require a maximum speed of 25 km/h.
approach_restricting	y-l-r	No	Expect next signal to require a Restricting aspect (15 km/h).

Top Head Red, Middle Head Green or Yellow Diverging Routes at Medium Speed - 50 km/h			
Aspect Name	Light Profile	Diverging	Description
medium_clear	r-g-r	Yes	Proceed through turnout at 50 km/h, then resume track speed.
medium_approach	r-y-r	Yes	Proceed at 50 km/h through turnout, prepared to stop at next signal.
medium_approach_medium	r-gf-r	Yes	Proceed at 50 km/h; expect next signal to require max 50 km/h.
medium_approach_slow	r-y-y	Yes	Proceed at 50 km/h; expect next signal to require max 25 km/h.

medium_advance_approach	r-yf-r	Yes	Proceed at 50 km/h; second signal ahead is at Stop.
medium_approach_slow_clear	r-y-g	Yes	Proceed at 50 km/h; next signal governs a clear Slow Speed turnout.

Top and Middle Heads Red Diverging Routes at Slow Speed 25 km/h / Restricted Speed 15 km/h			
Aspect Name	Light Profile	Diverging	Description
slow_clear	r-r-g	Yes	Proceed through turnout at 25 km/h, then resume track speed.
slow_approach	r-r-y	Yes	Proceed at 25 km/h, prepared to stop at next signal.
restricting	r-r-l	Yes/No	Proceed at Restricted Speed (15 km/h) into yards or occupied blocks.
stop	r-r-r	—	Stop. Absolute interlocking halt.

LOW MAST SIGNALS (DWARF SIGNALS)

The clear aspect is omitted from dwarf configurations as it is functionally obsolete on modern Union Pacific infrastructure.

1. ONE-LENS DWARF SIGNALS

Aspect Name	Light Profile	Description
app_restricting	yf	Proceed at Restricted Speed (15 km/h) through current block.
restricting	l	Proceed at Restricted Speed / Sight-restricted yard movement (15 km/h).
stop	r	Stop.

2. TWO-LENS DWARF SIGNALS

Aspect Name	Light Profile	Description
approach	y-r	Expect next signal at Stop.
app_restricting	r-y	Proceed at 15 km/h; expect upcoming signal to display a Restricting aspect.
restricting	r-l	Proceed at Restricted Speed / Sight-restricted yard movement (15 km/h).
stop	r-r	Stop.

Technical Specifications in Train Director

Icon Filename Syntax

All graphic .xpm icon assets observe a strict architectural naming convention:

[Signal_Type]-[Function]-[Colors]-[Orientation].xpm

- Signal Type: L1, L2, L3 denote 1, 2, or 3-head high masts; D1, D2 denote 1 or 2-lens Dwarf signals.
- Function: The inclusion of an i modifier (e.g., L2-i-...) designates an Intermediate signal, rendering the physical white MP number plate on the mast icon.
- Colors: Displays the vertical orientation of lens assets from top to bottom (e.g., rgy = Red top, Green middle, Yellow bottom).
- Orientation: Cardinal direction facing on the simulation screen (e = East, w = West, n = North, s = South).

TDS Signal Logic Files

One-Head Scripts	
up-L1.tds	Absolute high mast signal for yards, siding ends, and controlled junctions.
up-L1-int.tds	Intermediate automatic signal for mainline block spacing. Block territory must not contain turnouts. Must be placed with the "Intermediate signal" attribute enabled in TD.
up-L1-dist.tds	One-head distant signal for an interlocking signal leaving non-CTC territory.
up-D1.tds	Absolute single-lens Dwarf signal for stub tracks, engine houses, or yard tracks.

Two-Head Scripts

up-L2.tds	Absolute high mast signal protecting interlockings. It does not execute checks regarding block length and distance from the red signal.
up-L2-chd.tds	Absolute high mast signal protecting interlockings. It executes checks regarding block length and distance from the red signal.
up-L2-int.tds	Intermediate automatic mainline signal preceding a 2 or 3-head absolute signal. Block territory must not contain turnouts. Must be placed with the "Intermediate signal" attribute enabled.
up-L2-com.tds	High mast Group Signal positioned at yard exits to govern multiple tracks. Must be paired upstream with an auxiliary up-D2-com.tds per track.
up-L2-yard.tds	Absolute high mast signal dedicated to internal yard ladders. Suppresses mainline profiles, rendering only medium_clear, medium_approach, and restricting.
up-D2.tds	Absolute two-lens Dwarf signal for terminal environments. Parallels the complete aspect array of the up-L2 high mast script.
up-D2-com.tds	Absolute two-lens Dwarf signal positioned on individual tracks within a yard ladder, coded specifically to interlock with the up-L2-com.tds Group Signal.

Three-Head Scripts	
up-L3.tds	Absolute high mast signal protecting complex plant interlockings. Governs high-speed main tracks, crossovers, and complex medium/slow turnout matrices.
up-L3-int.tds	Intermediate automatic 3-head signal for high-speed corridors. Coded to handle deep braking profiles over 4 to 5 blocks (approach_fourth and approach_third). Must be placed with the "Intermediate signal" attribute enabled.

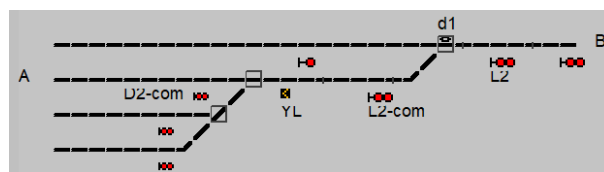
Auxiliary Scripts	
up-YL.tds	Yard Limit marker board. Must be placed as an intermediate signal. If a train approaches via a yard switching route, the route clears only up to this board. Mainline line routes pass it normally.
up-bumper.tds	End-of-track bumper stop block.

Group Signals (Signals Common to Multiple Tracks)

Train Director's core logic dictates that a single signal pointer can only process routes originating from a single track section. To simulate a Group Signal—a single high mast protecting an entire yard throat, clearing dynamically for whichever individual track initiates an exit route—this package deploys a logical cascading architecture inspired by Paolo Rosati's RFI 6.0 design.

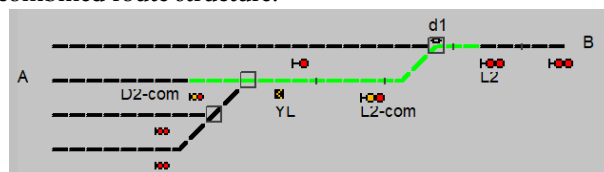
Example Track Layout:

- L2 (up-L2.tds): First automatic block signal on the mainline, located downstream of the yard convergence.
- L2-com (up-L2-com.tds): High mast Group Signal common to the entire yard throat.
- D2-com (up-D2-com.tds): Individual two-lens Dwarf signal assigned to a specific yard track.
- YL (up-YL.tds): Yard Limit board protecting the switching lead.
- d1: Mainline turnout connecting the yard lead to the Main Track.



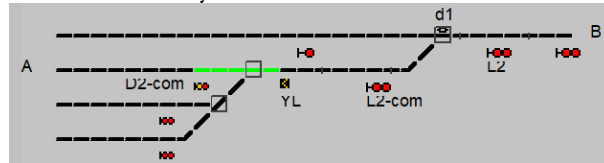
Interlocked Route Dynamics:

1. **Mainline Departure Route:** When a route is cleared from an individual yard track onto the mainline, the local Dwarf (D2-com) drops its stop aspect and simultaneously forces the shared Group Signal (L2-com) to display a clear departure aspect. This cascade executes only if the turnout d1 is physically reversed and locked for the main track. This interlocking path enforces safety limits all the way to mainline signal L2. Knocking down Dwarf D2-com to red instantly cancels the entire combined route structure.

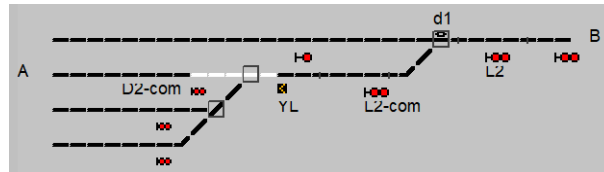


2. **Switching Route to Yard Lead:** If turnout d1 is normal (lined away from the main track) or the mainline is occupied, clearing Dwarf D2-com authorizes a local shunting movement restricted entirely to the switching lead, forcing the train to terminate its movement at the Yard Limit (YL) board.

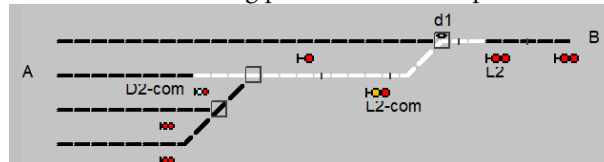
Layout Placement Rule: If the layout designer omits the YL board from the track design, this local shunting function is suppressed. The system reverts entirely to Rule 1, meaning the individual track Dwarf will refuse to clear unless a continuous mainline path is lined all the way to L2.



3. **Internal Shunting Movements:** Internal switching paths (e.g., sorting freight or running locomotives around a cut of cars) can be lined at any time, provided turnout d1 is set to its diverging position, isolating the switching operation from the Main Track.



4. **In the absence of a YL board,** this local switching path can be lined up to mainline signal L2.



Interdependent Script Mapping

These files function via interlocking dependencies and must always be deployed as an integrated pair, never in isolation.

- up-L2-com.tds: Shared interlocking Group Signal governing the yard exit. Contains the complete aspect profile of the standard up-L2.tds script.
- up-D2-com.tds: Local track Dwarf signal linked to the shared exit path. Contains the complete aspect profile of the standard up-D2.tds script.

Regulatory References

The logic frameworks and speed parameters implemented within these scripts have been extracted and adapted from the following official North American signaling rulebooks and technical resources:

- **UPRR - General Code of Operating Rules (GCOR):** The master operating rulebook governing GCOR practices, updated as of May 15, 2026. Available at: <https://www.up.com/ert/gcor.pdf>
- **UPRR - System Special Instructions (SSI):** The comprehensive compendium of specific Union Pacific operational amendments and local instructions, updated as of February 5, 2026. Available at: <https://www.up.com/ert/ssi.pdf>. For signal aspects and relative rules, see Item 19 in particular.

Additional Resources on North American Signaling:

- **The Signal Page** (<https://thesignalpage.nl/en/index.php>): A global repository containing documentation and visual schematics on railway signaling systems implemented worldwide.
- **Al Krug's Railroad Facts - Signals (Archived Database):** A highly detailed and comprehensive analytical breakdown explaining the operational meaning, physics, and philosophy behind US railroad signal indications. Available via the Wayback Machine at: <https://web.archive.org/web/20160313144451/http://alkrug.vcn.com/rrfacts/signals/signals.htm>