# Cytosolic calcium dynamics

## L-type Ca current (ICa & ICaK)[[1]](#footnote-20)

Common pool of subspace calcium model

| Parameter | Value | Units | Description |
| --- | --- | --- | --- |
|  |  |  | Mode transition parameter |
|  |  |  | Mode transition parameter |
|  |  | Hz | Mode transition parameter |
|  |  | Hz | Transition rate into open state |
|  |  | Hz | Transition rate into open state |
|  |  | Hz | Transition rate into open state |
|  |  | Hz | Transition rate into open state |
|  |  |  | L-type Ca2+ channel permeability to Ca2+ |
|  |  |  | L-type Ca2+ channel permeability to K+ |
|  |  |  | ICa level that reduces equation Pk by half |

## Ryanodine receptor (calcium release, Jrel)[[2]](#footnote-23)

With optimization from Plank et al. (2008)

| Parameter | Value | Units | Description |
| --- | --- | --- | --- |
|  |  | Hz | RyR flux channel constant |
|  |  |  | Cooperativity parameter |
|  |  |  | Cooperativity parameter |
|  | $1.215 ^{13} $ |  | RyR rate constant |
|  |  |  | RyR rate constant |
|  | $4.05 ^{6} $ |  | RyR rate constant |
|  |  |  | RyR rate constant |
|  |  |  | RyR rate constant |
|  |  |  | RyR rate constant |

## Plama membrane calcium ATPase (PMCA) current (IpCa)[[3]](#footnote-25)

Modified rate expression incorporating the ATP-dependence of pump activity. Plama membrane calcium ATPase (PMCA) rate exhibits two different K0.5 values for ATP

| Parameter | Value | Units | Description |
| --- | --- | --- | --- |
|  |  |  | Maximum sarcolemmal Ca2+ pump current |
|  |  |  | Ca2+ half-saturation constant for sarcolemmal Ca2+ pump |
|  |  |  | First ATP half-saturation constant for sarcolemmal Ca2+ pump |
|  |  |  | Second ATP half-saturation constant for sarcolemmal Ca2+ pump |
|  |  |  | ADP inhibition constant for sarcolemmal Ca2+ pump |

## SERCA calcium pump (Jup)[[4]](#footnote-27)

Michaelis-Menten dependence of enzyme activity with respect to ATP and mixed-type inhibition of the enzyme by ADP.

Reversible during diastole (low cytoplasmic calcium).

| Parameter | Value | Units | Description |
| --- | --- | --- | --- |
|  |  |  | SERCA forward rate parameter |
|  |  |  | SERCA reverse rate parameter |
|  |  |  | Forward Ca2+ half-saturation constant of SERCA |
|  |  |  | Reverse Ca2+ half-saturation constant of SERCA |
|  |  |  | Forward cooperativity constant of SERCA |
|  |  |  | Reverse cooperativity constant of SERCA |
|  |  |  | ATP half-saturation constant for SERCA |
|  |  |  | ADP first inhibition constant for SERCA |
|  |  |  | ADP second inhibition constant for SERCA |

## Ca2+ transport and buffering parameters

| Symbol | Value | Units | Description |
| --- | --- | --- | --- |
|  |  | Hz | Time constant for transfer from subspace to myoplasm |
|  |  | Hz | Time constant for transfer from NSR to JSR |
|  |  |  | Ca2+ half saturation constant for calmodulin |
|  |  |  | Ca2+ half saturation constant for calsequestrin |
|  |  |  | Ca2+ on-rate for troponin high-affinity sites |
|  |  |  | Ca2+ off-rate for troponin high-affinity sites |
|  |  |  | Ca2+ on-rate for troponin low-affinity sites |
|  |  |  | Ca2+ off-rate for troponin low-affinity sites |
|  |  |  | Total troponin high-affinity sites |
|  |  |  | Total troponin low-affinity sites |
|  |  |  | Total myoplasmic calmodulin concentration |
|  |  |  | Total NSR calsequestrin concentration |

## ODE for cytosolic calcium

1. Cortassa S, Aon MA, O’Rourke B, et al. A computational model integrating electrophysiology, contraction, and mitochondrial bioenergetics in the ventricular myocyte. Biophys J. 2006;91(4):1564-89. [PMC1518641](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1518641/) [↑](#footnote-ref-20)
2. Cortassa S, Aon MA, O’Rourke B, et al. A computational model integrating electrophysiology, contraction, and mitochondrial bioenergetics in the ventricular myocyte. Biophys J. 2006;91(4):1564-89. [PMC1518641](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1518641/) [↑](#footnote-ref-23)
3. Cortassa S, Aon MA, O’Rourke B, et al. A computational model integrating electrophysiology, contraction, and mitochondrial bioenergetics in the ventricular myocyte. Biophys J. 2006;91(4):1564-89. [PMC1518641](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1518641/) [↑](#footnote-ref-25)
4. Cortassa S, Aon MA, O’Rourke B, et al. A computational model integrating electrophysiology, contraction, and mitochondrial bioenergetics in the ventricular myocyte. Biophys J. 2006;91(4):1564-89. [PMC1518641](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1518641/) [↑](#footnote-ref-27)