Technical Specification - Primary Microcontroller (m450-1)

Scope

This technical specification associates signal names that are used in the platform software interfaces with hardware functionality. It is not meant to be a complete description of the functionality and capabilities of the BMU.

Connectors

Low Voltage Connectors

Pin	Description	Type
J101-1	Spare (AUXLSDD)	Low side outputs
J101-2	AC Charge Positive Contactor	Low side outputs
J101-3	AC Charge Positive Contactor	High side outputs
J101-4	AC Charge Negative Contactor	High side outputs
J101-5	Spare (MHSDOUT11)	High side outputs
J101-6	Main Positive Contactor	High side outputs
J101-7	12V Power (VBAT)	Power
J101-8	12V Ground (VBAT_NEG)	Power
J101-9	AC Charge Negative Contactor	Low side outputs
J101-10	Main Positive Contactor	Low side outputs
J102-1	Main Negative Contactor	High side outputs

Pin	Description	Type
J102-2	DC Charge Positive Contactor	High side outputs
J102-3	Pre-Charge	High side outputs
J102-4	Switched Battery	High side outputs
J102-5	Redundant pack current	Analog Inputs
J102-6	Battery Coolant	Analog Inputs
J102-7	5V Sensor supply (VREF)	Supply
J102-8	DC Charge Negative Contactor	High side outputs
J102-9	Main Negative Contactor	Low side outputs
J102-10	DC Charge Positive Contactor	Low side outputs
J102-11	Pre-Charge	Low side outputs
J102-12	Switched Battery Ground	Supply
J102-13	Spare (AIND)	Analog Inputs
J102-14	Spare (AINC)	Analog Inputs
J102-15	Sensor Ground	Supply
J102-16	DC Charge Negative Contactor	Low side outputs
J103-1	Spare (MHSDOUT10)	High side outputs
J103-2	Charge HVIL	High side outputs
J103-3	Main HVIL	High side outputs
J103-4	Primary Flash Code	Flash Code Output
J103-5	FEPS	FEPS
J103-6	Spare (DIGINPUTF)	Digital Inputs
J103-7	Mod-CAN Low	CAN
J103-8	Mod-CAN High	CAN
J103-9	PT-CAN Low	CAN
J103-10	PT-CAN High	CAN
J103-11	Spare (AUXLSDC)	Low side outputs
J103-12	Redundant CHVIL Status	Low side outputs
J103-13	Redundant MHVIL Status	Low side outputs
J103-14	Secondary Flash Code	Reserved
J103-15	Vehicle Wake (Ignition)	Wake
J103-16	Spare (DIGINPUTE)	Digital Inputs
J103-17	Crash Signal	Digital Inputs
J103-18	Redundant contactor command	Digital Inputs
J103-19	CHVIL Return	Digital Inputs
J103-20	MHVIL Return	Digital Inputs

High Voltage Connectors

Pin	Description
J104-1	MOD_ISO_SPI_P
J104-2	MOD_ISO_SPI_N
J104-3	ISOSPI2E_P

Pin	Description
J104-4	ISOSPI2E_N
J104-5	CHASSIS_GND
J104-6	CHASSIS_GND
J104-7	SHUNT_POS1
J104-8	SHUNT_NEG1
J104-9	NTC_H (V12)
J104-10	NTC_L
J104-11	SHUNT_NEG2
J104-12	SHUNT_POS2
J105-1	VBAT_POS
J105-4	VBUS_AC_POS (V3)
J105-6	VBUS_DC_NEG (V6)
J105-8	VBAT_NEG
J105-10	VBUS_POS (V1)
J105-12	VBUS_DC_POS (V5)
J105-14	FUSE_HS (V7)
J105-16	FUSE_LS (V8)
J105-18	VBUS_AC_NEG (V4)
J105-20	VBUS_NEG (V2)

High side outputs

Note: SBAT must be enabled in order for high side outputs to work.

Function	Control Signal	Gate Monitor	Voltage Monitor	Current Monitor
Main Positive	MHSDOUT0	HSGATE0	MAIN_P_PWR_SENSE	HSDCSNS0
Main Negative	MHSDOUT1	HSGATE1	MAIN_N_PWR_SENSE	HSDCSNS1
DC Charge Positive	MHSDOUT2	HSGATE2	DC_CHG_P_PWR_SENSE	HSDCSNS1
DC Charge Negative	MHSDOUT3	HSGATE3	DC_CHG_N_PWR_SENSE	HSDCSNS2
AC Charge Positive	MHSDOUT4	HSGATE4	AC_CHG_P_PWR_SENSE	HSDCSNS0
AC Charge Negative	MHSDOUT5	HSGATE5	AC_CHG_N_PWR_SENSE	HSDCSNS0
Precharge	MHSDOUT6	HSGATE6	PRECHG_PWR_SENSE	HSDCSNS1
Switched Battery	MHSDOUT7	HSGATE7	SWB_PWR_SENSE	HSDCSNS1
Charge HVIL	MHSDOUT8	HSGATE8	CHVIL_SRC	HSDCSNS2
Main HVIL	MHSDOUT9	HSGATE9	MHVIL_SRC	HSDCSNS2
Spare	MHSDOUT10	none	HSDVAIN10	HSDCSNS2
Spare	MHSDOUT11	none	HSDVAIN11	HSDCSNS0

Voltage monitors:

To convert measured voltage (Vm) to actual voltage (Va) use the equation, Va=Vm*3.938

Current monitors:

To convert measured voltage (Vm) to current (I) use the equation, I=Vm*0.497

The high side outputs are driven by ASICs that control four output channels each. The ASICs are capable of reporting the current monitor signal for one channel concurrently per device. The HSDSEL signals determines which outputs are monitored.

The current monitor signals serve a dual purpose. The output must be configured to produce a steady state output rather than a PWM to serve either purpose.

1. If there are not any hard faults (shorts, over-temperature, over-current, open load off), then the signals will report current according to the transfer function.
2. If a hard fault is detected, then the signal will indicate a fault condition by reporting Vm = 5V.

Since the fault value overlaps the valid current range, these signals are most suitable for detecting open load in the off state.

HSDSEL1 State	HSDSEL0 State	Current Sense signal	Output current monitored
0	0	HSDCSNS0	Main Positive
0	1	HSDCSNS0	MHSDOUT11
1	0	HSDCSNS0	AC Charge Negative
1	1	HSDCSNS0	AC Charge Positive
0	0	HSDCSNS1	Switched Battery
0	1	HSDCSNS1	Precharge
1	0	HSDCSNS1	DC Charge Positive
1	1	HSDCSNS1	Main Negative
0	0	HSDCSNS2	Main HVIL
0	1	HSDCSNS2	Charge HVIL
1	0	HSDCSNS2	MHSDOUT10
1	1	HSDCSNS2	DC Charge Negative

Low side outputs

Function	Control Signal	Gate Monitor	Voltage Monitor	Current Monitor
Main Positive	MAIN_P_DRV	LSDGATE0	MAIN_P_V_SENSE	MAIN_P_CURRENT
Main Negative	MAIN_N_DRV	LSDGATE1	MAIN_N_V_SENSE	MAIN_N_CURRENT
DC Charge Positive	DC_CHG_P_DRV	LSDGATE2	DC_CHG_P_SENSE	DC_CHG_P_CURRENT
DC Charge Negative	DC_CHG_N_DRV	LSDGATE3	DC_CHG_N_SENSE	DC_CHG_N_CURRENT
AC Charge Positive	AC_CHG_P_DRV	LSDGATE4	AC_CHG_P_SENSE	AC_CHG_P_CURRENT
AC Charge Negative	AC_CHG_N_DRV	LSDGATE5	AC_CHG_N_SENSE	AC_CHG_N_CURRENT

Function	Control Signal	Gate Monitor	Voltage Monitor	Current Monitor
Precharge	PRECHG_DRV	LSDGATE6	PRECHG_SENSE	PRECHG_CURRENT
Redundant MHVIL	AUXLSDA	LSDGATE7	VAUXLSD0	none
Redundant CHVIL	AUXLSDB	LSDGATE8	VAUXLSD1	none
Spare	AUXLSDC	none	VAUXLSD2	none
Spare	AUXLSDD	none	VAUXLSD3	none

Voltage monitors:

To convert measured voltage (Vm) to actual voltage (Va) use the equation, Va=Vm*3.938

Current monitors:

To convert measured voltage (Vm) to current (I) use the equation, I= Vm*2.174

Note: The AUXLSDD PWM output does now have its own internal counters. It is configured to share the counters of AUXLSDC. As a result, the output will operate at a frequency that is different from the frequency commanded by the block. It will always operate at the frequency commanded by the AUXLSDC block.

Digital Inputs

Signal Name	Description
CTR_CMD	Redundant contactor command
CRASH	Crash Signal
MHVIL_RTN_IN	MHVIL Return
CHVIL_RTN_IN	CHVIL Return
DIGINPUTE	Spare Digital Input
DIGINPUTF	Spare Digital Input

Analog Inputs

Signal Name	Description	Transfer function
COOL_AI	Battery Coolant	Va = Vm * 4.000
AINC	Spare Analog input	Va = Vm * 4.000
AIND	Spare Analog Input	Va = Vm * 4.000
LEM_AI	Redundant pack current	Va = Vm * 4.000
VIGNWAKE	Ignition	Va = Vm * 5.700
FEPS	FEPS	Va = (Vm - 4.123) * 5.700
LV_SUPPLY	Internal Low voltage supply monitor	Va = Vm * 8.000
SENS_SUPPLY	Internal Sensor supply voltage monitor	Va = Vm * 1.162
+5V8	Internal 5V8 supply voltage monitor	Va = Vm * 2.000
VDD	Internal VDD voltage monitor	Va = Vm * 2.000
+3V3	Internal 3V3 voltage monitor	Va = Vm * 1.000
VDC	Internal VDC voltage monitor	Va = Vm * 1.000
VDC2	Internal VDC2 voltage monitor	Va = Vm * 1.000

Note: the transfer function describes how to convert measured voltage (Vm) to actual voltage (Va)

Internal Control Signals

SBATENAB:

Enables switched battery

- 1 enabled
- 0 disabled

HSDSEL:

Determines which outputs are current monitored.

- See High side outputs

NREFEN1::

Enables sensor reference supply.

- 0 enabled
- 1 disabled

RIP_STATUS:

Interprocessor status signal.

- Conveys an application defined status between the two microcontrollers

NRESET2:

Secondary microcontroller reset

- 1 Enable the secondary microcontroller
- 0 Reset the secondary microcontroller

HOLDON:

Primary microcontroller power hold signal for keeping both microcontrollers awake in the absence of another wake source.

- 1 Keep ECU awake
- 0 Allow ECU to sleep if other wake sources are not present

IsoSPI Communication

Two Linear Technologies isoSPI interfaces are implemented.

Name	Description
External IsoSPI	External IsoSPI interface
Internal IsoSPI	Internal LTC2949 IsoSPI interface

A decoder selection signal for external IsoSPI direction is available. The external IsoSPI may be routed to either of two LTC6820 devices. If the external daisy chain consists of LTC6810s, then one LTC6820 may be connected to each end of the daisy chain.

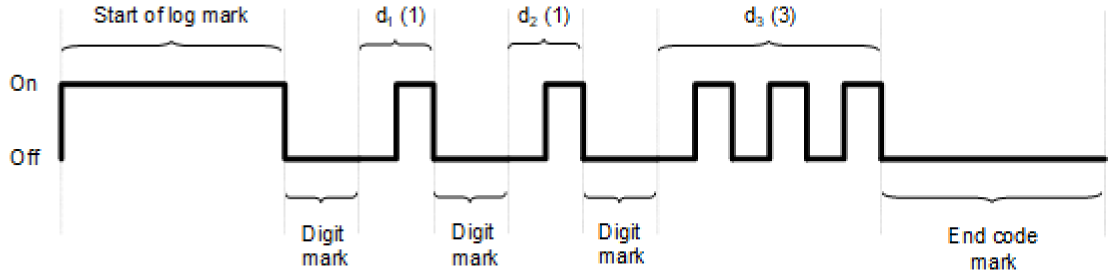
ISOSPI_DIR	Active Connection	6820CS0_N state	6820CS1_N state
0	MOD_ISO_SPI	0	1
1	ISOSPI2E	1	0

6820CS0_N, 6820CS1_N are chip select monitor signals that may be used to confirm the correct operation of ISOSPI_DIR. They are only read by the secondary microcontroller.

Flash Code Output

The ECU has a dedicated external low side driver suitable for flashing an LED.

The flash sequence represents a set of codes. Each code is a three digit number, where each digit is flashed a number of times equal to its value. An example would be the flash sequence for code 113. The flash sequence is broken down into a series of marks, or on and off pulses as follows:



Each of the marks lasts for a specific duration:

Mark	Duration and meaning
Start of log mark	3s — marks the start of the flash code list
Digit mark	1s — marks the start of a digit
dn	ns — n digits, where the output is turned OFF for 0.5 second, then ON for 0.5 seconds, n times
End code mark	3s — marks the end of a code (i.e., end of 3 digits)

After the end code mark, the ECU will either flash the next code, or return to the start of the list and flash the first code. The ECU always has at least one code to flash.

Each code represents information about the ECU state. If there is no flash sequence, or a malformed flash sequence, then the ECU is malfunctioning. Otherwise, the flash sequence will represent one of the following codes:

Code	Meaning
111	In application mode — no other condition has been detected.
112	In reprogramming mode with the FEPS pin negative.
113	In reprogramming mode with the FEPS pin high.
114	In reprogramming mode via a FEPS-less reprogramming request.
115	In reprogramming mode because no valid application software exists.
116	In reprogramming mode due to FEPS pin electrical failure.
117	In reprogramming mode due to repeated reset during application mode.
118	In reprogramming mode due to failed application checksum tests.
128	In reprogramming mode due to failed memory check tests.

Code	Meaning
119	In reprogramming mode due to a FEPS-less ISO reprogramming request.
121	In reprogramming mode due to an unknown failure.
123	In reprogramming mode due to a watchdog reset.
222	In reprogramming mode due to the application not having a valid license.

FEPS

The ECU can run in one of two system modes: reprogramming mode and application mode. In reprogramming mode, both processors of the ECU can be reprogrammed with application software from a calibration tool. In application mode, the ECU runs the programmed application software.

The ECU enters reprogramming mode either by measuring a dedicated external pin called FEPS at power up, or when attempting to reflash over CCP when the application is not inhibiting reprogramming.

Voltage	System mode
< -16V	Enter reprogramming mode. Use the default CCP settings: **Bus:** PT-CAN **Baud rate:** 500kbps **CRO:** 0x6F9 **DTO:** 0x6F8 **Station:** 0 Use the default UDS settings: **Bus:** PT-CAN **Baud rate:** 500kbps **Functional ID:** 0x7DF **Physical ID:** 0x7E0 **Response ID:** 0x7E8
> -16V	Enter application mode if valid application software has previously been programmed, otherwise enter reprogramming mode.

CAN

Three CAN interfaces are implemented:

Name	Description
PT-CAN	Vehicle power-train CAN
MOD-CAN	Battery internal CAN
SEC-CAN	BMU internal CAN to secondary microcontroller

Note: Reprogramming over CAN is only supported when the Vehicle Wake (Ignition) signal is asserted.

BMU Blockset

Supported Blocks

The BMU supports the following blocks from the OpenECU blockset.

Note: The BMU blockset functionality sometimes differs from that described by OpenECU blockset documentation. Each block below references supplemental information to clarify BMU functionality and feature support.

Note: Many blocks include provisions to support simulation behaviors. This functionality is provided for convenience only. The behavior under simulation is not guaranteed to corresponds to the behavior of the embedded software.

- brtc_Control
- bspi_Transaction
- bspi_TransactionStatus
- pai_BasicAnalogInput
- pcp_CCPConfiguration
- pcp_CCPInhibitReprogramming
- pcp_CCPRxCount
- pcp_CCPSecurity
- pcp_RasterConfig
- pcx_BusStatus
- pcx_CANConfiguration
- pcx_CANReceiveMessage
- pcx_CANTransmitMessage
- pcx_CANdb_ReceiveMessage
- pcx_CANdb_TransmitMessage
- pdd_DataInput
- pdg_ExtendedDataRecord
- pdg_InfotypeInput
- pdg_Permissions
- pdg_RoutineControl
- pdtc_ClearAll
- pdtc_ClearAllIfActive
- pdtc_ClearAllIfInactive
- pdtc_ClearDtcs
- pdtc_Control
- pdtc_DiagnosticTroubleCodeExt
- pdtc_EnablePeriodicLampUpdates
- pdtc_MatchExists
- pdtc_Memory
- pdtc_Table
- pdtc_TableCleared
- pdx_DigitalInput
- pdx_DigitalOutput

- pdx_PWMVariableFrequencyOutput
- pff_Configuration
- pff_FreezeFrame
- piso_Configuration
- pkn_TaskDuration
- pkn_TaskPeriodOverrun
- pmem_MemoryConfiguration
- pnv_File
- pnv_FileFlush
- pnv_FileStats
- pnv_FilesystemInfo
- ppid_Pid
- ppid_Scaling
- preg_RetrieveKey
- psc_AppBuildDate
- psc_AppVersion
- psc_CpuLoading
- psc_CvnCalc
- psc_KickWatchdog
- psc_PlatformBuildDate
- psc_PlatformPartNumber
- psc_PlatformVersion
- psc_PrgBuildDate
- psc_PrgPartNumber
- psc_PrgVersion
- psc_ResetCount
- psc_StackUsed
- psc_UnstableResetCount
- ptm_RealTime
- put_Identification
- put_Reset

Supplemental Blockset Information

Additional considerations for the BMU blockset are captured here.

brtc_Control

The RTC device must be reset by the application following an RTC generated wake event. If the device is not reset, then then the circuit responsible for waking the ECU will continue to dissipate power. Failure to reset the device in a timely manner when FUSE_LS voltages are above 350V at maximum operating temperature may damage the hardware.

bspi_Transaction

None.

bspi_TransactionStatus

None.

pai_BasicAnalogInput

None.

pcp_CCPConfiguration

If no configuration block exists in the model, CCP communications are disabled when the model is running. When reprogramming, the following default settings are used:

CRO:	0x6F9
DTO:	0x6F8
Station:	0

pcp_CCPInhibitReprogramming

None.

pcp_CCPRxCount

None.

pcp_CCPSecurity

Limitations

- No delay is enforced following failed seed-key exchanges.

Known Behaviors

- “Calibration” access is not required to obtain “Data acquisition” access.

pcp_RasterConfig

Limitations

- A combined maximum of 120 ODTs may be configured, not 254 as the user documentation suggests.

pcx_BusStatus

None.

pcx_CANConfiguration

Limitations

- Only 500 kBps baud rate is in scope.

pcx_CANReceiveMessage

Limitations

- Field start bit, width, sign, and type codes are not configurable.

Known Behaviors

Field Mnemonics

- Providing fewer than 8 entries in the “Field Mnemonics” parameter will result in some outports not being named. The signals at the unnamed outports may still be used.
- Providing greater than 8 entries in the “Field Mnemonics” parameter will result in corruption in the mask displayed on the block but the outport signals will be usable as normal.

Outport behavior deviations/clarifications:

- error_flag:

  The error_flag port is *not* set to 1 due to a detected bus-off state. The error_flag port is *not* set to 1 when the bus specified for reception is not configured.

- rx_trig_flag:

  The rx_trig_flag is set *whenever* a message of the specified ID is received and the data-link layer checksum is valid. It is set *even if the message length differs from the expected length*.

pcx_CANTransmitMessage

Limitations

- Field start bit, width, sign, and type codes are not configurable.

Known Behaviors

Field Mnemonics

- Providing fewer than 8 entries in the “Field Mnemonics” parameter will result in some inports not being named. The signals at the unnamed inports may still be used.
- Providing greater than 8 entries in the “Field Mnemonics” parameter will result in corruption in the mask displayed on the block but the inport signals will be usable as normal.

Limitations

- A platform managed checksum in the final byte is out of scope.
- CANdb signals of type “double” are not supported.
- Reception of CANdb messages *without* signals is not supported.

Known Behaviors

Loss of precision/accuracy:

Limitations described for the pcx_CANdb_TransmitMessage block apply to this block as well.

Outport behavior deviations/clarifications:

- error_flag:

  The error_flag port is *not* set to 1 due to a detected bus-off state. It *is* set if the received message length differs from that specified by the CANdb. The error_flag port is *not* set to 1 when the bus specified for reception is not configured.

- rx_trig_flag:

  The rx_trig_flag is set *whenever* a message of the specified ID is received and the data-link layer checksum is valid. It is set *even if the message length differs from the expected length*.

- timestamp:

  This timestamp is updated whenever the rx_trig_flag is set.

- Signal ports:

  Signal ports are updated whenever the rx_trig_flag is set. During simulation, raw signal outports are inappropriately clipped to engineering values.

  Warning: The outports may contain invalid values if the received message length differs from the expected.

  All CAN message signals should latched by application logic only when rx_trig_flag is set and error_flag is not set.

- RAW Signal ports:

  The RAW values are always reported as unsigned integers. If the CANdb signal is signed, then the application is responsible for conversion into a signed value. 32-bit signals may be converted by casting. Signals less than 32-bits must be sign extended to 32-bits prior to casting.

pcx_CANdb_TransmitMessage

Limitations

- A platform managed checksum in the final byte is out of scope.
- CANdb signals of type “double” are not supported.
- Transmission of CANdb messages *without* signals is not supported.

Known Behaviors

Loss of precision/accuracy:

Platform conversion between raw and engineering values can result in loss of precision/accuracy. (The block temporarily converts all signals to single-precision floating point numbers while applying linear conversions.)

1. Engineering values are typically packed/unpacked with accuracy of +/- the CANdb scale factor for that signal.
2. If the signal length is greater than 23 bits, greater error may occur due to floating-point precision loss.

Example 1: Consider a transmit block that sends a temperature (in degrees Fahrenheit) packed as an 8-bit integer with scale 2 and offset 0. A block input value of 89.9 is packed and transmitted as either 88 or 90.

Example 2: Consider a receive block that extracts a rolling counter packed as a 32-bit integer with scale 1 and offset 0. A count value of 4294967060 (that is, 2^32 - 236) is unpacked as 4294967040 (an error of -20).

> **Warning:** Floating-point precision loss can cause extreme values of a data type to be packed/unpacked with large error (e.g. 2^27 - 1 is packed as “0” in a unsigned integer of length 27). This may be avoided by carefully specifying the engineering limits (e.g. [0, 134217720] in the case of a 27-bit unsigned integer).

Outport clarifications:

- Request, overwrite, and ack counters wrap after reaching 65535.

pdd_DataInput

None.

pdg_ExtendedDataRecord

None.

pdg_InfotypeInput

None.

pdg_Permissions

None.

pdg_RoutineControl

None.

pdtc_ClearAll

Limitations

- J1939 DTCS and associated functionality/parameters are out of scope.

pdtc_ClearAllIfActive

Limitations

- J1939 DTCS and associated functionality/parameters are out of scope.

pdtc_ClearAllIfInactive

Known Behaviors

- Previously active DTCs are considered inactive.

Limitations

- J1939 DTCS and associated functionality/parameters are out of scope.

pdtc_ClearDtcs

Limitations

- J1939 DTCS and associated functionality/parameters are out of scope.

pdtc_Control

None.

pdtc_DiagnosticTroubleCodeExt

Limitations

- J1939 DTCS and associated functionality/parameters are out of scope.

pdtc_EnablePeriodicLampUpdates

None.

pdtc_MatchExists

Limitations

- J1939 DTCS and associated functionality/parameters are out of scope.

pdtc_Memory

Limitations

- Storage location 'Battery Backed RAM' is not supported.

pdtc_Table

None.

pdtc_TableCleared

Limitations

- J1939 DTCS and associated functionality/parameters are out of scope.

pdx_DigitalInput

None.

pdx_DigitalOutput

Known Behaviors

- A sample time parameter is not present. The block inherits sample time from the signals connected to inports.

pdx_PWMVariableFrequencyOutput

Limitations

- The minimum output frequency is ~24 Hz.
- The offset parameter is not supported.

Known Behaviors

- The ‘Minimum duty cycle’ parameter range is [0,0.9].
- The ‘Maximum duty cycle’ parameter range is [0.1,1].

pff_Configuration

Limitations

- J1939 DTCS and associated functionality/parameters are out of scope.

pff_FreezeFrame

Limitations

- J1939 DTCS and associated functionality/parameters are out of scope.

Known Behaviors

- It is possible to configure a single freeze frame block for both J1979 (freeze frame) and UDS (snapshot). If this occurs, then the both the freeze frame and the snapshot will follow the J1979 deletion rules.
- PIDs that are not defined in the application may be listed in the PIDs to capture field. The application will build, but the freeze frame may not behave as expected during runtime.
- Non-volatile PIDs may be listed in the PIDs to capture field. The application will build, but the freeze frame may not behave as expected during runtime.

piso_Configuration

Known Behaviors

- The “Functional receive ID” value is used only during application execution. “0x7DF” is always used by the firmware. The physical request and response IDs configured by the application, however, are used by the firmware if the application is valid.
- The Service $03 response parameter must be set to “Transmit Active and Previously Active DTCs” to provide J1979 compliant Service $03 behavior.

pkn_TaskDuration

Limitations

- The “Sample time (task)” and “Sample time (block)” parameters are restricted to the range [0.001, 53] seconds instead of the documented range of [0.001, 3600] seconds to ensure accurate task durations reported by this block. The “duration” outport is restricted to the range [0, 53000000] microseconds.

pkn_TaskPeriodOverrun

Limitations

- This block reports overruns for application defined tasks. There are several tasks that are defined by the platform software rather than the application configuration. The platform defined tasks must also be monitored for skips and overruns. Platform task skips and overruns are reported by the pdd_DataInput block.

pmem_MemoryConfiguration

Two memory configurations are supported.

Configuration	Description
A	On-line calibration **enabled**.
B	On-line calibration **disabled**.

When on-line calibrations are disabled, calibrations are read directly from flash.

pnv_File

None.

pnv_FileFlush

None.

pnv_FileStats

None.

pnv_FilesystemInfo

None.

ppid_Pid

Limitations

- Mask dialog check box parameters “KWP (8-bit)” and “J1939 (SPN)” are not in scope and should not be checked.

Mask Visibility Rules:

- “1979 (8 bit)” check box is visible if “Non-volatile storage” is *not* checked.
- J1979 (8 bit) “ID” select box is visible if “J1979 (8 bit)” is checked.
- “ISO (16 bit)” check box is always be visible.
- ISO (16 bit) “ID” select is visible if “ISO (16 bit)” is checked.
- “ReadScalingByIdentifier (UDS $24) support” check box is visible if

  - “ISO (16 bit)” is checked.
  - “Non-volatile storage” is *not* checked.

- “Scaling Data Type” select box is visible if “ReadScalingByIdentifier (UDS $24) support” is checked.

- “Number of data bytes” text box is visible if “Scaling data type” is *not* “F: Manually enter scaling bytes”.

- “Mask Bytes” is visible if “Scaling Data Type” is “2: Bit Mapped - specify mask below”.

- “Manual entry scaling bytes” text box is visible if “Scaling data type” *is* “F: Manually enter scaling bytes”.

- “Specify scaling formula?” check box is visible if “Scaling data type” is one of the following:

  - “0: Unsigned Numeric”
  - “1: Signed Numeric”
  - “4. Binary Coded Decimal”
  - “5. State Encoded Variable”
  - “6. ASCII”
  - “7: Signed Floating Point”
  - “8: Packet”

- “Formula type” select box is visible if “Specify scaling formula?” is checked.

- “C0” text box is visible if:

  - “Specify scaling formula?” is checked.
  - “Formula type” contains “C0” in the selected formula.

- “C1” text box is visible if:

  - “Specify scaling formula?” is checked.
  - “Formula type” contains “C1” in the selected formula.

- “C2” text box is visible if:

  - “Specify scaling formula?” is checked.
  - “Formula type” contains “C2” in the selected formula.

- “Custom Formula Bytes” text box is visible if:

  - “Specify scaling formula?” is checked.
  - “Formula type” is “A: custom / manufacturer defined”

- “Specify engineering units?” check box is visible if “Scaling data type” is one of the following:

  - “0: Unsigned Numeric”
  - “1: Signed Numeric”
  - “4. Binary Coded Decimal”
  - “5. State Encoded Variable”

    - “6. ASCII”
    - “7: Signed Floating Point”
    - “8: Packet”

- “Units” select box is visible if “Specify engineering units?” is checked.

- “Use Unit Prefix?” check box is visible if “Specify engineering units?” is checked.

- “Unit prefix” select box is visible if “Use Unit Prefix?” is checked.

- “Specify state and connection type?” check box is visible if “Scaling data type” is *not* “F: Manually enter scaling bytes”.

- “Signal Type” select box is visible if “Specify state and connection type?” is checked.

- “Active State Definition” select box is visible if “Specify state and connection type?” is checked.

- “Active Signal Definition” is visible if “Specify state and connection type?” is checked.

- “Signal HW Configuration”** is visible if “Specify state and connection type?” is checked.

- “Scaling bytes sent to test tool”** is visible if “ReadScalingByIdentifier (UDS $24) support” is checked.

- “Allows IOControl” check box is visible if

    - “ISO (16 bit)” is checked.
    - “Non-volatile storage” is *not* checked.

- “Resend input as output” check box is visible if “Allows IOControl” is checked.

- “Number of controlEnableMask bytes expected” text box is visible if “Allows IOControl” is checked.

Known Behaviors

- “String PID” check box and associated parameters are not accessible.
- The “write_to_nv” inport is rising-edge triggered.
- Fields may remain when configurations are changed in the block that should cause them to be hidden. These fields may be ignored. Alternately the block may be replaced with a new copy added from the library.
- Extra outports may remain when configurations are changed in the block. They are corrected when the diagram is updated or the model is built
- Fields that are automatically added or hidden may not appear automatically following a change. To ensure the correct fields are present, always use the ‘apply’ button to apply the change.
- The ‘Specify State and Connection Type’ may be hidden in some circumstances when it should be available. It can be avoided by replacing the block with a new copy from the library, and avoiding selecting and de-selecting unnecessary configuration options.
- The ‘write_to_nv’ inport is rising edge triggered.

- “Scaling bytes sent to test tool” text box is never enabled for editing. It is a read only field intended to provide information to the developer.

ppid_Scaling

None.

preg_RetrieveKey

None.

psc_AppBuildDate

None.

psc_AppVersion

None.

psc_CpuLoading

None.

psc_CvnCalc

Known Behaviors

- when runtime calibration changes are made via CCP, the currently calculated CVN will be invalidated, and the “available” outport will be set to FALSE until the CVN is recalculated with a rising edge on the “trigger” inport.
- after the CVN has been calculated for the first time, it will be automatically stored in NVM, and recalled by the block during initialization on the next reset. The “available” and “cvn” outport will be updated with the previously calculated results after a power cycle.

psc_KickWatchdog

The watchdog expires after one timer period. If no psc_KickWatchdog block is present in the model, the platform kicks the watchdog periodically in a low priority task.

Description	Period (ms)
Watchdog Timeout	120
Platform Watchdog Servicing	60

psc_PlatformBuildDate

None.

psc_PlatformPartNumber

None.

psc_PlatformVersion

None.

psc_PrgBuildDate

None.

psc_PrgPartNumber

None.

psc_PrgVersion

None.

psc_ResetCount

None.

psc_StackUsed

None.

psc_UnstableResetCount

None.

ptm_RealTime

None.

put_Identification

Limitations

- Only “Generic Pin Naming” applies.

Known Behaviors

- Non-volatile memory storage fails if any of the major/minor/sub-minor version numbers exceed 255.

Warning: The application developer must ensure all version numbers are within [0, 255].

- The *mpl_* automatic ASAP2 entries are not available when Simulink data dictionaries are used.
- The “Application name” mask parameter %target% token is replaced by M550_000 instead of BMU_000.

put_Reset

Known Behaviors

- The *fp_reset* outport will never be set. Floating point exceptions are disabled.
- The *boot_duration* outport reports the boot duration incorrectly at half of the actual boot duration.

Diagnostic Service Information

Supported Diagnostic Services

The BMU supports the following diagnostic services. This list is a subset of the services described in the OpenECU user guide.

J1979 Service 0x01

Request Current Powertrain Diagnostic Data

This service reports J1979 8-bit PIDs

Justification

Support provided as a result of a direct requirement in the SOR.

Associated blocks:

- ppid_Pid
- piso_Configuration

J1979 Service 0x02

Request Powertrain Freeze Frame Data

This service reports emissions related freeze frames

Justifications

Support provided as a result of a requirement in the SOR to capture J1979 freeze frames.

Associated blocks:

- ppid_Pid
- pff_FreezeFrame
- piso_Configuration

J1979 Service 0x03

Request Emission-Related Diagnostic Trouble Codes

This service reports only DTCs that are classified as emissions related Justification: Supported as a result of a direct requirement in the SOR.

Justification

Supported provided as a result of a direct requirement in the SOR.

Associated blocks

- pdtc_DiagnosticTroubleCodeExt
- piso_Configuration

Negative Response Codes

0x12 subFunctionNotSupported-InvalidFormat

J1979 Service 0x04

Clear/Reset Emission-Related Diagnostic Information

Clears only DTCs defined as emission-related

Justification

Supported provided as a result of a direct requirement in the SOR.

Associated blocks

- pdtc_DiagnosticTroubleCodeExt
- piso_Configuration

Negative Response Codes

0x22 conditionsNotCorrectOrRequestSequenceError

J1979 Service 0x07

Request Emission-Related Diagnostic Trouble Codes Detected During Current or Last Completed Driving Cycle

Fetch pending diagnostic trouble codes

Justification

Supported provided as a result of a direct requirement in the SOR.

Associated Blocks

- pdtc_DiagnosticTroubleCodeExt
- piso_Configuration

Negative Response Codes

0x12 subFunctionNotSupported-InvalidFormat

J1979 Service 0x09

Request Vehicle Information

Request vehicle specific information

Justification

Supported provided as a result of a direct requirement in the SOR.

Associated Blocks

- pdg_InfotypeInput

J1979 Service 0x0A

Request Emission-Related Diagnostic Trouble Codes with Permanent Status

Fetch confirmed DTCs with permanent status

Justification

Supported provided as a result of a direct requirement in the SOR.

Associated Blocks

- pdtc_DiagnosticTroubleCodeExt
- piso_Configuration

Negative Response Codes

0x12 subFunctionNotSupported-InvalidFormat

UDS Service 0x10

DiagnosticSessionControl

Enables different diagnostic sessions

Justification

Required for access to reprogramming mode and some other services

Negative Response Codes

- 0x12 sub-functionNotSupported
- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x22 conditionsNotCorrect
- 0x78 requestCorrectlyReceived-ResponsePending

Associated Blocks

- pdg_Permissions
- pdd_DataInput

UDS Service 0x11

ECUReset

Request the ECU to reset

Justification

Required for transition from firmware to application after reprogramming

Limitations

- Supported in reprogramming mode only
- Physical ID only

- Limited subfunction support:
    - 0x01 (Hard reset)
    - 0x03 (soft reset)

Negative Response Codes

- 0x11 serviceNotSupported
- 0x12 sub-functionNotSupported
- 0x13 incorrectMessageLengthOrInvalidFormat

UDS Service 0x14

ClearDiagnosticInformation

Clears diagnostic information from memory

Justification:

Required for clearing stored DTC and snapshot information

Associated Blocks

ppid_Pid pff_FreezeFrame pdtc_DiagnosticTroubleCodeExt

Negative Response Codes

- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x31 requestOutOfRange

UDS Service 0x19

ReadDTCInformation

Reads the status of a DTC

Justification:

Required for reporting DTC information

Limitations

Limited subfunction support

- 0x01 reportNumberOfDTCByStatusMask
- 0x02 reportDTCByStatusMask
- 0x03 reportDTCSnapshotIdentification
- 0x04 reportDTCSnapshotRecordByDTCNumber
- 0x06 reportDTCExtDataRecordByDTCNumber
- 0x07 reportNumberOfDTCBySeverityMaskRecord
- 0x08 reportDTCBySeverityMaskRecord
- 0x09 reportSeverityInformationOfDTC
- 0x0A reportSupportedDTC
- 0x0B reportFirstTestFailedDTC
- 0x0C reportFirstConfirmedDTC
- 0x0D reportMostRecentTestFailedDTC
- 0x0E reportMostRecentConfirmedDTC
- 0x12 reportNumberOfEmissionsRelatedOBDDTCByStatusMask
- 0x13 reportEmissionsRelatedOBDDTCByStatusMask

Limited DTCStatusMask support:

- 0x01 testFailed
- 0x02 testFailedThisOperationCycle
- 0x04 pendingDTC
- 0x08 activeDTC
- 0x80 warningIndicatorRequested

Associated Blocks

ppid_Pid pff_FreezeFrame pdtc_DiagnosticTroubleCodeExt

Negative Response Codes

- 0x12 sub-functionNotSupported
- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x31 requestOutOfRange

UDS Service 0x22

ReadDataByIdentifier

Read data record values identified by one or more dataIdentifiers

Justification:

Required for reporting values by 16-bit PID

Associated Blocks

ppid_Pid

Negative Response Codes

- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x14 responseTooLong
- 0x31 requestOutOfRange

UDS Service 0x23

ReadMemoryByAddress

Read data in memory by address and size

Justification:

Required for reading memory

Associated Blocks

piso_configuration

Negative Response Codes

- 0x12 sub-functionNotSupported
- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x31 requestOutOfRange
- 0x33 securityAccessDenied

UDS Service 0x24

ReadScalingDataByIdentifier

Request scaling data for a 16-bit PID

Justification:

Required for reporting values by 16-bit PID scaling data

Associated Blocks

ppid_Pid

Negative Response Codes

- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x31 requestOutOfRange

UDS Service 0x27

SecurityAccess

Access data or diagnostic services which have restricted access

Justification:

Required to support seed-key security

Limitations

- Physical addressing only
- Optional parameter securityAccessDataRecord is not supported

Associated Blocks

pdg_Permissions

Negative Response Codes

- 0x12 sub-functionNotSupported
- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x22 conditionsNotCorrect
- 0x24 requestSequenceError
- 0x35 invalidKey
- 0x7F serviceNotSupportedInActiveSession

UDS Service 0x28

CommunicationControl

Switch on/off the transmission/reception of certain messages

Justification:

Required to manage bus load

Limitations

- nodeIdentificationNumber not supported
- Limited subfunction support
    - 0x00 enableRxAndTx
    - 0x01 enableRxAndDisableTx
    - 0x02 disableRxAndEnableTx
    - 0x03 disableRxAndTx

Negative Response Codes

- 0x12 sub-functionNotSupported
- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x22 conditionsNotCorrect
- 0x31 requestOutOfRange
- 0x7F serviceNotSupportedInActiveSession

UDS Service 0x2E

WriteDataByIdentifier

Write data to the location specified by a PID

Justification:

Required for writing values by 16-bit PID

Limitations

Physical addressing only

Associated Blocks

ppid_Pid

Negative Response Codes

- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x31 requestOutOfRange
- 0x22 conditionsNotCorrect
- 0x72 generalProgrammingFailure

UDS Service 0x31

RoutineControl

Execute a defined sequence of steps and obtain any relevant results

Justification:

Required for reprogramming support as well as arbitrary application based routines.

Limitations

Physical addressing only

Associated Blocks

pdg_RoutineControl

Negative Response Codes

- 0x12 sub-functionNotSupported
- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x22 conditionsNotCorrect
- 0x31 requestOutOfRange
- 0x24 requestSequenceError
- 0x33 securityAccessDenied
- 0x72 generalProgrammingFailure
- 0x78 requestCorrectlyReceived-ResponsePending

UDS Service 0x34

RequestDownload

Initiate a data transfer to the ECU

Justification

Required for transferring data during reprogramming

Limitations

- Physical addressing only
- Supported in reprogramming mode only
- compressionMethod not supported
- encryptionMethod not supported

Negative response codes

- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x31 requestOutOfRange
- 0x22 conditionsNotCorrect
- 0x33 securityAccessDenied
- 0x70 uploadDownloadNotAccepted
- 0x7F serviceNotSupportedInActiveSession

UDS Service 0x36

TransferData

Transfer data to or from the ECU

Justification

Required for transferring data during reprogramming

Limitations

- Physical addressing only
- Supported in reprogramming mode only

Negative response codes

- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x24 requestSequenceError
- 0x71 transferDataSuspended
- 0x72 generalProgrammingFailure
- 0x73 wrongBlockSequenceCounter
- 0x7F serviceNotSupportedInActiveSession

UDS Service 0x37

RequestTransferExit

Terminate a data transfer

Justification

Required to end a data transfer during reprogramming

Limitations

- Physical addressing only
- Supported in reprogramming mode only

- transferRequestParameterRecord is not supported

Negative response codes

- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x24 requestSequenceError
- 0x72 generalProgrammingFailure
- 0x7F serviceNotSupportedInActiveSession

UDS Service 0x3E

TesterPresent

Indicate that the connection is still present and certain services that have been previously active are to remain active

Justification:

Mandatory for support of other services

Negative Response Codes

- 0x12 sub-functionNotSupported
- 0x13 incorrectMessageLengthOrInvalidFormat

UDS Service 0x85

ControlDTCSetting

Stop or resume the updating of DTC status bits

Justification:

This service was used in the EPB application

Limitations

- Limited subfunction Support
    - 0x01 on
    - 0x02 off
- DTCSettingControlOptionRecord is not supported

Associated Blocks

pdtc_DiagnosticTroubleCodeExt

Negative Response Codes

- 0x12 sub-functionNotSupported
- 0x13 incorrectMessageLengthOrInvalidFormat
- 0x7F serviceNotSupportedInActiveSession