



RAMTERA

TECHNICAL WHITE PAPER SERIES · PHYSICAL IMPLEMENTATION (PRE)

RAMTERA-WP19

Filler, Well-Tap, and End-Cap Insertion

Validated by exact free-area accounting and delete round-trips

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Physical Completion: Filler, Well-Tap, and End-Cap Insertion

Validated by Exact Area Accounting

Before stream-out, every row must be physically continuous: end caps terminate rows, well taps bound substrate resistance at a declared interval, and fillers close the remaining gaps. PRE implements the standard insertion commands with their documented option behavior, and validates runs by an accounting identity: inserted filler area must equal the free row span exactly.

245.00 μm^2 filler area — exact to the identity	125/125 instances legal after insertion	round-trip delete restores the pre-fill netlist	interval + checker tap placement modes
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Documented behaviors honored

Behavior	Detail
ordering	end caps after floorplan and before well taps, as the reference documentation specifies
tap search	a blocked tap position searches toward the previous tap first, then away; checkerboard mode offsets alternate rows by half the interval
preplaced status	taps and caps insert fixed
gap fitting	largest-fits-first, with an option that avoids leaving a sub-minimum sliver by stepping one size down
deletion	physical-only instances removed by prefix; net-connected cells are never touched, and netlist indices are remapped so timing keeps running

The accounting identity

On the reference row of 180 μm : placed logic occupies 2.2 μm , end caps 0.8 μm , taps 2.0 μm , leaving 175 μm of free span. At 1.4 μm row height that is 245.0 μm^2 — and the insertion report states 245.00 μm^2 across 114 filler instances. The placement checker then confirms 125 of 125 instances legal with zero out-of-core. Deleting by prefix removes exactly the 114, a second delete removes the remaining 7 physical cells, and a timing run afterwards still times every net — the index remap is part of the validated contract.

SERIES CROSS-REFERENCE — Physical-only cells appear in the stream-out as ordinary structure references, so the GDS validation of the companion paper (WP-17) covers them with no special casing.

About Ramtera

Ramtera Inc. (Delaware, USA), with R&D at Ramtera Design Automation India Pvt Ltd (Bangalore), builds electronic design automation software for physical verification and physical implementation. LVR is Ramtera's physical verification engine (DRC, LVS, ERC, XOR, parasitic extraction); PRE is Ramtera's physical implementation environment (floorplanning, placement, clock tree synthesis, routing, timing analysis and optimization), built on industry-standard command conventions so existing flow scripts and operator skills transfer directly. The company holds granted patents and registered copyrights covering its engines.

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This document reports measurements from Ramtera's engineering environment (Ubuntu 24.04, GCC 13.3, Tcl 8.6) unless stated otherwise. Product behavior and figures are subject to change; no compatibility, certification, or endorsement by any third party is stated or implied.