

Immobilizer

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Description and Operation

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Immobilizer Description and Operation

Immobilizer System

The purpose of the Immobilizer system is to provide additional theft deterrence to the vehicle in which it is installed and to prevent it from being stolen or driven by unauthorized users.

The verification of the user authorization is done by an ignition key with integrated transponder.

The external LED displays the Immobilizer status and has an additional theft deterrence function. To secure the communication, the status is exchanged between the Immobilizer and the ECM in a 5 byte of encoded data.

These 5 bytes are composed by a mixture of random data and two types of fixed codes are:

- A vehicle model identification number : MIN
- A vehicle specific identification : VIN

The MIN is known from the first supply of the system.

The VIN is realized by ICU on the special order from the key coding (reading of transponder code and storing it as valid key code in Immobilizer EEPROM).

A different random data is computed at each key transition.

All the immobilization communication between the ECM and ICU is made on K line (K line : Serial data line V7).

Due to the learning of the Vehicle specific identification Number, both ICU and ECM can stay in 3 stable modes

- Virgin mode (VIN not learnt)
- Learnt mode (VIN learnt)
- Neutral mode (for a new VIN learning)

In case of using valid key, the release message communication with the ECM take place and the LED displays the Immobilizer status valid key. In case of using invalid key, the ECM disables the fuel injector circuit with coded intervention and sets Diagnostic Trouble Code (DTC).

The above conditions are maintained until the ignition is switched off.

An ECM without an immobilizer control unit cannot be interchanged for an ECM that is used with an immobilizer control unit system. The immobilizer control unit and ECM must have a matching ID code. ID coding and key coding are accomplished by using Scanner 100.

The immobilizer system consists of the following:

- A maximum of 5 ignition keys with integrated transponder
- The toroidal coil (Detection coil) for energizing and reading the transponder mounted at the ignition lock.
- The immobilizer control unit (ICU) with :
 - - Power supply
 - Ignition input circuit
 - Transponder modulation and demodulation unit
 - EEPROM
 - Driver electronic for the external status led
 - Serial data link hardware
- The external status led for displaying the immobilizer status.

- The serial data link between immobilizer and ECM.

Electronically Coded Keys

Each valid ignition key has an internal transponder which is a read/write transponder.

The transponder contains an implementation of a crypto algorithm with 96 bits of user configurable secret key contained in EEPROM and transmits data to the ICU by modulating the amplitude of the electromagnetic field, and receives data and commands in a similar way.

Immobilizer Control Unit

The function of the immobilizer system is shared between the ICU and the ECM.

The task of the immobilizer electronic control unit (ICU) are:

- Reading of the input information 'ignition ON/OFF'
- Controlling the status LED
- Controlling the transponder read/write process (modulation, demodulation, decoding, comparison of the read code with the code of the valid keys).
- Communication with the ECM after ignition ON (receiving of the ECM request and transmission of release message).
- Special functions for calculation and handling of the VIN code.

The VIN code is calculated by the Immobilizer using a random generator.

The VIN code is transmitted from the Immobilizer in the release message communication only in case of using an authorized key. Without an authorized key it is not possible to get the system VIN code. In case of ECM internal state is in Virgin mode or neutral mode the ECM learns the system VIN code automatically after receiving the first release response message.

To get a synchronized Immobilizer system (same VIN code in Immobilizer and ECM, authorized key) the DLC test equipment has to be used for authorization of the keys (first key coding). The usage of this test equipment is restricted to authorized persons.

- Communication with the DLC test equipment. Main functions are the key coding procedure, the VIN code handling and the support for system test functions.
- Handling of the software watchdog

Operation

In the active mode of immobilizer (engine OFF, IG key OFF) the status LED is not blinking as mode A. When ignition is turned ON, the system wakes up and tries to read out the transponder.

In case of the detection of a valid key, the release message communication with the ECM takes place. The status LED displays the Immobilizer state 'valid key'.

After turning off the ignition (ignition OFF detection similar to the ECM ignition OFF detection), the Immobilizer changes to the active mode. The status LED is blinking as Mode A.

Data Link Connector (DIC) Mode

When the ignition is on, a scan tool can switch the immobilizer control unit to the DLC mode for diagnostics, key coding and ID coding.

- The status LED is turned off during DLC mode
- The Immobilizer will answer all correct messages, which are defined as Immobilizer messages.

ID Code Handling

One of 65,535 VIN codes is stored in the immobilizer EEPROM. The VIN code can be erased by using 'Reset VIN code' command of the scan tool.

When the immobilizer control unit calculates a new VIN code, ECM VIN code should be reset to get identical with the immobilizer control unit's.

During diagnostic procedures, the VIN code can be read for comparison with the ECM VIN code by using the scan tool's 'Read immobilizer control unit VIN code' command.

Serial Data Link

Serial data can be exchanged between a scan tool and the ECM and the Immobilizer control unit. The scan tool connection is the data link connector (DLC).

Electronic Control Module (ECM)

- ECM in Virgin mode
- In this mode, the ECM knows only the model vehicle identifier code.
- The engine can be locked/unlocked.
- ECM requests to ICU the VIN number. As soon as the ECM receives two correct consecutive communication frames with the same VIN code the ECM learns it.
- The VIN code will be stored in non-volatile memory at the end of power latch phase. ECM enters in Learnt mode.
- ECM in Learnt mode
- In such a state, ECM checks on every communication, the correct encoding of the ICU.
- If the code received is not correct, then the vehicle is immobilized.
- The coded 5 bytes of data emitted by ECM are a mixture of MIN code and random.
- The coded 5 bytes of data emitted by ICU are a mixture of VIN code and random.
- ECM in Neutral mode
- This mode is a special intermediate mode, used for ICU replacement or immobilizer option installation.
- ECM request to ICU the VIN number. As soon as the ECM receives two correct consecutive communication frames with the same VIN code the ECM learns it.
- The VIN code will be stored in non-volatile memory at the end of power latch phase. ECM enters in Learnt mode.
- After turning on the ignition the ECM will control the engine in a normal way for starting and running while waiting for a valid release response message from the immobilizer.
- After receiving a response message including the information 'ICU in learnt mode' and the correct system VIN code.
- The ECM enters the release state, which allows to continue the running of the engine.
- After receiving a response message including the information 'ICU in learnt mode' and a wrong system VIN code.
- The ECM does not send a new request and enters the blocked state, which causes the activation of the immobilization actions of the engine.
- If the ECM does not receive a response message within a defined time from beginning of the release time period or the ECM receives a no release answer.
- The ECM enters the blocked state, which causes the activation of the immobilization actions of the engine.
- The inactive state of the Immobilizer (valid key/invalid key) ends with turning off the ignition.

Security Indicator

There is a security indicator on the meter cluster.

Status LED

An external LED displays the immobilizer system status. The immobilizer contains the LED driver hardware for direct connection of one LED.

Status LED	Immobilizer System Status	Note
Blink	Active	Ignition OFF
Blink	Active	• Invalid key detected • Ignition ON

Status LED	Immobilizer System Status	Note
OFF	Inactive	• Invalid key detected • Ignition ON
Blink	Active	• VIN Code is different between ICU and ECM is learnt state • Ignition On
ON	Active	• Transponder reading error • Ignition On
OFF	Active	• Reader exciter ASIC error • Ignition On

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Diagnostic Information and Procedures

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DTC P1628

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1628

Theft Deterrent Start Enable Signal Not Received

Circuit/System Description

When the ignition is turned ON, the key is tested by the Immobilizer Control Module. While the key code is being read by the immobilizer control unit, the engine can start and run with any key that will turn the lock cylinder. The key code is read and compared with key codes that have been stored in the memory of the immobilizer control unit. If a valid key is detected, the immobilizer control unit sends a serial data release message to the electronic control module (ECM). Included in the release message is an identification (ID) code which assures that neither the immobilizer control unit nor the ECM has been substituted to defeat the system. If the ECM receives an invalid release message, the ECM disables the fuel injector circuit.

Conditions for Running the DTC

Ignition is in the RUN position.

Conditions for Setting the DTC

The ECM does not receive the signal from the immobilizer control module within 1.260 seconds after the ignition is turned on.

Action Taken When the DTC Sets

- The security indicator will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

- A current DTC P1628 will be when a valid calculation is received.
- A history DTC will be cleared after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

[Immobilizer Schematics](#)

Connector End View Reference

[Master Electrical Component List](#)

Description and Operation

[Immobilizer Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition OFF, disconnect the harness connector at the Immobilizer Control Module.
2. Test for less than 1 Ω between the ground circuit terminal 4 and ground.
3.
 - If greater than the specified range, test the ground circuit for an open/high resistance.
4. Ignition ON, verify that a test lamp illuminates between the ignition circuit terminal 1 and ground.
5.
 - If the test lamp does not illuminate, test the ignition circuit for a short to ground or an open/high resistance.
6. Verify that a test lamp illuminates between the B+ circuit terminal 2 and ground.
7.
 - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance.
8. Ignition Off, disconnect the harness connector at the ECM.
9. Ignition On, test for less than 1 Ω on the signal circuit terminal 56.
10.
 - If greater than 1 Ω , test the signal circuit for a short to voltage.
11. Ignition Off, test for infinite resistance between the signal circuit terminal 56 and ground.
12.
 - If less than the specified value, test the signal circuit for a short to ground.
13. Test for less than 1 Ω between terminal 56 at the ECM and terminal 6 at the Immobilizer Control Module connectors.
14.
 - If greater than the specified range, test the signal circuit for an open/high resistance.
15. If all circuits test normal, replace the Immobilizer Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for Immobilizer Control Module and ECM replacement, setup, and programming

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DTC P1629

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1629

Theft Deterrent Start Enable Signal Not Correct

Circuit/System Description

When the ignition is turned ON, the key is tested by the immobilizer anti-theft system. While the key code is being read by the immobilizer control unit, the engine can start and run with any key that will turn the lock cylinder. The key code is read and compared with key codes that have been stored in the memory of the immobilizer control unit. If a valid key is detected, the immobilizer control unit sends a serial data release message to the electronic control module (ECM). Included in the release message is an identification (ID) code which assures that neither the immobilizer control unit nor the ECM has been substituted to defeat the system. If the ECM receives an invalid release message, the ECM disables the fuel injector circuit.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

The ECM receives an incorrect release message from the immobilizer control unit more than five times.

Action Taken When the DTC Sets

- The security indicator will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

- A current DTC P1629 will be cleared when a correct fuel enable password is received.
- A history DTC will be cleared after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

[Immobilizer Schematics](#)

Connector End View Reference

[Master Electrical Component List](#)

Description and Operation

[Immobilizer Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

Perform the Relearn procedure. Refer to [Programming Theft Deterrent System Components](#). The ECM should successfully complete the password learn and the vehicle should start.

- If the ECM does not complete the learn or vehicle starting remains disabled, replace the ECM.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for ECM replacement, setup, and programming

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DTC P1648

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1648

Immobilizer Security Code Incorrect

Circuit/System Description

The immobilizer module or the vehicle theft deterrent (VTD) module sends the fuel enable password to the engine control module (ECM) via the serial data circuit. The ECM then challenges this password. Both the ECM and immobilizer module perform a calculation on this challenge. If the calculated response from the immobilizer module equals the calculation performed by the ECM, the ECM will allow vehicle starting. The ECM will disable vehicle starting if any of the following conditions occur:

- The fuel enable password is invalid.
- The fuel disable password is sent by the immobilizer module.
- No passwords are received. There is no communication with the immobilizer module.
- The immobilizer module calculated response to the challenge does not equal the calculation performed by the ECM.

Conditions for Running the DTC

- The ignition is ON.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects no immobilizer message ID.

Action Taken When the DTC Sets

- DTC P1648 is a Type C DTC.
- Vehicle starting is disabled.

Conditions for Clearing the DTC

DTC P1648 is a Type C DTC.

Reference Information

Schematic Reference

[Immobilizer Schematics](#)

Connector End View Reference

[Master Electrical Component List](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Wiring Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Connector Repairs](#)

Circuit/System Verification

1. Ignition ON, verify that DTC U0167 is not set in the K20 ECM.
2.
 - If the DTC sets, refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
3. Perform the immobilizer Neutral Mode function by selecting the Module Setup on the scan tool.
4. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the K89 Immobilizer Control Module.
2. Ignition OFF for 60 seconds, test for infinite resistance between the serial data circuit terminal 6 and ground.
3.
 - If less than the specified range, test the serial data circuit for a short to ground.
4. Ignition OFF, disconnect the harness connector at the K20 ECM.
5. Ignition ON, test for less than 1V between the serial data circuit terminal 6 and ground.
6.
 - If greater than the specified range, test the serial data circuit for a short to voltage.
7. Ignition OFF, test for less than 5 Ω between the serial data circuit terminal 6 of the K89 Immobilizer Control Module and the K20 ECM terminal listed below:
8.
 - K20 ECM terminal 56 (without FX3)
 - K20 ECM terminal 57 (with FX3)
 - K20 ECM terminal 76 X1 (LKY)
9.
 - If greater than the specified range, test the serial data circuit for open/high resistance.
10. If all circuits test normal, replace the K89 Immobilizer Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

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Symptoms - Immobilizer

Note:

The following steps must be completed before using the symptom tables.

1. Perform the [Diagnostic System Check - Vehicle](#) before using the symptom tables in order to verify that all of the following are true:
2.
 - There are no DTCs set.
 - The control modules can communicate via the serial data links.
3. Review the system operation in order to familiarize yourself with the system functions. Refer to [Immobilizer Description and Operation](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the systems. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.

Intermittent

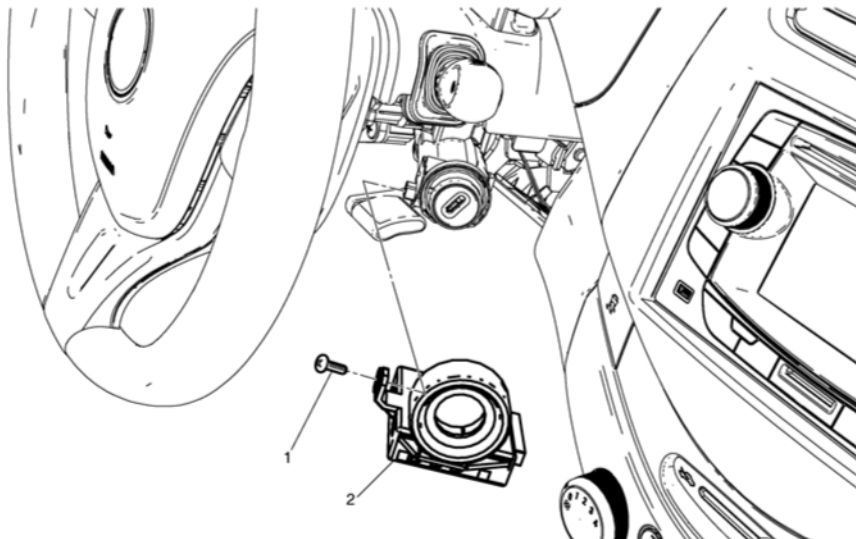
Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Flat Wire Repairs](#).

Repair Instructions

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Theft Deterrent Module Replacement





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Callout	Component Name
Warning: Refer to Battery Disconnect Warning . Preliminary Procedure 1. Remove the steering column lower trim cover. Refer to Steering Column Lower Trim Cover Replacement . 2. Disconnect battery negative cable. Refer to Battery Negative Cable Disconnection and Connection.	
1	Theft Deterrent Module Screw Caution: Refer to Fastener Caution . Tighten 3â€%N-m (27â€%lbâ€%in)

Callout	Component Name
2	Theft Deterrent Module Procedure 1. Disconnect wiring connectors as needed. 2. Unclip the module from the bracket.

Related Part Information

Part Name	Catalog Name	Part Code
Theft Deterrent Module	MODULE,THEFT DTRNT	3360A

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Immobilizer System Component Programming

This procedure will be used for ECM to learn the transponder data and VIN code stored in the immobilizer when ECM is only replaced. If the battery voltage is low, charge the battery before programming the control module.

Note:

Before programming the Immobilizer Function, the engine control module (ECM) must be programmed.

1. Connect a scan tool to the vehicle.
2. Insert the key programmed in immobilizer.
3. Turn on the ignition, with the engine OFF.
4. Select Module Setup on the immobilizer menu of the scan tool.
5. Select Neutral Mode.
6. Perform the programming according to on-screen instructions.
7. After completing the programming for all of additional key turn on the ignition.
8. Try to start the engine. If the engine can start, the key coding procedure is successful. If the engine cannot start, it is failed.

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Adding Keys

Note:

- This procedure only learns the vehicle keys. This procedure will not learn the immobilizer function.
- If the battery voltage is low, charge the battery before programming the control module.
- A total of 5 keys may be programmed to a single vehicle.

This procedure should be used when a new vehicle key needs to be programmed.

1. Connect a scan tool to the vehicle.
2. Insert new key.
3. Turn on the ignition, with the engine OFF.
4. Select Module Setup on the immobilizer menu of the scan tool.
5. Select Additional Key Learn.
6. Perform key learn according to on-screen instructions.
7. After completing learn for all of additional key turn on the ignition.
8. Try to start the engine. If the engine can start, the key coding procedure is successful. If the engine cannot start, it is failed.

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Programming Additional Keys

1. Install the immobilizer control unit cartridge in the scan tool.
2. Turn OFF the ignition.
3. Connect the scan tool.
4. Turn ON the ignition with the key to be coded.
5. Enter the 4-digit password that enables service personnel to use the scan tool for key coding.
6. A lost key can be deleted only by deleting all keys and reauthorizing the remaining keys as new keys. If a key is lost, go to the next step. If no keys have been lost but an additional key is desired, go to step 8.
7. Use the scan tool command DELETE ALL KEY CODES.
8. Use the scan tool command AUTHORIZE ONE ADDITIONAL KEY.
9. Repeat steps 4, 5, and 6 until the immobilizer control unit has recorded all of the new keys or, after a deletion, has reauthorized all of the remaining keys. The immobilizer control unit can record a maximum of 5 keys.
10. Return the system to the normal mode.
11. Turn OFF the ignition.
12. Turn ON the ignition.
13. Crank to start the engine.

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Replacing Keys

Note:

- This procedure only learns the vehicle keys. This procedure will not learn the immobilizer function.
- The procedure will first erase all vehicle keys when adding one or more keys. Even when only one key is added all vehicles are erased before learning the new key. The existing keys are relearned again during the program procedure. Be sure that all existing vehicle keys are available during the program procedure.
- If the battery voltage is low, charge the battery before programming the control module.
- A total of 5 keys may be programmed to a single vehicle.

This procedure should be used when the below cases take place:

- Replace all keys
 - Lost all keys
 - Replace the immobilizer
 - Replace the immobilizer and ECM and key
1. Connect a scan tool to the vehicle.
 2. Insert new key.
 3. Turn on the ignition, with the engine OFF.
 4. Select Module Setup on the immobilizer menu of the scan tool.
 5. Select Key Learn.
 6. Perform key learn according to on-screen instructions.
 7. After completing learn for all of additional key turn on the ignition.
 8. Try to start the engine. If the engine can start, the key coding procedure is successful. If the engine cannot start, it is failed.

Specifications

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Fastener Specifications

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
Note:	
All fasteners listed in this table can be reused after removal.	
Theft Deterrent Module Screw	3â€%N-mâ€%(27â€%lbâ€%in)

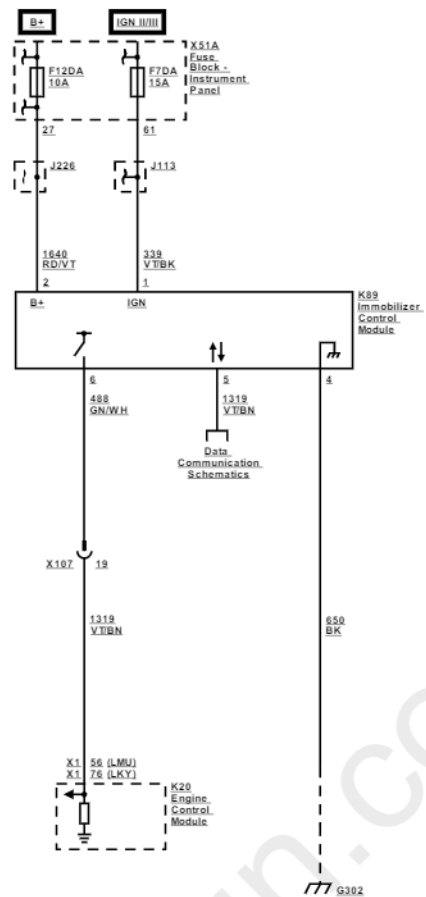
Schematic and Routing Diagrams

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Immobilizer Schematics

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Immobilizer (BAE)



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