

# SLA SLR Purchase Explanation

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what is purchase of SLA and SLR?

In the Toyota brake actuator, **SLA** and **SLR** are the two **linear proportional solenoid valves** that meter hydraulic pressure. They are not simple ON/OFF valves; instead, the skid control ECU drives them with varying current to precisely regulate brake pressure.

From the Toyota brake system description:

- **SLA = Linear Solenoid Valve A**
- **SLR = Linear Solenoid Valve R**

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## What each valve does

The documentation does not explicitly expand the letters "A" and "R," but their function becomes clear from the hydraulic operation tables.

### SLA – Pressure Supply (Increase) Valve

SLA controls the flow of **high-pressure brake fluid from the accumulator toward the wheel cylinders**.

When the ECU wants **more braking force**:

- SLA opens proportionally (half-open or more)
- SLR remains closed
- Accumulator pressure flows into the brake circuit
- Wheel cylinder pressure rises

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Think of SLA as the "**apply**" valve.

### SLR – Pressure Release (Reduction) Valve

SLR controls the path that **bleeds hydraulic pressure away** from the wheel cylinders.

When the ECU wants **less braking force**:

- SLA closes
- SLR opens proportionally

- Hydraulic pressure is relieved
- Wheel cylinder pressure decreases

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Think of SLR as the "**release**" valve.

## During normal braking

Toyota continuously modulates both valves:

Desired action	SLA	SLR
Increase brake pressure	Open (proportional)	Closed
Hold pressure	Partially open	Closed
Reduce pressure	Closed	Open (proportional)

These operating modes are shown in the Normal Braking Increase, Holding, and Reduction tables.

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## Why Toyota uses linear valves

Older ABS systems generally use only ON/OFF inlet and outlet valves, rapidly cycling them to approximate the desired pressure.

The Prius brake-by-wire system instead uses **linear proportional valves**, allowing the ECU to:

- smoothly blend **regenerative braking** with hydraulic braking,
- precisely control wheel cylinder pressure,
- reduce pedal pulsation,
- provide seamless transitions during ABS, VSC, TRAC, Brake Assist, Hill-Start Assist, and regenerative braking.

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## Simple analogy

Imagine two electronically controlled faucets:

- **SLA** = faucet that lets pressurized brake fluid **into** the brake circuit.
- **SLR** = faucet that lets brake fluid **out** of the brake circuit.

The ECU constantly adjusts how far each "faucet" is opened to achieve the exact wheel cylinder pressure required.

So although Toyota doesn't officially define the abbreviations in the manual, functionally you can think of them as:

- **SLA:** Apply/Supply linear solenoid valve (pressure increase)
- **SLR:** Release/Return linear solenoid valve (pressure reduction)

These two proportional valves are the primary components that enable the Prius' brake-by-wire system to produce smooth, continuously variable hydraulic brake pressure.

what is purpose of SMC solenoid

The **SMC (Switching Solenoid Valve SMC)** is one of the four switching valves in the Prius brake actuator. Its purpose is **not to modulate pressure** (that's what SLA and SLR do), but rather to **change which hydraulic circuits are connected**.

From the hydraulic diagram, the four switching valves are:

- **SSC**
- **SCC**
- **SMC**
- **SRC**

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## What SMC does

SMC is the **master cylinder switching valve**. Its primary job is to either:

1. **Isolate the master cylinder from the wheel circuits** during normal brake-by-wire operation, or
2. **Reconnect the master cylinder directly to the wheel cylinders** if the electronic brake actuator or hydraulic pressure supply fails.

Think of it as a **routing valve**, not a pressure-control valve.

## During normal operation

The Toyota manual specifies:

Valve	State
SSC	Open
SCC	Open
<b>SMC</b>	<b>Closed</b>
SRC	Closed

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With **SMC closed**:

- Your brake pedal does **not** directly pressurize the wheel cylinders.
- The master cylinder pressure is measured by sensors.
- The ECU decides how much braking is needed.
- SLA and SLR generate the required wheel pressure using the accumulator.

This is what allows:

- regenerative braking,
- brake blending,
- ABS,
- VSC,
- traction control.

## During fail-safe

If the brake actuator loses pressure or electronics fail, Toyota changes the valve states:

- SSC closes
- SCC closes
- **SMC opens**
- SRC opens

This reconnects the hydraulic booster/master cylinder directly to the brakes.

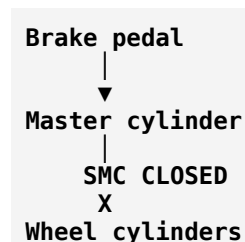
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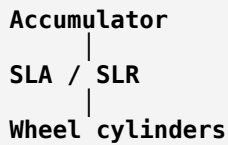
Now the driver can stop the vehicle mechanically even without electronic pressure control.

## Hydraulic analogy

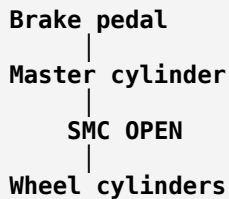
Imagine a railroad switch.

Normally:





In fail-safe:



SMC simply changes which path is active.

## Why Toyota needs SMC

Without SMC, every pedal movement would immediately send hydraulic pressure to the wheels. That would make it impossible for the ECU to:

- blend regenerative and friction braking,
- independently control wheel pressure for ABS/VSC,
- generate braking without pedal input (e.g., Pre-Collision System or Dynamic Radar Cruise Control).

By keeping SMC **closed** during normal operation, the ECU has complete authority over wheel cylinder pressure. Opening SMC only during failures provides a mechanical backup.

So, in summary:

- **SLA/SLR**: continuously meter hydraulic pressure (proportional control).
- **SMC**: switches the hydraulic source between **brake-by-wire control** and **direct mechanical braking** (fail-safe routing).

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what is purpose of SCC solenoid

The **SCC (Switching Solenoid Valve SCC)** is another routing valve in the Prius brake actuator, but unlike **SMC**, it is on the **wheel-cylinder side** of the hydraulic circuit.

Its purpose is to **connect or isolate the brake actuator from the wheel cylinders**.

## During normal brake-by-wire operation

CarShield

Ad

Toyota specifies:

Valve	State
SSC	Open
<b>SCC</b>	Open
SMC	Closed
SRC	Closed

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With **SCC open**:

- The brake actuator (controlled by SLA and SLR) has access to the wheel cylinders.
- The ECU can precisely increase, hold, or reduce wheel pressure.
- Regenerative braking, ABS, VSC, TRAC, and brake blending all function normally.

## During fail-safe operation

When the brake actuator or hydraulic pressure source fails, Toyota changes the switching valves:

Valve	State
SSC	Closed
<b>SCC</b>	Closed
SMC	Open
SRC	Open

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Closing **SCC** disconnects the brake actuator from the wheel cylinders.

At the same time:

- SMC opens.
- SRC opens.
- The driver's pedal pressure is routed directly to the brakes.

This prevents a failed actuator from interfering with braking.

## Why SCC is needed

Think of the hydraulic system as having **two possible pressure sources**:

1. **Brake actuator** (accumulator + SLA/SLR)
2. **Driver's master cylinder**

SCC acts like a gate between the **actuator** and the **wheel cylinders**.

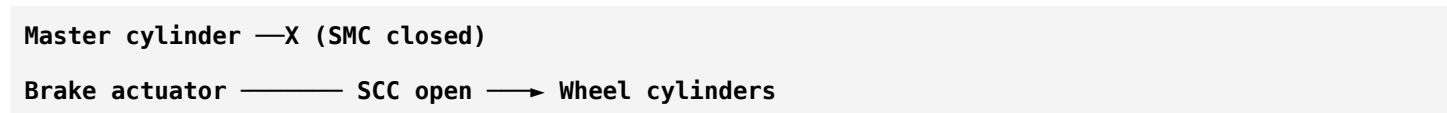
- **SCC open**: actuator controls the brakes.
- **SCC closed**: actuator is isolated from the brakes.

## Relationship between SMC and SCC

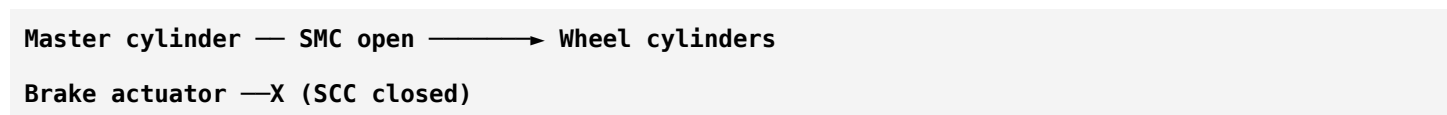
These two valves work together during mode switching:

Valve	Function
SMC	Connects/disconnects the master cylinder.
SCC	Connects/disconnects the brake actuator.

During normal operation:



During fail-safe:



## SSC vs. SCC

The names are similar, but they serve different hydraulic paths:

- **SSC** switches the connection on the **booster/pressure source side** of the actuator.
- **SCC** switches the connection on the **wheel-cylinder (control) side** of the actuator.

Together with **SMC** and **SRV**, these four switching valves reconfigure the hydraulic plumbing so the Prius can seamlessly switch between:

- brake-by-wire operation,
- regenerative brake blending,
- ABS/VSC/TRAC control,
- and direct hydraulic braking in fail-safe mode.

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what is wrong here?

Looking at this Techstream capture, the most suspicious thing is **not** the SLA/SLR currents. Those are behaving normally. The abnormal behavior is in the **switching solenoids**.

Here's what I see:

Solenoid	Expected during normal driving	Your graph
SLA	Modulates as needed	✓ Looks normal
SLR	Modulates as needed	✓ Looks normal
SSC	Should stay energized (~0.4 A)	✓ Mostly normal
SCC	Should stay energized (~0.6 A)	✓ Mostly normal
<b>SMC</b>	Should remain <b>0 A (closed)</b> during normal brake-by-wire	<b>Repeatedly goes to ~0.8 A</b>
<b>SRC</b>	Should remain <b>0 A (closed)</b> during normal brake-by-wire	<b>Repeatedly goes to ~0.4 A</b>

According to Toyota's hydraulic logic, during normal braking:

- SSC = ON
- SCC = ON
- **SMC = OFF**
- **SRC = OFF**

Only in fail-safe or certain special hydraulic transitions are SMC and SRC energized.

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## What concerns me

Notice the blue (SMC) and green (SRC) traces.

They switch ON for several seconds at approximately:

- 28–35 s
- 59–77 s
- 84–90 s

They switch together.

That means the ECU is deliberately changing hydraulic routing.

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## Possible explanations

### 1. Brake system entering backup hydraulic mode (most concerning)

If the ECU is losing confidence in:

- accumulator pressure,
- brake actuator,
- pressure sensors,
- or another brake component,

it can briefly switch to mechanical hydraulic routing.

This is the first thing I'd investigate.

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### 2. ECU performing self-check (possible)

If this log was taken:

- immediately after READY,
- while stopped,
- or shortly after startup,

Toyota sometimes exercises the switching valves.

However, your log spans almost **100 seconds** while driving at several mph, so repeated switching is less likely to be just self-test.

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### 3. Low accumulator pressure

Your accumulator voltage sits around **3.3–3.5 V** and varies normally.

I don't see obvious evidence of pressure collapse.

The pump also doesn't appear to be running excessively.

So this is **less likely**.

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### 4. Intermittent actuator problem

This is the one I'd suspect if you have symptoms like:

- brake buzz
- inconsistent pedal feel
- C1252
- C1253
- C1256
- C1391
- C1345

The ECU may be temporarily rerouting hydraulics.

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## What I would check next

1. **Any DTCs?** (Even history codes.)
  2. **Brake warning lights?**
  3. **Does the pump run frequently?**
  4. **Accumulator pressure target vs. actual**
  5. **Master cylinder pressure sensor**
  6. **Wheel cylinder pressures (if your Techstream version can display them)**
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## One thing I would like to know

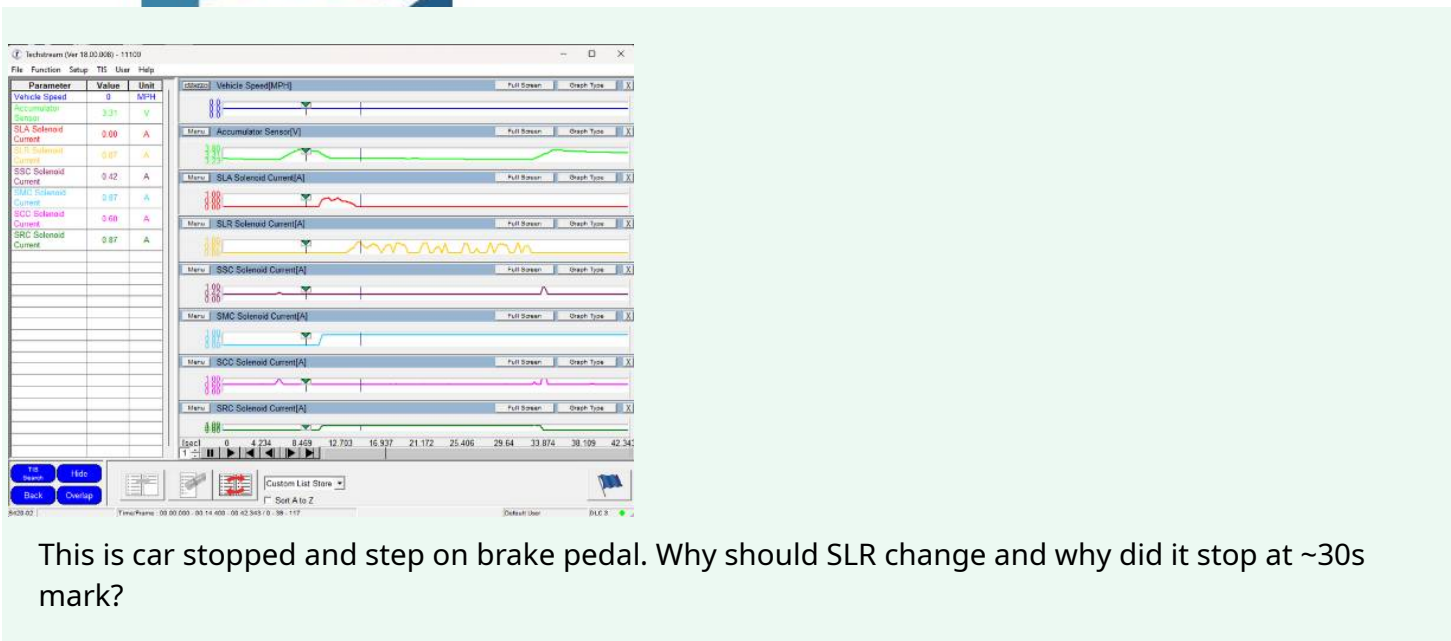
What problem are you diagnosing?

For example:

- C1391?
- Frequent pump cycling?
- Internal accumulator leak?
- Brake actuator replacement?
- Just investigating normal operation?

That context changes whether the SMC/SRC switching is expected or indicates a fault.

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This is car stopped and step on brake pedal. Why should SLR change and why did it stop at ~30s mark?

Toyota unfortunately **never officially expands "SRC"** in the New Car Features or Repair Manual. They simply call it **"Switching Solenoid Valve SRC."**

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However, from the hydraulic diagrams and fail-safe operation, its function is fairly clear.

### Most likely meaning

Although Toyota does not define the acronym, engineers generally interpret it as:

- **SR = Rear circuit (or Secondary circuit)**
- **C = Cutover (Switching) valve**

or simply:

- **Switching Rear Circuit**

The important point is its **function**, not the letters.

## What SRC actually does

SRC is the companion valve to SMC.

During normal brake-by-wire operation:

- SRC is in its normal hydraulic position.
- The rear/master-cylinder hydraulic path is isolated.
- The ECU controls braking using the accumulator and the linear valves.

During fail-safe:

- **SRC changes state**
- **SMC changes state**
- The hydraulic booster/master cylinder is connected directly to the brakes.

Toyota describes this in the fail-safe section:

When the brake actuator stops, SSC and SCC close, while **SMC and SRC open**, allowing brake pressure generated by the driver's pedal to be supplied directly to the wheel cylinders.

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## Relationship between the four switching valves

A useful way to think about them is:

Valve	Purpose
SSC	Connects/disconnects one hydraulic supply path
SCC	Connects/disconnects actuator output to wheel cylinders
SMC	Connects/disconnects the master cylinder
SRC	Connects/disconnects the return/rear hydraulic path during mode changes

## One interesting observation from your Techstream logs

Your data consistently shows:

- SSC  $\approx$  0.42 A

- $SCC \approx 0.60 \text{ A}$
- **SRC  $\approx 0.87 \text{ A}$  for long periods**
- **SMC  $\approx 0.87 \text{ A}$  at the same time**

The fact that **SMC and SRC always move together** strongly suggests they operate as a pair to switch the hydraulic plumbing between two configurations.

This matches Toyota's fail-safe descriptions: SMC and SRC are always commanded together in the operating tables.

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If you're trying to reverse-engineer the Gen 3 Prius brake actuator, I can also draw the internal hydraulic circuit showing exactly where **SSC, SCC, SMC, SRC, SLA, and SLR** are located relative to the accumulator, master cylinder, and wheel cylinders. That makes the role of each valve much easier to understand than the Toyota manual alone.

Catch the bugs that matter

Find critical issues across files, not just the diff. Bugs, rule violations, and req gaps vs ticket.

what do you think ECB Solenoid stands for?

That's a good question. Toyota's naming is unfortunately inconsistent, and many abbreviations are never officially expanded. We can, however, make an educated guess from Toyota's terminology and the valve's role.

## What "ECB" almost certainly means

In Toyota documentation, **ECB** stands for:

### **Electronically Controlled Brake**

This is Toyota's official name for the brake-by-wire system used on the Prius and several Lexus hybrids.

So **ECB Solenoid** almost certainly means:

### **Electronically Controlled Brake Solenoid**

or more specifically,

### **Electronically Controlled Brake Control Solenoid**

depending on the document.

## Why I think that's correct

Toyota divides the actuator valves into two groups:

### Switching solenoids

- SSC
- SCC
- SMC
- SRC

### Linear solenoids

- SLA
- SLR

Then there are the individual wheel valves:

- FLH, FRH, RLH, RRH (Pressure Holding)
- FLR, FRR, RLR, RRR (Pressure Reduction)

In some repair manuals and DTC descriptions, Toyota refers to the **entire hydraulic control assembly** as the **ECB Solenoid** because these valves collectively make up the Electronically Controlled Brake hydraulic unit.

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## If you mean the Techstream Active Test

Some Techstream versions have Active Tests like:

- ECB Motor
- ECB Solenoid
- Linear Valve Offset Learning

In that context, **ECB Solenoid** usually means **commanding the hydraulic valve assembly**, not one specific valve. It energizes a predefined combination of valves so the ECU can perform:

- bleeding,
  - initialization,
  - offset learning,
  - or diagnostics.
- 

## One interesting observation

From your earlier Techstream graphs, the ECU appears to control:

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- 2 proportional valves (SLA, SLR),
- 4 switching valves (SSC, SCC, SMC, SRC),
- 8 wheel valves (FLH, FRH, RLH, RRH, FLR, FRR, RLR, RRR).

That's **14 hydraulic solenoids** in the actuator. Toyota may refer to this entire collection as the **ECB solenoid assembly**, even though the individual valves have their own names.

If you have a specific Toyota manual or Techstream screen that says "**ECB Solenoid**", I can probably determine exactly which valve or valve group it refers to based on the context.

Stop for a second

Find the valve you need at [mscdirect.com](https://mscdirect.com)

problem symptom is clicking sound that can be felt on all 4 brake caliper lines with foot on brake and stopped. Does not occur if in reverse.

That symptom is actually a **very important clue**, and it changes what I would suspect.

The key observations are:

- ✓ Vehicle stopped.
- ✓ Foot held steadily on the brake.
- ✓ A distinct **click** is felt in **all four brake lines** (or calipers).
- ✓ It **does not happen in Reverse**.
- ✓ Your Techstream graphs show **SLR actively modulating** while this occurs.

## Why all four brake lines click

Because you can feel the click at **every caliper**, the source is almost certainly **upstream in the brake actuator**, not at an individual wheel valve.

A pressure pulse generated inside the actuator propagates through all four brake circuits, so every brake hose or caliper can transmit the same mechanical impulse.

That largely rules out:

- a sticking FLH/FRH/RLH/RRH valve,
- an individual caliper,
- a single pressure reduction valve.

It points toward one of the common hydraulic elements:

- SLA
  - SLR
  - hydraulic booster spool valve
  - accumulator pressure regulation
  - ECU pressure-control logic
- 

## Why only in Drive?

This is the strongest clue.

The biggest difference between **Drive** and **Reverse** on a Gen 3 Prius is **regenerative brake blending**.

In Drive:

- The ECU expects MG2 to provide regenerative torque (even at very low speeds, until nearly stopped).
- The skid ECU continuously adjusts hydraulic pressure to blend with the changing regenerative contribution.

In Reverse:

- Regenerative braking is greatly reduced or absent (depending on speed and operating conditions).
- Hydraulic braking strategy is different.
- Brake blending is much simpler.

So if the clicking disappears in Reverse, it strongly suggests the ECU is oscillating between hydraulic pressure targets associated with regenerative brake coordination.

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## Your SLR graph fits this

Earlier you showed:

- SLA active briefly
- SLR continuously PWMing
- then stopping after about 30 s

That is exactly the valve that **reduces** hydraulic pressure.

If SLR is repeatedly opening and closing, you'll feel pressure pulses throughout the hydraulic system.

The question is:

## Why is the ECU repeatedly commanding SLR?

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### Possible causes (ranked)

#### 1. Linear valve offset out of calibration ★★★★★

This is my leading hypothesis.

Toyota's ECB system depends on precise calibration of the proportional valves.

If the linear valve offset is incorrect, the ECU may overshoot pressure slightly, then use SLR to bleed it off, repeating the cycle.

This is why Toyota requires **Linear Valve Offset Learning** after:

- actuator replacement,
- ECU replacement,
- some repairs,
- certain DTCs.

If the offset has drifted, you can get exactly this sort of pressure hunting.

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#### 2. Internal leakage in the actuator ★★★★★

If an internal seal leaks,

the ECU sees:

```
pressure ↓  
add pressure  
pressure ↑  
too much  
bleed pressure  
pressure ↓  
repeat
```

That produces a rhythmic clicking.

The fact that it affects all four wheels supports this possibility.

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#### 3. Master cylinder pressure sensor noise ★★★★★

If the sensor signal jitters,  
the ECU continually changes its pressure target.  
SLR follows.

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#### 4. Booster spool valve instability ★★★

The hydraulic booster itself contains a spool valve and regulator piston. If that spool is sticking slightly, the ECU can chase pressure without ever settling. Toyota describes the spool valve as the component that meters booster pressure in response to pedal force.

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#### 5. Accumulator pressure oscillation ★★

Your accumulator voltage looked fairly stable.  
I don't think this is the primary issue.

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## A few tests I'd suggest

### Test 1 (most valuable)

Record these simultaneously while reproducing the click:

- Master Cylinder Pressure
- Front Wheel Cylinder Pressure (if available)
- Rear Wheel Cylinder Pressure (if available)
- SLA Current
- SLR Current
- Accumulator Sensor

If each click coincides with an SLR pulse and a small wheel-pressure drop, you've confirmed the ECU is intentionally releasing pressure.

### Test 2

With the car in **READY**, stopped, foot firmly on the brake:

- Shift between **D** and **R** without changing pedal force.

If the clicking starts in D and immediately stops in R, that's a very strong indication it's tied to the Drive brake-control strategy rather than a purely mechanical issue.

## Test 3

Perform (or verify) **Linear Valve Offset Learning** with Techstream if it hasn't been done recently. It's a relatively low-cost diagnostic step compared with replacing the actuator.

## One question

Is the clicking:

- **perfectly periodic** (for example, once every second),
- **random**, or
- **synchronized with the SLR current pulses** you see in Techstream?

If you can correlate the timing of the audible/physical click with the SLR trace, that would significantly narrow down whether the ECU is commanding the behavior or reacting to an internal hydraulic instability.

Repair Or Replace?

A quote may help you decide

my mistake, click noise occur for both D and R with foot on brake. Did Test 3, no change. Click is random. Unable to tell if sync to SLR current pulses : click sounds is relatively fast.

That additional information actually changes my thinking quite a bit.

The important facts now are:

- ✓ Occurs in **both D and R**
- ✓ Only when **READY** and **foot on the brake**
- ✓ Vehicle stopped
- ✓ Random clicking
- ✓ Can be **felt in all four brake hoses/calipers**
- ✓ Linear Valve Offset Learning made **no difference**
- ✓ No obvious accumulator pressure instability in the Techstream graphs you posted

This makes regenerative brake blending very unlikely to be the cause.

## My revised differential diagnosis

## 1. Internal brake actuator hydraulic regulation (most likely)

I now think the actuator itself is intermittently making small pressure corrections.

Remember that when you press the brake pedal, the Prius does **not** simply trap hydraulic pressure. The ECU continuously servo-controls wheel pressure using:

- master cylinder pressure sensor
- stroke simulator
- accumulator pressure
- SLA/SLR proportional valves

If there is a very small internal leak across one of the actuator's spool valves or valve seats, the ECU will periodically correct it.

The corrections don't have to be periodic. They can be completely random because leakage depends on:

- seal position,
- temperature,
- microscopic spool movement,
- accumulator pressure.

That fits your description remarkably well.

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## 2. Pressure relief through SLR

Your earlier graph showed SLR constantly making corrections while you held the pedal.

That isn't proof of a fault, but if the click frequency is higher than the graph resolution, Techstream may simply not be sampling fast enough.

The ECU can command valves much faster than Techstream updates the display.

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## 3. Switching valves (SMC/SRC)

Earlier we noticed SMC and SRC changing state.

I no longer think these are necessarily the source of the click.

Switching solenoids generally produce a **single distinct click** when energized or de-energized.

Your symptom is:

many random clicks while continuously holding the pedal.

That sounds much more like **continuous pressure regulation** than repeated switching.

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## 4. Pump motor

Does the click coincide with the pump?

Usually not.

The pump produces more of a:

bzzzzzzzz

than

click...click...

And you said you can physically feel it in the brake lines.

That points toward hydraulic pressure pulses rather than the electric motor.

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## One thing I'd like to know

Can you answer these?

**A.**

Is the click:

- one click every few seconds?

or

- several clicks per second?
- 

**B.**

Can you feel the click:

- directly on the brake actuator itself?

or only on the steel brake lines?

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**C.**

Does the brake pedal itself twitch?

Even a movement of **0.5-1 mm** would be significant.

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D.

Do you have any DTCs whatsoever?

Especially:

- C1252
- C1253
- C1256
- C1345
- C1391

Even "history" or "pending" codes would be relevant.

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## My current suspicion

If there are **no DTCs**, the accumulator pressure is stable, and the pump isn't cycling excessively, my leading hypothesis would be:

**An internal leak or unstable spool/seat inside the brake actuator causing the ECU to make random hydraulic pressure corrections.**

This is **not necessarily severe enough to set a fault code**. The ECU may still be able to maintain target pressure by making frequent small adjustments.

## A diagnostic test that could be very revealing

Since you already have Techstream, I'd recommend one more logging experiment:

Record only these four parameters at the highest sampling rate possible:

- **SLA Solenoid Current**
- **SLR Solenoid Current**
- **Accumulator Sensor**
- **Brake Pedal Stroke Sensor** (or Master Cylinder Pressure, if available)

Then have a helper listen for or mark the clicks while you hold steady brake pressure.

If every click corresponds to a pulse in **SLR** without a corresponding change in accumulator pressure, that would strongly indicate the ECU is trimming wheel-cylinder pressure rather than compensating for accumulator pressure loss.

One final question: **What is the model year and approximate mileage of the Prius, and is this the original brake actuator/booster assembly or has it been replaced before?** That history would help judge how likely an internal actuator issue is.

accumulator pump running doesn't correlate to click. Click is 1x every 0.5 to few seconds. No codes. No twitch on brake pedal. Hard to tell if click occurs on the actuator or the lines : it can be felt right at the line connecting to actuator and all the way to the brake caliper. I also suspect internal leak as accumulator pump seems to run more frequently than before

Show moreShow less

Based on everything you've told me over the last few messages, I think you're narrowing in on the right part of the system. Here's how I would interpret the evidence.

## What the evidence says

The following facts all fit together:

- No DTCs.
- Linear Valve Offset Learning made no difference.
- Pump cycling is more frequent than it used to be.
- Clicking is random (0.5–several seconds apart), not periodic.
- No brake pedal twitch.
- The click can be felt in all four brake lines.
- It occurs while simply holding the brake pedal.
- It is independent of D/R.

That combination makes me think this is **hydraulic pressure correction**, not an electrical or ECU timing issue.

## Why I think the pressure pulse originates inside the actuator

The click being transmitted to **all four brake lines** is a very important clue.

If an individual wheel valve (FLH, FRH, etc.) were opening, you'd expect the disturbance to be strongest on one circuit.

Instead, every line feels the same impulse.

That suggests the pressure pulse is occurring **before the hydraulic circuit splits to the four wheels**—inside the actuator/manifold itself.

## The internal leak hypothesis

Here's the sequence I suspect is occurring:

1. You apply the brake.
2. The ECU builds the desired wheel-cylinder pressure.
3. An internal leakage path slowly reduces pressure.
4. The ECU detects the pressure error.
5. It briefly actuates the linear valve(s) to restore pressure.
6. The rapid pressure correction produces a hydraulic "tick" that propagates through all four lines.
7. Repeat at random intervals.

The leak does **not** have to be external. It can be:

- a slightly leaking valve seat,
- spool valve clearance,
- check valve leakage,
- or a seal inside the actuator.

Because the leak rate varies with pressure and spool position, the corrections are naturally irregular rather than perfectly periodic.

## The pump cycling strengthens this theory

You mentioned:

"accumulator pump seems to run more frequently than before"

That is probably the most significant symptom.

If the pump is genuinely cycling more often (not just because you're paying closer attention), then **hydraulic pressure is being lost somewhere.**

There are only a few places that pressure can go:

- external leak (you'd see fluid),
- accumulator leak,
- pump check valve leak,
- internal actuator leak.

Since you don't report fluid loss, an **internal leak becomes much more plausible.**

## One thing I would verify

I would want to separate **accumulator pressure loss** from **wheel-cylinder pressure loss**.

### Test 1 — READY, no brake pedal

Leave the car READY without touching the brake.

Record:

- pump cycling interval,
- accumulator pressure (or accumulator sensor voltage).

If the pump still cycles frequently while you're not touching the brake, that points toward:

- accumulator,
- pump check valve,
- or internal actuator leakage unrelated to brake application.

If the pump behaves normally until you **press and hold the brake**, then the leak is more likely in the pressure-control path used during braking.

### Test 2 — Pump cycle timing

Toyota doesn't publish a strict specification, but owners generally notice actuator problems when the pump begins cycling much more often than normal.

It would be useful to know:

- With the car READY and your foot **off** the brake, how long between pump runs?
- With your foot **holding** the brake, how long between pump runs?

Even approximate numbers (e.g., "30 seconds" versus "3 minutes") are helpful.

## One possibility I wouldn't completely rule out

One subtle possibility is an **internal leakage across the linear control valves (SLA/SLR)** rather than the accumulator itself.

If SLR doesn't seal perfectly, the ECU can compensate indefinitely without ever setting a DTC, because it still reaches the commanded pressure—it just has to work harder.

That would explain:

- no codes,

- successful offset learning,
- random corrections,
- increased pump duty cycle.

## My confidence

Based on everything you've described, my confidence ranking would be:

1. **Internal hydraulic leak inside the brake actuator (valve seat, spool, or internal seal) — High confidence**
2. **Accumulator or pump check valve leakage — Moderate confidence**
3. **Pressure sensor drift/noise — Lower confidence** (usually you'd expect more obvious regulation anomalies or eventually a code)
4. **Software/calibration issue — Low confidence**, especially since offset learning didn't change anything.

I don't think you've yet described anything that clearly points to an ECU fault or a simple electrical problem. The symptoms all look like a hydraulic control system that is still functioning correctly but is having to make more frequent corrections than it used to.

One final question: **Has the frequency of the clicking and pump cycling been gradually increasing over months, or did it begin fairly abruptly?** A gradual increase would fit wear of an internal valve seat or seal much better than a sudden electronic fault.

graph data seems to suggest SLA might have a leak and SLR is activated to release the pressure while fully stopped with foot on brake. Perhaps the clicking sounds is from SLR pulsing to release the pressure.

I think that's a **plausible hypothesis**, but I would be careful about concluding that **SLA itself is leaking** based only on the graphs.

Here's why.

### What the graph can tell us

Suppose there is an internal leak that causes wheel cylinder pressure to slowly rise above the target while you're holding the pedal.

The ECU's correct response would indeed be:

- Keep **SLA closed** (0 A).
- Pulse **SLR** to bleed off the excess pressure.

- Pressure returns to target.
- Wait until the next correction.

That matches your observation that SLR is active while SLA is mostly inactive.

However, **that doesn't uniquely identify the source of the excess pressure.**

## Why it may not be an SLA leak

SLA is a proportional valve. If its seat were leaking, several other faults could produce the same symptom:

### 1. SLA valve seat leakage

- Accumulator pressure leaks past SLA into the wheel circuits.
- ECU detects pressure increasing.
- ECU opens SLR to bleed it back.
- Click.

### 2. Pressure regulator/spool leakage upstream of SLA

- Same end result.

### 3. Internal crossover leakage inside the actuator block

- Same end result.

### 4. Pressure sensor error

- Less likely, because you'd usually expect additional symptoms or eventually a DTC.

The Techstream graph alone can't distinguish among these.

## One thing that supports your theory

The fact that **the pump runs more frequently than before** is important.

If SLA is leaking internally, there is effectively a path:

```
Accumulator
  ↓
  SLA seat (leaks)
  ↓
Wheel circuits
  ↓
SLR opens briefly
  ↓
Reservoir / return
```

Every correction would waste a tiny amount of accumulator pressure, so the pump would have to recharge the accumulator more often.

That mechanism is internally consistent.

## But I'd expect one more thing

If the leak is through SLA, I would expect the **frequency of SLR corrections to increase when accumulator pressure is highest**—typically just after the pump stops.

A simple experiment could test this:

1. Let the pump finish charging.
2. Immediately begin holding the brake.
3. Listen to the clicking.
4. Continue holding until just before the pump runs again.

If the clicking is **most frequent immediately after a pump cycle** and then gradually decreases as accumulator pressure falls, that would support a leak from the high-pressure side (SLA or upstream).

If the click rate is completely independent of accumulator pressure, I'd lean more toward an internal leak in the wheel-pressure control circuit.

## The test I'd most like to do

If Techstream exposes **wheel cylinder pressure** (or target brake pressure), I'd log:

- Accumulator pressure
- Wheel cylinder pressure
- SLA current
- SLR current

Then watch for this sequence:

1. Wheel pressure slowly rises with no SLA command.
2. SLR pulses.
3. Wheel pressure drops back to target.

If that happens, it would be strong evidence that the ECU is correcting an unwanted pressure increase.

## Where I stand now

Given everything you've observed, I'd rank the possibilities as:

1. **Internal leak within the brake actuator hydraulic block** (high confidence).
2. **SLA valve not sealing perfectly** (plausible subset of #1).
3. **Leakage in the pressure regulator or another internal spool/seat** (also plausible).

At this point, I don't think the available data lets us confidently say "**SLA is the leaking component**" rather than another internal valve or passage. The ECU's use of SLR tells us it's correcting pressure, but it doesn't tell us exactly where the pressure is coming from.

One thing I'd like to know is whether your Techstream can log **Master Cylinder Pressure, Wheel Cylinder Pressure, or Target Brake Pressure**. Those parameters could help distinguish between an internal pressure rise and a commanded pressure adjustment.