LTCC

LT1 Coil per Cylinder Converter

Model LTC-1

With adjustable retard and intelligent rev limiter

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Manual: Andy Bogus

Version 1.9d

First Things, First

This manual is written for the experienced shade tree, or professional, mechanic. If you are not capable, and these instructions, for whatever reason, scare the hell out of you, please, consider taking this to a competent professional for installation.

It is highly recommended that you save these instructions. This manual contains valuable information that will permit you to trouble shoot and inform any future owner what you did – and why.

This manual will also outline some of the special requirements involved with installing this kit into a 1992 Corvette. The wiring **is** different, however, this is easily remedied.

This kit will work on any engine using the OptiSpark ignition system.

The OptiSpark Story

A Brief History

In 1991, General Motors Chevrolet Division introduced the 1992 Corvette with the Second Generation Small Block, designated by RPO code LT1. The LT1 was used exclusively in the Corvette until the 1993 model year, when it branched out into the new forth generation Camaro and Firebird, commonly referred to as F-Body cars, and in 1994, the GM B-Body, full sized rear drive sedans (the Chevrolet Impala SS and Caprice, Buick Roadmaster and Cadillac Fleetwood).

Based on the venerable Chevy Small Block that was originally introduced in the 1955 model year, this version was the most heavily reworked yet. The bottom end is essentially the same as in the outgoing L98, but the heads, cooling, intake, ignition, and output were much different. The last L98 produced 250 hp, the LT1, 300 hp.

Also unique to the LT1 is the reverse flow cooling system. The coolant goes through the heads then to the block, returning to the radiator. The idea is simple – cool the heads first will cut down on detonation. A unique facet of this system is the direct camshaft drive water pump, hence the ability to operate without a belt.

In 1996, in the last year of Corvette production, the LT1 was augmented by the LT4. The LT4 was a special, high output version of the LT1. It had unique heads, with roller rockers, unique intake manifold and camshaft. It all added up 330 hp. The LT4 was available in the Corvette, with the mandatory ZF 6-speed manual transmission. The LT1 was available only with the automatic.

In 1997, the LT4 was used in a limited number of special edition Camaro Z28 SS'.

At the end of the 1997 model year, the LT1/4 was retired, and with it, the last connection to the original Small Block Chevy engine. All that the LS1 shares with the LT1 and predecessors is bore center. Nothing else mechanical is compatible.

A word of caution, there are several versions of the LT1 engine. To a novice, they all look like an LT1, because of the OptiSpark and water pump placement. This cannot be further from the truth! The table below outlines the differences.

Cubic Inches	Horsepower SAE Net	Heads	Mains	Years	Usage
265	165	Iron	2 bolt	1994-1996	Base Caprice
350	185	Iron	2 bolt	1994-1996	Caprice, standard on the other GM sedans
350	265	Iron	2 bolt	1994-1996	Impala SS
350	275 *	Aluminum	2 bolt	1993-1997	F-Body
350	320	Aluminum	2 bolt	1996-1997	F-Body specials
350	300	Aluminum	4 bolt	1992-1996	Corvette
350	330	Aluminum	4 bolt	1996	Corvette and some F-Bodies in 1997.

* In 1995, there was a minor change in the exhaust that upped power to 285.

The Engineering

The OptiSpark itself is not a bad component; it is simply the result of poor planning and execution. The OptiSpark is essentially a conventional distributor, however, it is much more compact and does not have the facility for setting base timing. As accurate as it may be, its condition can deteriorate rapidly, depending on climate and maintenance.

The OptiSpark is made up of two halves, the "Opti" half, which consists of a metal disc with inner and outer rows of timing marks. The outer ring is for spark timing, the inner is used in conjunction for fuel delivery.

Mitsubishi manufactures the optical pickup used in the OptiSpark. These pickups are noted for their long-term durability.

The other half is the "Spark". It is much like a conventional distributor, with a single coil feeding 8 cylinders.

The Weaknesses

First, it is mounted below the water pump. If water is the OptiSpark's enemy, then antifreeze is its undoing.

Water, will, for the most part, simply evaporate, but not before causing carbon tracing on the cap's internal contacts. Over time, carbon tracing will cause serious problems for the spark to jump from the rotor to the contact on the cap. Carbon tracing is easily identified by the presence of a white crystalline substance on the points of the rotor and/or cap.

Antifreeze is extremely bad! Antifreeze is an alcohol-based fluid, ethylene glycol, which will eat the bearings inside the OptiSpark. The deterioration of the bearings will cause the internal drive shaft to wobble, which results in the optical pickup not being able to read the disc correctly, therefore, cause a timing/fuel delivery problem.

If you are experiencing a wandering idle, or a high RPM miss/stumble, you have a bad case of carbon tracing.

Editor's Note: *I installed this kit on my 1992 Corvette, approximately 18 months after my car was thoroughly drenched in a rainstorm of near epic proportions. The storm drowned my car's OptiSpark. Immediately after, it ran poorly due to the flooding of the external cap towers and the wires. Time & WD-40 healed that, but time also caused severe carbon tracing inside my OptiSpark's cap and rotor. It was to a point that the car would not hold idle.*

Recommended Reading

For more detailed information on this subject, I suggest "Corvette Fuel Injection & Electronic Ignition: 1982-2001", by Charles O. Probst. This book is available from Robert Bentley Publishers. Plus, a Helms Service Manual for the car you are servicing. These are approximately $120.00 and are available directly from the publisher at *www.helminc.com*.

Do not bother with the Chilton's or Haynes manuals; they are not specific enough for this project.

Additional Components Required

To correctly install the LTCC, you will need the following parts:

Quantity	Product	Part Number	Internet Price
8	GM LS1 Coils	12558948	$35.00 each
2	GM LS1 Coil Brackets	12562864	$8.00 each
1	Set, Taylor Spiro Pro Universal Wires	Color dependant	$80.00
1	Set, Taylor LT1 180 degree Ends	46052	$15.00
1	Set, Taylor LT1 Angled Ends	46066	$15.00
1	Taylor Wire Removal Tool	43392	$20.00
1	Taylor Wire Crimper	43390	$15.00
1	Assortment of fuses, 20-amps on up		$2.00
1	Taylor Convolute Tube, 25ft of ¼"	38092 (black)	$7.00

NOTE: Low resistance plug wires, such as the MSD Superconductor, as well as similar products by other manufacturers, have been known to cause problems on LTCC equipped vehicles. It is recommended you not use these wires, or wires like them.

Taylor and Magnacor are very good products that do work with the LTCC.

THE LTCC KIT

Please take a few minutes and familiarize yourself with these instructions and the kit itself.

Inside the LTCC package, you will find the LTCC module and the harness. The harness has 8 leads, each with a weather pack connector and a ground wire, a pigtail connector and four non-harnessed wires. Each is described below:

Pin	Wire Color	Description	Comments
A	Black	Low Resolution OPTI signal	4x
B	Purple	High Resolution OPTI signal	360x
C	Red	+12 volt signal for logic circuits	Switched Ignition
D	Brown	Ground for logic circuits	Reference Low from PCM

Table 1: Pigtail Pin out

E	Yellow	Step Trigger Input - Switched + 12 volt. Energize this input to activate the two-step or retard options.
F	White	EST input from PCM – connects to the ignition module.
G	Pink	Hot power to the coils. There are two of these wires.

Table 2: Standalone, Non-harnessed Wire

Connector	Description
1	Cylinder 1 Coil Output
2	Cylinder 2 Coil Output
3	Cylinder 3 Coil Output
4	Cylinder 4 Coil Output
5	Cylinder 5 Coil Output
6	Cylinder 6 Coil Output
7	Cylinder 7 Coil Output
8	Cylinder 8 Coil Output

Table 3: Coil Connectors

Installation Procedures

There are several ways you can go about installing this kit. We recommend taking a couple of stabs at it. Don't do any one thing that will get you in over your head, especially if you need the car during this process.

The following is a **recommended** installation procedure:

1. Install the coil packs. On the Corvette or F-Body cars, the coils can easily be mounted to the valve covers with home made stand-offs. It is easy enough to do both sides in one evening. See photo #1, for an example.

2. Installing the module and harness:
    a. It is important that the LTCC Module is kept away from heat and vibration – **both will damage the unit**. For any vehicle, forward of the engine is best. On the Corvette, the left headlight bucket is the best area. Mount the unit LOW. VERY LOW, to provide clearance. See photo's #2 & 3 for an example.
    b. Install the LTCC Harness. **Don't do any cutting yet!** Once you cut, you are committed. But you can so very easily fit the harness and get it dressed properly under the hood.

3. Cut and connect. Save this for last, unless you don't need your car.
    a. On the right (passengers) side of the intake manifold, under the fuel rail cover, is the diagnostic port for the OptiSpark. This is where the pigtail from the LTCC harness will intercept the data path. The connector is secured to the side of the intake with a 9/32" screw. When installing, be sure to securely retain this pigtail to the intake manifold. If it disconnects, the engine **will** quit. Check to make sure that the factory connector has no corrosion or defective connections. **If you are installing this on a 1992 Corvette, please go to Page 6 for specific instructions.**
    b. It may be a good idea to spray some dielectric grease into these connectors while you are in there.

It is essential that good grounds are present.

Tip: A good grounding point is a mounting bolt on the head for the factory spark plug wire looms. The grounding wires will reach them with no problem. Another great location is on the intake manifold itself. The standoffs that support the fuel rail cover are screwed into the manifold. These standoffs are an excellent ground spot. Additionally, it is far away from the heat of the exhaust headers, and is much easier to reach than the sparkplug wire loom mounting bolts.

Note: The LTCCs current draw is 16-amps; the existing fuse for the ignition is 10-amps, it must be upgraded to 20-amps before starting the car for the first time. If a problem occurs, move up in 5-amp increments.

Special Instructions for 1992 Corvette Installation

As noted above, the 1992 Corvette is a special case. The connector is not compatible with the later style connector used on the LTCC. To remedy this, there are two options, acquiring the harness ends that will allow you to change them over, or, carefully soldering the LTCC harness ends to the existing 1992 OptiSpark connector.

Either way, you will need to be aware of how the OE 1992 connector looks. Please see the graphic below, for the pin out.

<insert pic here>

What is most important to realize, the pins are letter coded, A, B, C and D. The GM "A" is EQUAL to the pigtails "A" on the LTCC harness.

<insert pic here>

Editor's Note: *I decided to solder. It was Saturday, and there was no chance to get the parts until later the following week. Soldering took less than 30 minutes.*

If you take the soldering route, here are some pointers that should make it a more pleasant experience.

If you are **NOT** good at soldering, **do not learn on this project**. The consequences of learning here are potentially expensive. Find a buddy who can and buy'm a six-pack!

If you are good, the better the iron, the better the job. I recommend the Blue Point Butane Iron. If you use electric, Weller's SP40 or SP80 are great tools, too.

The easiest way to do this is to remove the OptiSparks pigtail completely from the car. To remove it, remove the connector from the manifold, remove the SOV Purge Valve and remove the standoff from the fuel injection rail cover, and finally, remove the harness from the OptiSpark itself. It's a bit tricky, but can be done. Once off, peal-back about three inches of convolute tubing and remove the foil and electrical tape.

Next, remove about 3/8ths of an inch of insulation. **Do not cut the harness.** Simply strip the exposed wires from the LTCC OptiSpark harness wires to the bared wires, per the chart below.

Note: If you are color blind, please get help! Again, damage here will be expensive.

I recommend 3M Rubber Electrical Tape. Tape of this nature is sometimes called self-vulcanizing. **Do not use vinyl tape! It will not last! The same applies to liquid tape.** Heat has a tendency to cause liquid electrical tape to go brittle over time.

Similar problems exist with the coil wiring.
Connect the Pink Wires to the Pink w/Black trace wire that formerly fed the single LT1 coil. Some models use a pink wire here. Verify 12 volts key-on to feed the pink LTCC wires.

Note: The production coil and ignition module are no longer used.

There is a 4 Position “Mode” Dip Switch inside the unit that has the following functions;

Mode	Off	On	Comments	Default
1	Soft-Touch Rev Limiter	Hard Cut Off Rev Limiter		
2	Energize 2-step Input to Activate	De-Energize 2-step Input to Activate		
3	Rising edge	Falling edge	Determines 4x Low-Resolution Decode Mode	Leave off
4	NOS Retard Activated by 2-step Input	Low Rev Limit activated by 2-step Input		

Tuning

There are two dials inside the unit

- LIM is the rev limiter
- RET is the N.O.S. Retard & Low Rev Limit

The settings are as follows:

Setting	Result
0	Disabled
1	6100
2	6200
3	6300
4	6400
5	6500
6	6600
7	6700
8	6800
9	6900
A	7000
B	7100
C	7200
D	7300
E	7400
F	7500

Setting	Retard – above 2000 RPM	Low Rev Limiter
0	None	Disable
1	2	2600
2	4	2700
3	6	2800
4	8	2900
5	10	3000
6	12	3100
7	14	3200
8	16	3300
9	.5º per 1000 rpm	3400
A	.75º per 1000 rpm	3500
B	1.5º per 1000 rpm	3600
C	2º per 1000 rpm	3700
D	2.5º per 1000 rpm	3800
E	3º per 1000 rpm	3900
F	12º – active at 1500 rpm for turbo brake torque.	4000

The Soft-Touch Rev Limiter Spans about 400 rpm. If set to 3000, it may climb as high as 3400 until all cylinders are disabled. This can be altered if required.

LED Error Codes

Green is good, if on, the system is functioning correctly!

Red is not so good. During the first second of operation, it will light, as part of the power on self-test, however, if it starts blinking, there is a problem. Please refer to the table below for details on what the blinks mean.

1	Cylinder Decode Sequence Error.
2	Wrong number of Hi-Resolution pulses counted between Lo-Resolution rising edges
3	Wrong number of Hi-Resolution pulses counted during a High Lo-Resolution pulse or Low Lo-Resolution Pulse.
4	EST Signal from PCM Missed Pulse. Check connection to the white wire (External Rev-Limiter devices must not be used)

Note: The engine must make 50 revolutions before the error checking is enabled; this is a few seconds running or about 20 seconds of cranking.

Technical Support

If you have installation problems, please feel free to email either Bob or myself.

We can be reached via the following email addresses:

Bob Bailey bob@bailey-eng.com

If you have hardcore technical questions about how the unit functions, please contact Bob.