Supplementary Tables S1–S4 list the state variables and kinetic parameters of each model used in this study, together with a brief description and units for each symbol. Rate constants are reported in s^{-1}, bimolecular (binding and hybridization) rate constants in $nM^{-1}{\cdot}s^{-1}$, and concentrations in nM; the Hill coefficient is dimensionless. GFP fluorescence is the measured output in each model.

Table S1. State variables and kinetic parameters of the toehold-switch AND-gate model (Equation (1)).

Symbol	Description	Units
State variables		
T_a	Trigger RNA a	nM
T_b	Trigger RNA b	nM
T_{act}	Active trigger complex formed from Ta and Tb	nM
Tgt	Target RNA	nM
Tgt_{act}	Activated target RNA	nM
M_i	Translation intermediate	nM
G	GFP (measured output)	nM
Kinetic parameters		
α	Transcription rate of each RNA species from its template	s^{-1}
δ_{Ta}	Degradation rate of trigger RNA a	s^{-1}
δ_{Tb}	Degradation rate of trigger RNA b	s^{-1}
δ_{Tgt}	Degradation rate of target RNA	s^{-1}
δ_{Tgtact}	Degradation rate of activated target RNA	s^{-1}
δ_G	Degradation rate of GFP	s^{-1}
β_T	Hybridization rate forming Tact from Ta and Tb	$nM^{-1}\ s^{-1}$
v	Dissociation rate of Tact	s^{-1}
β_{basal}	Basal opening rate of the target RNA hairpin	s^{-1}
β_{Ta}	Trigger-a-dependent opening rate of the target hairpin	s^{-1}
β_{Tb}	Trigger-b-dependent opening rate of the target hairpin	s^{-1}
β_{Tact}	Active-complex-dependent opening rate of the target hairpin	s^{-1}
K_i	Forward rate of translation-intermediate formation	s^{-1}
K_e	Reverse rate of translation-intermediate formation	s^{-1}
K_{TL}	GFP translation rate	s^{-1}
K_a	Half-maximal constant for trigger a in the Hill function	nM
K_b	Half-maximal constant for trigger b in the Hill function	nM
K_{act}	Half-maximal constant for the active complex in the Hill function	nM
n	Hill coefficient	dimensionless
Fixed inputs (supplied as known conditions)		
C_{Ta}	Template concentration for trigger a	nM
C_{Tb}	Template concentration for trigger b	nM
C_{Tgt}	Template concentration for the target RNA	nM

Table S2. State variables and kinetic parameters of the CRISPRi model (Equation (2)).

Symbol	Description	Units
State variables		
crRNA	CRISPR RNA	nM
tracrRNA	Trans-activating CRISPR RNA	nM
gRNA	Guide RNA formed from crRNA and tracrRNA	nM
dCas9	Catalytically inactive Cas9 protein	nM
Complex	gRNA–dCas9 repression complex	nM
P_y	Free target promoter	nM
P_y^-	Target promoter occupied by the repression complex	nM
M	Target mRNA	nM
M_i	Translation intermediate	nM
G	Immature GFP	nM
G_m	Mature GFP (measured output)	nM
Kinetic parameters		
α_{cr}	Transcription rate of crRNA	s^{-1}
α_{tr}	Transcription rate of tracrRNA	s^{-1}
α_m	Transcription rate of target mRNA	s^{-1}
δ_{cr}	Degradation rate of crRNA	s^{-1}
δ_{tr}	Degradation rate of tracrRNA	s^{-1}
δ_g	Degradation rate of guide RNA	s^{-1}
δ_m	Degradation rate of target mRNA	s^{-1}
γ_1	crRNA–tracrRNA hybridization rate	$nM^{-1}\ s^{-1}$
γ_2	gRNA–dCas9 complex-formation rate	$nM^{-1}\ s^{-1}$
ω	Promoter-binding rate of the repression complex	$nM^{-1}\ s^{-1}$
K_i	Forward rate of translation-intermediate formation	s^{-1}
K_e	Reverse rate of translation-intermediate formation	s^{-1}
α_{gm}	GFP maturation rate (G to Gm)	s^{-1}
Fixed inputs (supplied as known conditions)		
P_{cr}	Template concentration for crRNA	nM
P_{tr}	Template concentration for tracrRNA	nM
P_y^{tot}	Total target promoter concentration	nM

Table S3. State variables and kinetic parameters of the original STAR model (Equation (3)).

Symbol	Description	Units
State variables		
$STAR$	STAR RNA	nM
M	Target mRNA	nM
M_i	Translation intermediate	nM
G	Immature GFP	nM
G_m	Mature GFP (measured output)	nM
Kinetic parameters		
α_S	Transcription rate of STAR RNA	s^{-1}
δ_S	Degradation rate of STAR RNA	s^{-1}
β_S	STAR-dependent activation (binding) rate of the target template	$nM^{-1}\ s^{-1}$
α_m	Transcription rate of target mRNA after STAR activation	s^{-1}
δ_m	Degradation rate of target mRNA	s^{-1}
K_i	Forward rate of translation-intermediate formation	s^{-1}
K_e	Reverse rate of translation-intermediate formation	s^{-1}
α_{gm}	GFP maturation rate (G to Gm)	s^{-1}
Fixed inputs (supplied as known conditions)		
P_S	STAR template concentration	nM
P_Y	Target template concentration	nM

Table S4. State variables and kinetic parameters of the reduced STAR model (Equation (4)).

Symbol	Description	Units
State variables		
$STAR$	Effective STAR RNA/expression state	nM
M	Target mRNA	nM
G_m	Mature GFP (measured output)	nM
Kinetic parameters		
α	Effective transcription/output rate	s^{-1}
β_S	STAR–target binding rate	$nM^{-1}\ s^{-1}$
δ	Common RNA degradation rate	s^{-1}
δ_G	GFP degradation rate	s^{-1}
Fixed inputs (supplied as known conditions)		
P_S	STAR template concentration	nM
P_Y	Target template concentration	nM