This paper attempts to develop a new automated multipoint model-order reduction (MOR) technique, based on matching moments of the system input-output function, which would be suited for fast and accurate computation of scattering parameters for electromagnetic (EM) systems over a wide frequency band. To this end, two questions are addressed. Firstly, the cost of the wideband reduced model generation is optimized by automating a greedy multipoint MOR scheme. This is achieved by introducing a new dual local-global model convergence scheme, which applies fast and reliable a posteriori error estimates to check both local model convergence, used to select the number of moments at a single expansion point, and global model convergence, used to optimally select the expansion points. Secondly, the question of optimal convergence measure is addressed by proposing an enhanced a posteriori error estimator particularly suited for scattering parameter computations for lossy EM systems. The effectiveness and efficiency of the proposed automated scheme is verified through numerical simulations using reduced-order models for examples of a bandstop dielectric resonator filter and a dielectric resonator antenna for a wide frequency band, and compared against the results obtained using the full-order model, a reduced model generated with the optimal greedy point selection algorithm, as well as the reduced-order models obtained using the reduced basis method (RBM) and the single-point second-order Arnoldi method for passive order reduction (SAPOR) method.