

Wavefront Phase Modifier [Surface, Output-Defined]

Digital Twin Specification Sheet | Version 1.0 | CF-WPMS02

Specification identity

Twin Code:	CF-WPMS02
Twin Name:	Wavefront Phase Modifier [Surface, Output-Defined]
Twin Family:	Wavefront Phase Modifier
Family Role:	Computes and applies a phase profile from a desired output phase on a curved surface
Category:	Component
Type:	Function-Based
Operation Type:	Mapped-pointwise wavefront phase modifier
Operator Domain:	Surface domain
Package:	Platform

1 Purpose

The **Wavefront Phase Modifier [Surface, Output-Defined]** combines the surface handling of the Surface, Profile-Defined variant with the output-defined concept of the Plane, Output-Defined variant.

The requested output wavefront phase is defined in the reference xy plane and internally propagated onto the selected WPM surface. There, the required wavefront phase profile is determined from the requested output wavefront phase and the incoming wavefront phase:

$$\Delta\psi^{\text{prf}}(u, v) = \psi^{\text{out}}(u, v) - \psi^{\text{in}}(u, v). \quad (1)$$

The resulting profile is then applied on the curved surface. This twin is useful when the target output wavefront is known but the required phase profile on a curved surface is not obvious.

2 Geometric Support

This twin is defined on a curved reference surface. The user selects the reference surface from the available surfaces in the optical setup. The requested output phase is defined in the reference plane and internally propagated onto the selected surface.

Model context: output propagation to surface

The requested output phase is defined in the reference plane and propagated onto the WPM surface with respect to the twin coordinate system. The local coordinate transformation is handled internally.

3 Supported Channels

This twin supports illumination from the front side only. The user selects either the transmission (T) or reflection (R) channel as the active output channel. The selected channel is the only generated output; the opposite channel is not generated. The requested output phase is defined for the selected channel.

4 Simulation Model

This is a function-based optical digital twin with an in-built design capability. It computes the required wavefront phase profile from the requested output wavefront phase and the incoming wavefront phase on the curved surface, then applies the computed profile.

The twin includes an aperture option: the user can select whether the component is used as *Single Function without Aperture* or *Single Function with Aperture*. The aperture is applied on the reference surface before the phase modification.

5 Parameters Where This Sheet Adds Guidance

The complete parameter documentation is available in the VirtualLab Fusion manual and from the twin via **Help**. This sheet only lists parameters for which additional modeling interpretation, usage guidance, or cross-twin selection advice is useful.

Requested Output Wavefront Phase

Role: Specifies the desired output wavefront phase ψ^{out} in the reference plane.

Spec-sheet insight: The component internally propagates the requested phase onto the selected surface and computes the required profile. Three input formats are available: Even Order Radial Polynomial, User-Defined Formula, and Data Based.

Reference Surface

Role: Selects the curved surface on which the phase is applied.

Spec-sheet insight: The user can load, edit, or view the selected surface. The requested output phase is propagated onto this surface.

Flip Output Phase Sign

Role: Inverts the sign of the specified output wavefront phase.

Spec-sheet insight: Use this to correct a wrong sign setting without redefining the desired output.

Selected Output Channel

Role: Selects the active output channel: Transmission or Reflection.

Spec-sheet insight: The requested output phase is defined for the selected channel. Only the selected channel is generated.

Consider Phase Effect Only

Role: Ignores amplitude and polarization effects from energy conservation.

Spec-sheet insight: Use this for studying the pure phase effect in isolation.

Display Wavefront Profile Data After Simulation

Role: Outputs the internally computed wavefront phase profile.

Spec-sheet insight: The displayed data shows the profile that was applied, not the requested output phase.

Aperture Size and Shape

Role: Defines the aperture truncation applied to the field before the phase modification.

Spec-sheet insight: The aperture is applied in the reference domain before the phase addition.

6 Recommended Usage

- Use this twin when the desired output wavefront is known and the phase profile must be applied on a curved surface.
- Use the *Even Order Radial Polynomial* format for rotationally symmetric output phases.
- Use the *Data Based* format for output phases from measurements or external simulations.
- Use the *Display Wavefront Profile Data After Simulation* option to verify the internally computed profile.
- Use the *Consider Phase Effect Only* flag for pure phase studies.

7 Related Twins

Related twins belong to the same function-based family or to closely neighboring function-based variants.

Related twin	Main distinction
Wavefront Phase Modifier [Surface, Profile-Defined]	Same surface geometry; profile is supplied directly.
Wavefront Phase Modifier [Plane, Profile-Defined]	Profile-defined concept on a plane.
Wavefront Phase Modifier [Plane, Output-Defined]	Output-defined concept on a plane.

8 Possible Replacement Twins

Replacement twins provide another modeling route for the same design intention.

Possible replacement twin	When it replaces this twin
Wavefront Phase Modifier [Surface, Profile-Defined]	Use when the required profile is already known and can be supplied directly.
Holographic Optical Element (HOE) Twin	Use when the phase profile should be realized by a diffractive structure on a curved substrate.
Refractive Surface Twin	Use when the phase profile should be realized by a curved refractive surface.

9 Further Reading

For complete software parameter documentation, see the VirtualLab Fusion manual, Sec. 69.9, *Wavefront Phase Modifier [Surface, Output-Defined]*.

For the theoretical foundations of the Wavefront Phase Modifier family see the white paper on [From Phase to Structure: A Two-Step Design Workflow with Wavefront Phase Modifier Twins](#) (LightTrans Document ID: WP-WPM-PUB).