

RoadRelay 4 Open Interface Specification

1	Physical Interface Requirements	4
1.1	Baud Rate	4
1.2	Connector Type	4
1.3	Device Readiness.....	4
2	Open Interface Protocol.....	4
2.1	Definitions	4
2.2	Non-Volatility of Configuration data	5
2.3	Interface Protocol	5
2.3.1	Lines	6
2.3.2	Instructions	6
2.3.3	File Streams	6
2.4	Line Identifier Descriptions	7
2.4.1	Summary of Line Identifiers.....	7
2.4.2	CAP - Capture Data	8
2.4.3	CCELL – Configure Cellular.....	8
2.4.4	CDID – Configure Driver ID.....	8
2.4.5	CLR – Clear the captured-data buffer.....	9
2.4.6	CM – Configure Messages	10
2.4.7	CMISC – Configure Miscellaneous Items	10
2.4.8	CPM – Configure Preventative Maintenance	11
2.4.9	CPORT – Configure Functionality of RoadRelay 4 Ports	12
2.4.10	CPU – Configure Pop-ups	12
2.4.11	CR– Configure Route	13
2.4.12	CSFUNC – Configure Functions for the Security Feature	14
2.4.13	CSREG – Configure Register Values for the Security Feature	15
2.4.14	CTRIP – Configure Trip.....	15
2.4.15	CUOM – Configure Units of Measure	15
2.4.16	CVAT – Configure Vehicle Antitheft	16
2.4.17	END – End of File Stream.....	16
2.4.18	IBH – Information for Brake Histograms.....	17
2.4.19	ICIPH – Information for Ciphers.....	17
2.4.20	IDID – Information for Device IDs	18
2.4.21	IECM – Information for Engine Control Module.....	18
2.4.22	IESH – Information for Engine Speed/Road Speed Histograms.....	18
2.4.23	IF – Information for Faults.....	20
2.4.24	IGPS – GPS Information	20
2.4.25	IID – Identification Information	20
2.4.26	IPME – Information for Preventative Maintenance Interval Elapsed Information.....	21
2.4.27	IPST – Information for Panic Stop Time.....	21
2.4.28	IR – Information for Route.....	21
2.4.29	IRR – Information for RoadRelay 4.....	22
2.4.30	IRSRT – Information for Road Speed Recorder Stop Time.....	23
2.4.31	ISEED – Information for Security Key Seed.....	23
2.4.32	ISS – Information for a Stop Sample.....	23
2.4.33	IT – Information for Trip.....	23
2.4.34	IUTC – Universal Time Coordinated Information	26
2.4.35	LOCK – Disallow Access to RoadRelay 4 Functionality.....	26
2.4.36	NOK – Not all commands successfully executed.....	27
2.4.37	OK – All commands successfully executed.....	29

2.4.38	REM - Remarks	30
2.4.39	RESET – Reset Data Item	30
2.4.40	RGPS – Request GPS Data	30
2.4.41	RID – Request Device ID	30
2.4.42	RUTC – Request UTC Data	30
2.4.43	SDID – Set Driver ID	31
2.4.44	SND – Send Data File Stream	31
2.4.45	START - Beginning of a file stream	32
2.4.46	UNLOCK - Allow Access to RoadRelay 4 Functionality	32
2.4.47	WPB – Write Parameter Block	33
2.5	RoadRelay 4 File Stream Descriptions	33
2.5.1	Controlled cipher data - cdciphVID	33
2.5.2	Controlled diagnostic stack data - cddsVID	33
2.5.3	Controlled fault data - cdfaultVID	33
2.5.4	Controlled gps data - cdgpsVID	33
2.5.5	Controlled captured histogram data - cdhistoVID	33
2.5.6	Controlled Preventative Maintenance elapsed interval data - cdpmeVID	34
2.5.7	Controlled captured Route data - cdrouteVID	34
2.5.8	Controlled seed data - cdseedVID	34
2.5.9	Controlled captured stop data - cdstopVID	34
2.5.10	Controlled captured trip data - cdtripVID	35
2.5.11	Control files - controlVID	35
2.5.12	Snapshot event log Information – sseventlogVID	35
2.5.13	Snapshot RoadRelay 4 Information – ssrrinfoVID	36
2.5.14	Snapshot Trip Information – sstripVID	36
3	Examples	36
3.1	Example showing a request to RoadRelay 4 for capture and retrieval of data	36
3.2	Example showing request to RoadRelay 4 to send data	37
3.3	Example showing a change of configuration on a locked RoadRelay 4	38
3.4	Example showing a configuration change to RoadRelay 4	39
3.5	Example showing request to RoadRelay 4 (rr85) using addressing	39

REVISION HISTORY

Date	Name	Description
04/10/01	A.F.Muellenbach	Created
05/17/01	A.F.Muellenbach	PRCR 42785 Added configurations
05/30/01	A.F.Muellenbach	PRCR 42982 Added security feature
06/13/01	A.F.Muellenbach	PRCR 43219 RESET updated to include reset of PM and driver messages SND,GPS and cdgps file stream identifier CPM change for monitor base values CCELL VID not character string
07/05/01	A.F.Muellenbach	PRCR 43583 Connector names; SND,GPS details; add RID/IID/IDID/ssrrinfo changes; remove NOK,4 supplemental data; add CUOM ; add CPORT; add IPME and cdpm file.
07/31/01	A.F.Muellenbach	PRCR 43583 Updated CR description, CPORT, IECM, LOCK, OK, and UNLOCK updates; Add SND,cdds and RESET,DS.
	A.F.Muellenbach	Updated examples, removed INFORM/INSPEC columns, Updated NOK
06/25/02	A.F.Muellenbach	Added sstripVID description. Added differences between 4.3 and 4.4 calibrations for the IESH and IBH line identifiers.
08/16/02	A.F.Muellenbach	Added defaults. Removed INFORM names. Added updates to CMISC and IT for 4.4L02 calibration.
12/10/02	A.F.Muellenbach	Modified controlVID description. Added CLR to capture-data example. Updated ssrrinfo request example. Added configuration example.
12/17/02	A.F.Muellenbach	Added changes for 4.5 release. This includes the addition or modification of CDID, CTRIP, SDID, NOK, IT, LOCK, STAT, CPU, IF, IECM
03/31/03	M.A. Rebman	Added WPB

1 Physical Interface Requirements

1.1 Baud Rate

The connection shall be RS-232 using 9600 baud, 8 data bits, no parity, 1 stop bit. No flow control.

1.2 Connector Type

The RoadRelay 4 physical connection is a male, 10-pin, Packard connector. This connector supports two RS-232 connections. Either may be used for connection. If constructing your own cable, be sure to connect pins A and J for back-up battery connection.

Cavity Position	Signal Names
A	Battery(-)
B	Wake-up+
C	Digital Input
D	RS-232 RXD Port 2
E	RS-232 RXD Port 1
F	RS-232 TXD Port 1
G	Digital Output
H	Pull-down wake up
J	Back-up Battery(-)
K	RS-232 TXD Port 2

Packard P/N 12064769 Connector 10 Pos.

1.3 Device Readiness

The RoadRelay 4 shall assume that if keyswitch is ON, the device is ready.

2 Open Interface Protocol

2.1 Definitions

- Line - A line consists of a character stream with a carriage return and/or line feed termination. The first element in any line will be a Line Identifier.
- File Stream - File streams are groupings of lines to be interpreted as a whole. The first line in a file stream contains a START Line Identifier; the last line will contain an END Line Identifier. The END Line will contain a checksum that is used to validate the File Stream integrity prior to execution/acceptance of the file stream contents.
- Instruction - A Line not contained in a file stream.
- Line Identifier - A character-sequence used to identify the contents of the Line as a command or data descriptor. It will always be the first element in a Line.
- Device - Electronic device communicating with RoadRelay 4 through an RS-232 interface.
- VID - Abbreviation for Vehicle ID. Suffix for files returned from the RoadRelay 4. VID is not literally "VID "; it represents the Vehicle ID.

2.2 Non-Volatility of Configuration data

Configuration data is only saved in FLASH at power-down following a key-off. If a power loss occurs- both primary and back-up - after configuring items, the new configurations will not be saved in FLASH. When power is restored the previously saved values will be restored.

2.3 Interface Protocol

The RoadRelay 4 and device shall interact through instructions or file streams.

2.3.1 Lines

- 2.3.1.1 The first element of a Line shall be a Line Identifier.
- 2.3.1.2 Commas shall be used to delineate any further elements in the Line.
- 2.3.1.3 A null field shall indicate that the field is invalid or unused.
- 2.3.1.4 If all data in a line is invalid, the Line shall still be sent.
- 2.3.1.5 Elements that are character strings shall be delineated with quotes (").
- 2.3.1.6 Lines from the RoadRelay 4 shall always be terminated with a carriage return and line feed.
- 2.3.1.7 If extra comma-separated values are in a Line, the receiver shall ignore them and accept the line as valid.
- 2.3.1.8 If fewer-than-expected comma-separated values are in a line, the receiver shall assume the missing items are invalid and accept the received values, unless otherwise noted.
- 2.3.1.9 The RoadRelay 4 will not perform any range checking on values. RoadRelay 4 operation with incorrect data is undefined.
- 2.3.1.10 The RoadRelay 4 shall disallow Lines longer than 90 characters.

2.3.2 Instructions

- 2.3.2.1 An Instruction is not executed until a carriage return and/or line feed is received.
- 2.3.2.2 The RoadRelay 4 shall acknowledge execution of the Instruction by a control File Stream response.

2.3.3 File Streams

- 2.3.3.1 Control file streams contain instructions and responses to file streams. They shall be identified as control if from device or controlVID if from RoadRelay 4.
- 2.3.3.2 Data file streams contain data and shall have unique identifiers to aid in the identification of the data therein.
- 2.3.3.3 START shall indicate the first line of a file stream.
- 2.3.3.4 END shall indicate the last line of a file stream.
- 2.3.3.5 All Lines in a file stream shall appear in any final file derived from the file stream.
- 2.3.3.6 File streams from the RoadRelay 4 shall have a VID suffix in the identifier. This will allow remote software to manage multiple sessions with different RoadRelay 4s. The VID shall be the Written ID if present; else the Engine Serial Number shall be used, if valid; else the VID shall be 0.
- 2.3.3.6.1 Written IDs may only contain alphanumeric characters (0-9, A-Z, a-z).

- 2.3.3.6.2 Engine Serial numbers are valid only if the first 10 characters are alphanumeric characters (0-9, A-Z, a-z).
- 2.3.3.7 The RoadRelay 4 shall disallow File Streams longer than 256 characters.
- 2.3.3.8 Each line in the file stream shall conform to the rules for individual Lines.
- 2.3.3.9 The Lines in a file stream shall not be executed/accepted until the checksum in the final END line is used to verify the file contents.
- 2.3.3.10 If unrecognized Line Identifiers are encountered in a verified file, the lines shall be discarded without assertion of an error.
- 2.3.3.11 All RoadRelay 4 responses shall be in the form of a file stream unless specifically stated otherwise.
- 2.3.3.12 A configurable delay during data transfer will signal an abort. Default will be 5 seconds.
- 2.3.3.13 Control File Streams identify the device as a tool. The device may always change fleet mode-controlled settings through a control file.

2.4 Line Identifier Descriptions

2.4.1 Summary of Line Identifiers

Line Identifier	Description
CAP#	Capture data
CCELL#	Configure Cellular
CLR#	Clear Controlled Data
CM#	Configure Messages
CMISC#	Configure Miscellaneous Items
CPM#	Configure Preventative Maintenance
CPORT#	Configure Functionality of RoadRelay 4 Ports
CPU#	Configure Pop-ups
CR#	Configure Route
CSFUNC#	Configure Functions for the Security Feature
CSREG#	Configure Register Values for the Security Feature
CUOM#	Configure Units of Measure
CVAT#	Configure Vehicle Antitheft
END	End of file stream
IBH	Brake Histogram Information
ICIPH	Information for Ciphers
IDID	Device ID Information
IECM	ECM Information
IESH	Engine Speed Histogram Information
IF	Fault Information
IGPS	GPS Information
IID*	Device ID Information
IPME	Preventative Maintenance Elapsed Interval Information
IPST	Panic Stop Time Information
IR	Route Information
IRR	RoadRelay Information
IRSRT	Road Speed Recorder Time Information
ISEED	Information for Security Key Seed

RoadRelay 4 Open Interface Specification

Rev 1.10.0

Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.

ISS	Stop Information for Panic Stop or Road Speed Recorder
IT	Trip Information
IUTC*	Universal Time Coordinated Information
LOCK#	Disallow Access to RoadRelay 4 Functionality
NOK	Action was not successfully completed
OK	All actions successfully completed
REM	Remarks
RESET#	Reset indicated data
RGPS	Request GPS data
RID	Request device ID
RUTC	Request UTC Time
SND	Send indicated file stream
START	Start of File stream
UNLOCK#	Allow Access to RoadRelay 4 Functionality

* Supported by the device only

Instruction disallowed when in fleet mode

2.4.2 CAP - Capture Data

Certain data within the RoadRelay 4 must be properly managed to maintain data integrity. This data is manipulated using the CAP and CLR commands. The data included is: Trip, Route, Histograms, Stops, and Driver IDs. Upon capture, data is moved to the "captured-data buffer". All of the above data in the RoadRelay 4 is reset. The captured data is then available to be read through a captured-data file. New data can not be captured until the "captured-data buffer" is cleared via a CLR command. If the RoadRelay 4 loses primary and backup battery power sources, the data in the "captured-data buffer" is lost. A CAP line has no following elements. A CAP instruction is disallowed when in fleet mode.

2.4.3 CCELL – Configure Cellular

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution	Default
Written ID. Use this as VID	10 characters max, Must be alpha-numeric	No default
Abort delay.	Numeric 3,0 – seconds	5
Set Real Time clock	Timestamp: yyyy-mm-dd hh:mm:ss	1996-01-01 00:00:00

Cellular configurations

A CCELL instruction is disallowed when in fleet mode.

2.4.4 CDID – Configure Driver ID

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution	Default
------------	------------	---------

RoadRelay 4 Open Interface Specification

Rev 1.10.0

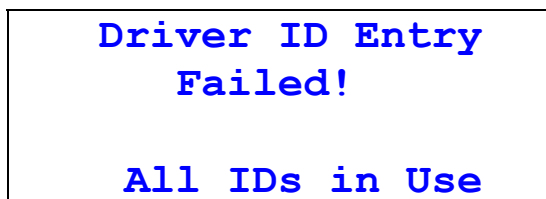
Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.

Definition	Resolution	Default
Trip reset behavior. 0=Reset <u>all</u> Driver IDs when Trip reset. Current driver ID becomes "Other". 1=Reset all but current Driver ID when Trip reset. Current driver ID remains selected. 2=Reset <u>no</u> Driver IDs when Trip reset. Current driver ID remains selected. Note: There are a finite number of Driver IDs – new drivers may not be entered if all IDs are in use.	Numeric 1,0	1
Show driver IDs 0=Disabled. Driver IDs may only be seen when entered. The selection menu only shows "New" or "Other". If all IDs are used, an error message will be shown after the ID is entered. 1=Enabled	Numeric 1,0	1
Force entry of driver ID at key-on. 0=Disabled 1=Enabled. A driver MUST be entered or "Other" must be selected. Failure to select a valid ID will return the user to this screen.	Numeric 1,0	0
The maximum number of Driver IDs allowed. This number does not include "Other". Minimum value is 1, maximum is 15	Numeric 2,0	3
Hide Driver IDs on the Driver ID menu 0=Disabled – IDs are visible on the ID menu 1=Enabled – IDs are not shown on the ID menu. The user must select "Driver New" to enter any ID except "Other".	Numeric 1,0	0

Driver ID configurations

A CDID instruction is disallowed when in fleet mode.

If an attempt is made to enter a driver ID and all IDs are in use, the following screen shall be shown on the RoadRelay 4:



Note: See CMISC command for "Save data by driver." to enable the Driver ID feature.

2.4.5 CLR – Clear the captured-data buffer.

CLR shall cause the RoadRelay 4 to erase all data in the "captured-data buffer". A CLR line has no following elements. A CLR instruction is disallowed when in fleet mode.

RoadRelay 4 Open Interface Specification	Rev 1.10.0
<p>Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.</p>	
9	

2.4.6 CM – Configure Messages

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution	Default
Message Type 0=Power-up message 1=Driver Message 1 2=Driver Message 2 3=Driver Message 3 4=Driver Message 4 5=Driver Message 5 6=Driver Message 6 101= Driver Alert Message 1 102= Driver Alert Message 2 103= Driver Alert Message 3 104= Driver Alert Message 4 105= Driver Alert Message 5 106= Driver Alert Message 6	Numeric 3,0	No default
Message	Character string - 80 characters max	0 – Road Relay 4 Run Hard!!! Dream Big!!! All others no default

Message configurations

A power-up message is shown when the RoadRelay 4 is initially powered.

Driver Messages are stored in a RoadRelay 4 "scratchpad" area for driver access. An unread message causes the text "Message" (if English language selected) to flash periodically in the upper left-hand corner of the RoadRelay 4 display.

A Driver Alert Message will be displayed on the RoadRelay 4 screen for 5 seconds. The display is accompanied by a loud beep. If further messages are received, they will be displayed sequentially; each accompanied by a loud beep. Driver Alert messages are discarded after being displayed.

A CM instruction is disallowed when in fleet mode.

2.4.7 CMISC – Configure Miscellaneous Items

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution	Default
Display PTO data separately. 0=Disabled 1=Enabled	Numeric 1,0	1

Definition	Resolution	Default
Save data by driver. 0=Disabled 1=Enabled	Numeric 1,0	0
Transmission Type. 0=Manual 1=Automatic 2=Top-2	Numeric 1,0	0
Power Down Interval	Numeric 3,0 – seconds	30
Fleet Idle Goal	Numeric 3,0 – percent	20
Add short idle time to drive totals. 0=Disabled 1=Enabled	Numeric 1,0	1
The maximum idle time that will be added to drive totals if short stop is enabled.	Numeric 3,0 – seconds	300
Allow changes to RR4 configuration. 0=Disabled, Fleet mode enabled 1=Enabled, Fleet mode disabled	Numeric 1,0	1
Prevent changes to RR4 Anti-theft configuration. 0=Disabled, Users may change the security mode and anti-theft passwords. 1=Enabled, Users may NOT change the security mode or anti-theft passwords.	Numeric 1,0	0

Miscellaneous configurations

A CMISC instruction is disallowed when in fleet mode.

2.4.8 CPM – Configure Preventative Maintenance

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution	Default
Monitor to be configured (1-4)	Numeric 1,0	No default
PM popup enable. 0=Disabled 1=Enabled	Numeric 1,0	0
The percent complete of the interval that will cause the popup to be displayed	Numeric 3,0 – percent	90
Description of the maintenance that is being monitored by this schedule.	Character string - 20 characters max	Oil Change Tire Change Brake Change Filter Change
The measure used to determine when this PM schedule is complete. 0=Distance 1=Fuel 2=Engine hours 3=Time 4=Date	Numeric 1,0	0 0 0 2

Definition	Resolution	Default
Threshold.	Numeric 8,0 – miles, gallons, hours, days OR Timestamp: yyyy-mm-dd	20000 30000 50000 500
0=Count up 1=Count down	Numeric 1,0	0

Preventative maintenance configurations

A CPM instruction is disallowed when in fleet mode.

2.4.9 CPORT – Configure Functionality of RoadRelay 4 Ports

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution	Default
Request enable/disable Bit 0 = Request ID information on Port 1 (default off) Bit 1 = Request ID information on Port 2 (default off) Bit 2 = Request GPS information on Port 1 (default off) Bit 3 = Request GPS information on Port 2 (default off) Bit 4 = Request UTC information on Port 1 (default off) Bit 5 = Request UTC information on Port 2 (default off)	Numeric 4,0 – hexadecimal	00H

Port Functionality

When enabled to send RID, the RoadRelay 4 will send a RID as described in the RID section.

When enabled to send RGPS, the RoadRelay 4 will send a RGPS as described in the RGPS section.

When enabled to send RUTC, the RoadRelay 4 will send a RUTC as described in the RUTC section.

When any request is enabled, the RoadRelay 4 will immediately send the request. Thus if the RID request is enabled, an immediate request will be sent, though normally it is sent only after power-up.

2.4.10 CPU – Configure Pop-ups

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution	Default
Sweet spot popup enable. 0=Disabled 1=Enabled	Numeric 1,0	0
Sweet spot minimum engine speed.	Numeric 4,0 – RPM	1200
Sweet spot maximum engine speed.	Numeric 4,0 – RPM	1700

RoadRelay 4 Open Interface Specification

Rev 1.10.0

Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.

Definition	Resolution	Default
Engine loaded percent for sweet spot popup.	Numeric 3,0 – Percent	15 if UK or Europe UOM selected 30 if US or Metric UOM selected
Engine over speed popup enable. 0=Disabled 1=Enabled	Numeric 1,0	0
Engine over speed limit.	Numeric 4,0 – RPM	2400
Vehicle over speed popup enable. 0=Disabled 1=Enabled	Numeric 1,0	0
Vehicle over speed limit 1.	Numeric 3,1 – MPH	62
Vehicle over speed limit 2.	Numeric 3,1 – MPH	65
Driver reward popup enable. 0=Disabled 1=Enabled	Numeric 1,0	0
ESP popup enable. 0=Disabled 1=Enabled	Numeric 1,0	0
Warm-up popup enable. 0=Disabled 1=Enabled	Numeric 1,0	0
Engine brake reminder popup enable. 0=Disabled 1=Enabled	Numeric 1,0	0
Engine over speed pop-up delay.	Numeric 2,0 – Seconds	10

Pop-up configurations

A CPU instruction is disallowed when in fleet mode.

2.4.11 CR– Configure Route

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution	Default
Route recording enable. 0=Disabled 1=Enabled	Numeric 1,0	0
The length of time the vehicle must be stopped before the RR4 will end the current route segment.	Numeric 5,0 – seconds	1800
Route Marker Threshold	Numeric 3,0 – miles	200
Continue route on reset 0=Disabled 1=Enabled (No pop-up)	Numeric 1,0	0

Route configurations

A CR instruction is disallowed when in fleet mode.

2.4.12 CSFUNC – Configure Functions for the Security Feature

The RoadRelay 4 contains a bank of 9 functions (F1 – F9) for use by the security feature. F1 through F9 are configurable through the CSFUNC command. Each function consists of 4 operations.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table. Elements left empty result in no change to those values in the function.

Definition	Resolution	Default
Function Number 1 – 9	Numeric 1,0	See table below
Operation 1	2-character ASCII	See table below
Operation 2	2-character ASCII	See table below
Operation 3	2-character ASCII	See table below
Operation 4	2-character ASCII	See table below

Security function configuration

An operation is defined as an action and a register. The operation will use the given action upon the given register to modify the key/seed value. A function is complete when all actions are executed. The 1st operation uses the given seed; subsequent operations use the seed resulting from the previous operations.

Allowed actions are:

Action	Result
	Seed is always 123 register value is always 456
A – Do Nothing	$123 = 123$
B – Add register	$123 + 456 = 579$
C – Add 1 st register digit	$123 + 4 = 127$
D – Add 2 nd register digit	$123 + 5 = 128$
E – Add 3 rd register digit	$123 + 6 = 129$
F – Multiply by [(1 st register digit mod 3) +1]	$123 * [(4 \text{ mod } 3) + 1] = 123 * [1 + 1] = 123 * 2 = 246$
G – Multiply by [(2 nd register digit mod 3) +1]	$123 * [(5 \text{ mod } 3) + 1] = 123 * [2 + 1] = 123 * 3 = 369$
H – Multiply by [(3 rd register digit mod 3) +1]	$123 * [(6 \text{ mod } 3) + 1] = 123 * [0 + 1] = 123 * 1 = 123$
I – Add Sum of all register digits	$123 + (4 + 5 + 6) = 123 + 15 = 138$
J – Add Sum of 1 st and 2 nd register digits	$123 + (4 + 5) = 123 + 9 = 132$
K – Add Sum of 2 nd and 3 rd register digits	$123 + (5 + 6) = 123 + 11 = 134$
L – Add Sum of 1 st and 3 rd register digits	$123 + (4 + 6) = 123 + 10 = 133$

The default values are:

F1 value	F1,G4,D3,E7
F2 value	F1,C6,H3,I4
F3 value	J5,I6,K4,H8
F4 value	B6,H1,D5,L3
F5 value	B4,L2,F9,I7
F6 value	F8,K2,J1,E4
F7 value	E8,F2,G5,H2

RoadRelay 4 Open Interface Specification

Rev 1.10.0

Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.

F8 value	D1,C9,B3,G7
F9 value	L1,G1,E9,A4

A CSFUNC instruction is disallowed when in fleet mode.

2.4.13 CSREG – Configure Register Values for the Security Feature

The RoadRelay 4 contains a bank of 9 registers (R1 – R9) for use by functions. R1 through R9 are configurable through the CSREG command. The register values must be 3 non-zero digits.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table. Elements left empty result in no change to those values in the register bank.

Definition	Resolution	Default
R1 value	Numeric 3,0	129
R2 value	Numeric 3,0	248
R3 value	Numeric 3,0	367
R4 value	Numeric 3,0	486
R5 value	Numeric 3,0	515
R6 value	Numeric 3,0	634
R7 value	Numeric 3,0	753
R8 value	Numeric 3,0	872
R9 value	Numeric 3,0	991

Security Registers configuration

A CSREG instruction is disallowed when in fleet mode.

2.4.14 CTRIP – Configure Trip

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution	Default
Over-rev with fuel – delay before accumulating. Number of seconds of Over-rev with fuel that must elapse before accumulating.	Numeric 2,0	10
Coast – delay before accumulating. Number of seconds of Coast that must elapse before accumulating.	Numeric 2,0	30

Trip configurations

A CTRIP instruction is disallowed when in fleet mode.

Note : See CMISC command for "Add short idle time to drive totals." and "The maximum idle time that will be added to drive totals if short stop is enabled."

2.4.15 CUOM – Configure Units of Measure

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

RoadRelay 4 Open Interface Specification	Rev 1.10.0
<p>Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.</p>	
15	

Definition	Resolution	Default
Defines the units of measure for displayed data. 0=US 1=Metric 2=UK 3=Europe	Numeric 1,0	0
Fuel economy units of measure. 0=mpg 1=kpl 2=lp100k 3=mpG (Imperial Gallons)	Numeric 1,0	0
Volume units of measure. 0=US gallons 1=liters 2=Imperial Gallons	Numeric 1,0	0
Date format. 0=mm/dd/yy 1=dd/mm/yy	Numeric 1,0	0
Language used to display data. 0=English 1=Spanish 2=French 3=Finnish 4=Portugese 5=Italian	Numeric 1,0	0

Units-of-Measure configurations

A CUOM instruction is disallowed when in fleet mode. Note: The user, through the RoadRelay 4 keypad, may always modify these configurations.

2.4.16 CVAT – Configure Vehicle Antitheft

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution	Default
Antitheft Mode 0=Off 1=Manual 2=Semiautomatic 3=Automatic 4=Thatcham-UK	Numeric 1,0	0
Antitheft Lock-out time	Numeric 4,0 – seconds Up to 6550	30 if UK UOM 10 elsewhere

Vehicle Antitheft configuration

A CVAT instruction is disallowed when in fleet mode.

2.4.17 END – End of File Stream

END shall indicate the end of a file stream. It shall be followed by a checksum.

Ex. END,AF81<cr><lf>

RoadRelay 4 Open Interface Specification	Rev 1.10.0
<p>Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.</p>	
16	

- 2.4.17.1 A checksum must be present – it is not an optional element.
- 2.4.17.2 The checksum shall be a 16-bit ASCII-hexadecimal value created by adding each byte of all preceding lines in the file. The END line is not part of the checksum (although it is part of the final file).
- 2.4.17.3 The checksum will always contain 4 digits; it will not have leading 0's suppressed.
- 2.4.17.4 If the checksum is incorrect an error in transmission of the file stream shall be assumed.

2.4.18 IBH – Information for Brake Histograms.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Service brake count while mph = 0	Numeric 5,0
Service brake count while 0 < mph <= 30	Numeric 5,0
Service brake count while 30 < mph <= 35	Numeric 5,0
Service brake count while 35 < mph <= 40	Numeric 5,0
Service brake count while 40 < mph <= 45	Numeric 5,0
Service brake count while 45 < mph <= 50	Numeric 5,0
Service brake count while 50 < mph <= 55	Numeric 5,0
Service brake count while 55 < mph <= 60	Numeric 5,0
Service brake count while 60 < mph <= 65	Numeric 5,0
Service brake count while 65 < mph <= 70	Numeric 5,0
Service brake count while 70 < mph <= 75	Numeric 5,0
Service brake count while 75 < mph <= 80	Numeric 5,0
Service brake count while 80 < mph <= 85	Numeric 5,0
Service brake count while 85 < mph <= 90	Numeric 5,0
Service brake count while 90 < mph <= 95	Numeric 5,0
Service brake count while 95 < mph <= 100	Numeric 5,0
Service brake count while 100 < mph <= 105	Numeric 5,0
Service brake count while 105 < mph <= 110	Numeric 5,0
Service brake count while 110 < mph <= 115	Numeric 5,0
Service brake count while mph >= 116	Numeric 5,0

Brake Histogram Information

Note: On 4.3 calibrations this information will only contain data for driver "Other". If the driver ID feature is not "On", all data is collected under "Other". On 4.4 calibrations, it is a summary of data for all drivers.

2.4.19 ICIPH – Information for Ciphers

The ICIPH line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Function Bank Cipher	Numeric 10,0

Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.

Definition	Resolution
Register Bank Cipher	Numeric 10,0

Cipher Information

The function bank cipher is determined as follows:

- 1 – Convert the action letter to a number. 'A' is '1', 'B' is '2', etc. Concatenate this value with the register value to create the number. (B8 becomes 28, K2 becomes 112.)
- 2 – Sum all 36 numbers.

The register bank cipher is determined by summing all 9 register values.

A RoadRelay 4 with default values will have a function bank cipher of 2556 and a register bank cipher of 4995.

2.4.20 IDID – Information for Device IDs

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Response from RID request on Port 1	character string, 20 characters
Response from RID request on Port 2	character string, 20 characters

Device ID Information

2.4.21 IECM – Information for Engine Control Module.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
ECM Type – 0=COMPETITIVE 1=CUMMINS_UNK 2=ISM, ISX 3=ECHO 4=ISB 5=ISC 6=DODGE 7=ECMC 8=ISB02/ECHO '02 (CM850) 9=ISM/ISX '02 (CM870)	Numeric 2,0
Engine Serial Number – First 10 characters	character string, first 10 characters of ESN
Written ID	10 characters max, Must be alpha-numeric
Engine SSPH	ASCII-hexadecimal 8,0

ECM Information

2.4.22 IESH – Information for Engine Speed/Road Speed Histograms.

The line shall have the elements listed in the table. They shall be in the order shown from

RoadRelay 4 Open Interface Specification	Rev 1.10.0
<p>Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.</p>	

top-to-bottom in the table.

Definition	Resolution
Lower limit of engine speed	Numeric 4,0 – RPM
Amount of time in a given RPM range while Mph = 0	Numeric 8,2 – hours
Amount of time in a given RPM range while 0 < mph <= 30	Numeric 8,2 – hours
Amount of time in a given RPM range while 30 < mph <= 35	Numeric 8,2 – hours
Amount of time in a given RPM range while 35 < mph <= 40	Numeric 8,2 – hours
Amount of time in a given RPM range while 40 < mph <= 45	Numeric 8,2 – hours
Amount of time in a given RPM range while 45 < mph <= 50	Numeric 8,2 – hours
Amount of time in a given RPM range while 50 < mph <= 55	Numeric 8,2 – hours
Amount of time in a given RPM range while 55 < mph <= 60	Numeric 8,2 – hours
Amount of time in a given RPM range while 60 < mph <= 65	Numeric 8,2 – hours
Amount of time in a given RPM range while 65 < mph <= 70	Numeric 8,2 – hours
Amount of time in a given RPM range while 70 < mph <= 75	Numeric 8,2 – hours
Amount of time in a given RPM range while 75 < mph <= 80	Numeric 8,2 – hours
Amount of time in a given RPM range while 80 < mph <= 85	Numeric 8,2 – hours
Amount of time in a given RPM range while 85 < mph <= 90	Numeric 8,2 – hours
Amount of time in a given RPM range while 90 < mph <= 95	Numeric 8,2 – hours
Amount of time in a given RPM range while 95 < mph <= 100	Numeric 8,2 – hours
Amount of time in a given RPM range while 100 < mph <= 105	Numeric 8,2 – hours
Amount of time in a given RPM range while 105 < mph <= 110	Numeric 8,2 – hours
Amount of time in a given RPM range while 110 < mph <= 115	Numeric 8,2 – hours
Amount of time in a given RPM range while mph >= 116	Numeric 8,2 – hours

Engine Speed Histogram Information

Note: mph ranges assume default configuration.

Note: On 4.3 calibrations this information will only contain data for driver "Other". If the driver ID feature

RoadRelay 4 Open Interface Specification	Rev 1.10.0
<p>Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.</p>	
19	

is not "On", all data is collected under "Other". On 4.4 calibrations, it is a summary of data for all drivers.

2.4.23 IF – Information for Faults.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Fault status. 0=Inactive 1=Active	Numeric 1,0
Fault occurrence count	Numeric 3,0
Cummins fault code	Numeric 4,0
Time and date this fault first occurred.	Timestamp: yyyy-mm-dd hh:mm:ss
Latitude at which this fault first occurred.	Numeric 4,6 – degrees
Longitude at which this fault first occurred.	Numeric 4,6 – degrees
Time and date this fault last occurred.	Timestamp: yyyy-mm-dd hh:mm:ss
J1939 System Address	Numeric 3,0
J1587 Message Identifier	Numeric 3,0
J1587 Parameter Identifier	Numeric 3,0
J1587 Subsystem Identifier	Numeric 3,0
J1939 Suspect Parameter Number	Numeric 3,0
J1587 Failure Mode Identifier	Numeric 3,0
Road Speed	Numeric 3,1 - MPH

Fault Information.

2.4.24 IGPS – GPS Information

This information is assumed to be provided by a local GPS receiver. The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Latitude (RMC)	Numeric 4,4 – DDMM.SSSS
Latitude Direction (RMC)	1 character – N or S
Longitude (RMC)	Numeric 5,4 – DDDMM.SSSS
Longitude Direction (RMC)	1 character – E or W
Ground Speed (RMC)	Numeric 3,1 – Knots
Heading (RMC)	Numeric 3,1 - Degrees
Satellites in View (GSV)	Numeric 2,0
Altitude (GGA)	Numeric 5,1 – meters

GPS Information (RMC, GSV, and GGA are NMEA standard messages.)

Ex. IGPS,3339.7332,N,11751.7598,W,12.0,121.7,07,27.0<cr><lf>

2.4.25 IID – Identification Information

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

RoadRelay 4 Open Interface Specification	Rev 1.10.0
<p>Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.</p>	
20	

Definition	Resolution
Device ID	string, 20 characters max OR character string, 20 characters max, exclusive of double-quotes (if wish to include commas in ID)

ID Information

If any IID information has been received, the ssrrinfoVID file stream will contain the IID information after an IDID identifier.

2.4.26 IPME – Information for Preventative Maintenance Interval Elapsed Information. The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Amount of interval used in PM schedule 1.	Numeric 3,0 – percent OR Timestamp: yyyy-mm-dd
Amount of interval used in PM schedule 2.	Numeric 3,0 – percent OR Timestamp: yyyy-mm-dd
Amount of interval used in PM schedule 3.	Numeric 3,0 – percent OR Timestamp: yyyy-mm-dd
Amount of interval used in PM schedule 4.	Numeric 3,0 – percent OR Timestamp: yyyy-mm-dd

Preventative Maintenance Interval Elapsed Information

2.4.27 IPST – Information for Panic Stop Time.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Driver ID when panic stop occurred.	Numeric 10,0 or Other
Time and date of the panic stop	Timestamp: yyyy-mm-dd hh:mm:ss
GPS Latitude of the panic stop	Numeric 4,6 – degrees
GPS Longitude of the panic stop	Numeric 4,6 – degrees

Panic Stop Time Information

2.4.28 IR – Information for Route.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Driver ID when route segment started.	Numeric 8,0
Number entered through the keypad that identifies the current driver.	Numeric 10,0 or Other
UTC Time and date of start of route.	Timestamp: yyyy-mm-dd hh:mm:ss
ECM Life to Date Distance at the beginning of this segment.	Numeric 8,1 – miles

Definition	Resolution
Latitude at the beginning of this route segment.	Numeric 4,6 – degrees
Longitude at the beginning of this route segment.	Numeric 4,6 – degrees
1=New Route 2=Continuation 3=Driving 4=Driver Change 5=End Route 6=Extended Idle 7=Extraction 8=Key-On 9=Key-Off 10=Reset	Numeric 2,0
Miles driven on this route segment.	Numeric 8,1 – miles
Number of hours the vehicle was moving.	Numeric 8,2 – hours
Amount of time vehicle was not moving and engine was running (not including extended idles).	Numeric 8,2 – hours
Amount of time the vehicle was not moving and engine was running for more than <i>Vehicle Stop Definition.</i>	Numeric 8,2 – hours
Amount of fuel used during route.	Numeric 8,1 - gallons
Time and date of end of route	Timestamp: yyyy-mm-dd hh:mm:ss
1=New Route 2=Continuation 3=Driving 4=Driver Change 5=End Route 6=Extended Idle 7=Extraction 8=Key-On 9=Key-Off 10=Reset	Numeric 2,0
Number used to tell if routes with the same route number are new routes or a continuation of a previous route.	Numeric 3,0

Route Segment Information

2.4.29 IRR – Information for RoadRelay 4.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Application Software Phase Designation	7 characters
Bootloader Software Phase Designation	7 characters
RoadRelay Part Number	10 characters max
RoadRelay Serial Number	10 characters max

RoadRelay 4 Information

RoadRelay 4 Open Interface Specification	Rev 1.10.0
<p>Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.</p>	
22	

2.4.30 IRSRT – Information for Road Speed Recorder Stop Time.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Driver ID when RSR occurred.	Numeric 10,0 or Other
Time and date of the road speed recording	Timestamp: yyyy-mm-dd hh:mm:ss
GPS Latitude of the road speed recording	Numeric 4,6 – degrees
GPS Longitude of the road speed recording	Numeric 4,6 – degrees

Road Speed Recorder time data

2.4.31 ISEED – Information for Security Key Seed

The device will request an encrypted seed by requesting a cdseed file stream. The reply will contain a single line with an ISEED line identifier.

The ISEED line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Encrypted Key	Numeric 10,0
Encryption Formula	Numeric 1,0
Iteration Register	Numeric 1,0

Seed Information

By running the key through the indicated formula from 1 to 3 times, the RoadRelay 4 creates the encrypted key. The number of iterations is determined by performing a modulo-3 + 1 operation on the last digit of the iteration register. The device must run the reverse operations to determine the key.

2.4.32 ISS – Information for a Stop Sample.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Flag set TRUE when the service brake is pressed. 0=Brakes are NOT being pressed 1=Brakes ARE being pressed	Numeric 1,0
Flag set TRUE when the clutch is pressed. 0=Clutch is NOT being pressed 1=Clutch ARE being pressed	Numeric 1,0
Road speed	Numeric 3,1 – MPH
Engine speed	Numeric 4,0 – RPM

Stop sample data

2.4.33 IT – Information for Trip.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

RoadRelay 4 Open Interface Specification	Rev 1.10.0
<p>Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins’ business interests.</p>	
23	

Definition	Format
Driver ID for trip data.	Numeric 10,0 or Other
Total fuel used	Numeric 8,1 – gallons
Total distance traveled	Numeric 8,1 – miles
Average engine load	Numeric 3,1 – percent
Panic stop count	Numeric 3,0
Maximum vehicle speed	Numeric 3,1
Engine speed when max vehicle speed attained	Numeric 4,0
Time and date max vehicle speed was reached	Timestamp: yyyy-mm-dd hh:mm:ss
GPS latitude where the max vehicle speed was reached	Signed Numeric 4,6 – degrees
GPS longitude where the max vehicle speed was reached	Signed Numeric 4,6 – degrees
Maximum engine speed	Numeric 4,0
Vehicle speed when max engine speed attained	Numeric 3,1
Time and date max engine speed was reached	Timestamp: yyyy-mm-dd hh:mm:ss
GPS latitude where the max engine speed was reached	Numeric 4,6 – degrees
GPS longitude where the max engine speed was reached	Numeric 4,6 – degrees
Hot shutdown count	Numeric 3,0
Warm-up violation count	Numeric 3,0
Engine de-rate time	Numeric 8,2 – hours
Idle shutdown count	Numeric 3,0
Idle shutdown override count	Numeric 3,0
Fuel used while driving	Numeric 8,1 – gallons
Total driving time	Numeric 8,2 – hours
Distance traveled while driving	Numeric 8,1 – miles
Average horsepower while driving	Numeric 4,0
Average engine load while driving	Numeric 3,0 – percent
Average engine speed while driving	Numeric 4,0 – RPM
PTO moving fuel used	Numeric 8,1 - gallons
PTO moving time	Numeric 8,2 – hours
PTO moving distance	Numeric 8,1 – miles
PTO non-moving fuel used	Numeric 8,1 - gallons
PTO non-moving time	Numeric 8,2 – hours
Fuel used while idling	Numeric 8,1 - gallons
Time spent idling	Numeric 8,2 – hours
Short stop fuel used	Numeric 8,1 - gallons
Short stop time	Numeric 8,2 – hours
Cruise control fuel used	Numeric 8,1 - gallons
Cruise control time	Numeric 8,2 – hours
Cruise control distance	Numeric 8,1 – miles
Road speed governor fuel used	Numeric 8,1 - gallons
Road speed governor time	Numeric 8,2 – hours

RoadRelay 4 Open Interface Specification

Rev 1.10.0

Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.

Definition	Format
Road speed governor distance	Numeric 8,1 – miles
Top gear fuel used	Numeric 8,1 - gallons
Top gear time	Numeric 8,2 – hours
Top gear distance	Numeric 8,1 – miles
Coast Fuel used	Numeric 8,1 - gallons
Coast Time	Numeric 8,2 – hours
Coast Distance	Numeric 8,1 – miles
Electronic smart power fuel used	Numeric 8,1 - gallons
Electronic smart power time	Numeric 8,2 – hours
Electronic smart power distance	Numeric 8,1 – miles
Sweet spot fuel used	Numeric 8,1 - gallons
Sweet spot time	Numeric 8,2 – hours
Sweet spot distance	Numeric 8,1 – miles
Vehicle over-speed 1 fuel used	Numeric 8,1 - gallons
Vehicle over-speed 1 time	Numeric 8,2 – hours
Vehicle over-speed 1 distance	Numeric 8,1 – miles
Vehicle over-speed 2 fuel used	Numeric 8,1 - gallons
Vehicle over-speed 2 time	Numeric 8,2 – hours
Vehicle over-speed 2 distance	Numeric 8,1 – miles
Engine brake time	Numeric 8,2 – hours
Engine brake distance	Numeric 8,1 – miles
Service brake time	Numeric 8,2 – hours
Service brake distance	Numeric 8,1 – miles
Fan on time	Numeric 8,2 – hours
Fan on time due to engine system.	Numeric 8,2 – hours
Fan on time due to manual switch.	Numeric 8,2 – hours
Fan on time due to AC refrigerant pressure.	Numeric 8,2 – hours
Air compressor on time	Numeric 8,2 – hours
Driver reward 1 fuel used	Numeric 8,1 - gallons
Driver reward 1 time	Numeric 8,2 – hours
Driver reward 1 distance	Numeric 8,1 – miles
Driver reward 2 fuel used	Numeric 8,1 - gallons
Driver reward 2 time	Numeric 8,2 – hours
Driver reward 2 distance	Numeric 8,1 – miles
Driver reward 3 fuel used	Numeric 8,1 - gallons
Driver reward 3 time	Numeric 8,2 – hours
Driver reward 3 distance	Numeric 8,1 – miles
Driver reward 4 fuel used	Numeric 8,1 - gallons
Driver reward 4 time	Numeric 8,2 – hours
Driver reward 4 distance	Numeric 8,1 – miles
Over-speed-with-fuel fuel used	Numeric 8,1 - gallons
Over-speed-with-fuel time	Numeric 8,2 – hours
Over-speed-with-fuel distance	Numeric 8,1 – miles
Over-speed-with-engine brake-active fuel used	Numeric 8,1 - gallons
Over-speed-with-engine brake-active time	Numeric 8,2 – hours
Over-speed-with-engine brake-active distance	Numeric 8,1 – miles

RoadRelay 4 Open Interface Specification

Rev 1.10.0

Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.

Definition	Format
Out-of-Gear Count	Numeric 3,0 - count
Out-of-Gear Time	Numeric 8,2 – hours
Next gear fuel used	Numeric 8,1 - gallons
Next gear time	Numeric 8,2 – hours
Next gear distance	Numeric 8,1 – miles
Service brake count	Numeric 4,0 - count

Trip Information

2.4.34 IUTC – Universal Time Coordinated Information

This information is assumed to be provided by a local GPS receiver. The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Year	Numeric 4,0
Month	Numeric 2,0
Day	Numeric 2,0
Hours	Numeric 2,0
Minutes	Numeric 2,0
Seconds	Numeric 2,0

UTC Information

Ex. IUTC,2001,04,20,10,02,22

2.4.35 LOCK – Disallow Access to RoadRelay 4 Functionality

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Encrypted Key	Numeric 10,0
Encryption Formula	Numeric 1,0
Iteration Register	Numeric 1,0
Locked functionality Bit 0 = Disallow configuration on both ports (CCELL, CDID, CM, CMISC, CPM, CPORT, CPU, CR, CSFUNC, CSREG, CTRIP, CUOM, CVAT) Bit 1 = Disallow operations with captured data on both ports (CAP; CLR; SND,cdtrip; SND,cdroute, SND, cdstop; SND,cdhisto)	Numeric 4,0 – hexadecimal

RoadRelay 4 Feature Lock elements

The device must request a new key for every LOCK. When locking, at least one of the first 3 elements must differ from the values returned from the seed request. A LOCK instruction is disallowed when in fleet mode.

RoadRelay 4 Open Interface Specification

Rev 1.10.0

Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.

2.4.36 NOK – Not all commands successfully executed.

2.4.36.1 The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

2.4.36.2 The Text Status Description may be null if this is a response to a file stream.

Definition	Format
Status 0=CAP command when data already captured 1=Timed Out 2=Checksum Error 3=Unrecognized Parameter 4=RoadRelay 4 Input Buffer Overrun 5=Line > 90 characters or file stream > 256 characters 6=Tried to read empty captured-data buffer 7=Instruction not allowed in fleet mode 8=Instruction not allowed while unit locked 9=Invalid Key 10=All Driver IDs in Use 11=Invalid Driver ID	Numeric 2,0
Supplemental data NOK status = 0 => null NOK status = 1 => null NOK status = 2 => null NOK status = 3 => "XXX...XXX" where the X's are the line which was not understood – up to 80 characters. CR and LF are replaced with spaces. NOK status = 4 => null NOK status = 5 => "XXX...XXX" where the X's are the line/file stream that was too long – first 80 characters of line or file stream. CR and LF are replaced with spaces. If a line in a file stream is too long the line is returned. NOK status = 6 => null NOK status = 7 => "XXX...XXX" where the X's are the line which was not allowed – up to 80 characters. CR and LF are replaced with spaces. NOK status = 8 => null NOK status = 9 => null NOK status = 10 => null NOK status = 11 => "XXXX" where XXXXX is the invalid driver ID. ID must be all numeric (up to 10 numbers) or Other	character string - 80 characters max

Text Status Description	characters
NOK status = 0 => "Data already CAPtured"	
NOK status = 1 => "Time Out Error"	
NOK status = 2 => "Checksum Error"	
NOK status = 3 => "Unrecognized Parameter"	
NOK status = 4 => "RR4 Buffer Overrun"	
NOK status = 5 => "Line or File Stream Too Long"	
NOK status = 6 => "No Data CAPtured"	
NOK status = 7 => "Disallowed in Fleet Mode"	
NOK status = 8 => "Disallowed While Locked"	
NOK status = 9 => "Invalid Key"	
NOK status = 10 => "All IDs In Use"	
NOK status = 11 => "Invalid ID"	

NOK line elements

- 2.4.36.3 If a repeat CAP command is encountered (NOK0), no subsequent commands in the control file will be executed. Previous commands will have been successfully executed.
- 2.4.36.4 If a timeout error occurs (NOK1), no commanded actions will be executed.
- 2.4.36.5 If a checksum error occurs (NOK2), no commanded actions will be executed.
- 2.4.36.6 If an unrecognized parameter is encountered (NOK3), no subsequent commands in the control file will be executed. Preceding Lines will have been successfully executed. Preceding elements in the line may have been updated.
- 2.4.36.7 If an input buffer overrun occurs (NOK4), at least one instruction or file stream was lost. The device must determine which instructions or file streams were lost. The contents of any lost instruction or file stream would not have been executed.
- 2.4.36.8 If a line or file stream are too long (NOK5), the contents of the instruction or file stream are discarded without execution.
- 2.4.36.9 If requested to send data from an empty captured-data buffer (NOK6), no subsequent commands in the control file will be executed. Previous commands will have been successfully executed.
- 2.4.36.10 If an instruction is disallowed (NOK7), the instruction is discarded without execution.
- 2.4.37 OK – All commands successfully executed.
- 2.4.37.1 The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.
- 2.4.37.2 The Text Status Description shall be null if this is a response to a file stream.
- 2.4.37.3 Each OK with a non-zero status shall be considered a warning.

Definition	Format
Status 0=No Errors Non-zero=warning 1=At least one data file stream contained no data 2=At least one unrecognized Line Identifier	Numeric 1,0
Text Status Description OK status = 0 => "No Errors" OK status = 1 => "At least one file contains no data" OK status = 2 => "At least one unrecognized line identifier"	characters

OK line elements

2.4.38 REM - Remarks

Any characters following a REM identifier are ignored.

2.4.39 RESET – Reset Data Item

2.4.39.1 The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Format
Data Set Identifier DM (Driver Message) DS (Diagnostic Stack) faults (Faults) PM (Preventative Maintenance Schedule) VID (Vehicle ID)	characters
Sub-Identifier VID – n/a faults – n/a PM – 1 to 4, identifies monitor to be reset DM – 0 to 6; 0 will reset (delete) all driver messages, 1 to 6 will reset (delete) individual messages	Numeric 1,0

Data that can be reset

2.4.40 RGPS – Request GPS Data

Every 4 seconds after key-on the RR4 will send an RGPS request on both RS232 ports. The RoadRelay 4 checks for the port to be idle before sending any requests. If the port is busy the command will be sent after the port becomes idle. The device must respond to the RGPS command if it is supported. All fields in the response may be empty if the data is currently not valid - such as at power-up.

To request GPS information, the RoadRelay 4 will send:

RGPS<cr><lf>

Device responds with IGPS information. This information may be in the form of an Instruction, or a File Stream with a "gps" identifier.

2.4.41 RID – Request Device ID

To request ID information after a RoadRelay 4 power-up/reset, the RoadRelay 4 will send:

RID<cr><lf>

Device responds with IID information. This information may be in the form of an Instruction, or a File Stream with a "iid" identifier.

2.4.42 RUTC – Request UTC Data

15 minutes after key-on, the RR4 will send an RUTC request on both RS232 ports. Only one RUTC request is sent on each port. The unit must power-down and then back up for

15 minutes before the RUTC is sent again. The RoadRelay 4 checks for the port to be idle before sending any requests. If the port is busy the RUTC will be sent as soon as it goes idle.

RoadRelay 4 uses UTC time to keep the RoadRelay 4 clock synchronized.

RoadRelay 4 will send:

RUTC<cr><lf>

Device responds with IUTC information. This information may be in the form of an Instruction, or a File Stream with a "utc" identifier.

2.4.43 SDID – Set Driver ID

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution	Default
Driver ID to be entered	Numeric 10,0 or Other	n/a

Driver ID Entry

Note : This setting of the ID should also clear the Driver ID entry screen if currently being shown.

2.4.44 SND – Send Data File Stream

2.4.44.1 The RoadRelay 4 shall send a file stream with the data indicated by the file stream name. Only one file stream may be requested per SND line. The file-stream-response shall have VID appended.

Ex. cdtrip returns cdtripVID

2.4.44.2 If the requested file contains no data, the RoadRelay 4 shall respond with a file stream containing no data.

2.4.44.3 Summary of File Stream Identifiers

File Stream Identifier	Data Set
cdciph	Cipher Data
cdsds	Diagnostic Stack Data
cdfault	Fault Data
cdgps	GPS Data
cdhisto*+	Brake Histogram, captured
cdhisto*+	Engine Speed Histogram, captured
cdpme	Preventative Maintenance Elapsed Intervals
cdroute+	Route, captured
cdseed	Seed Data
cdstop*+	Panic Stop, captured
cdstop*+	Road Speed Recorder, captured
cdtrip+	Trip, captured
Sseventlog	Event Log from Diagnostics
Ssrinfo	RoadRelay 4 Info, with remarks
Sstrip	Trip, snapshot, data not captured or reset

* Data may be combined with other data sets in file.

RoadRelay 4 Open Interface Specification	Rev 1.10.0
---	-------------------

Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.

+ Data which is captured with the CAP command

2.4.45 START - Beginning of a file stream.

2.4.45.1 START shall indicate the beginning of a file stream.

Ex. START,trip0,2001-02-22 13:18:23<cr><lf>

2.4.45.2 The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Format
File Stream Name and (optional if initiator) Source ID	20 characters max
Timestamp For captured-data, the timestamp will indicate when the data was captured; for all other files it indicates the time of the file stream creation.	Timestamp: yyyy-mm-dd hh:mm:ss
File Stream Destination	VID of destination unit

START line elements

2.4.45.3 The file stream name must be present - it is not an optional element.

2.4.45.4 The File Stream Name will always be "control" for the initiating File Stream.

2.4.45.5 The Source ID in the File Stream Name is optional in the initiating File Stream. If it is present, the response(s) to the File Stream will include a File Stream Destination derived from the File Stream Name's Source ID.

2.4.45.6 The File Stream Destination is optional in the initiating File Stream. If it is present, only devices with the indicated VID should respond.

2.4.46 UNLOCK - Allow Access to RoadRelay 4 Functionality
Unlocking the RoadRelay 4 allows access to all features.

The line shall have the elements listed in the table. They shall be in the order shown from top-to-bottom in the table.

Definition	Resolution
Encrypted Key	Numeric 10,0
Encryption Formula	Numeric 1,0
Iteration Register	Numeric 1,0
Unlock Time An Unlock time of 0 indicates disabling of the security feature until next LOCK command	Numeric 3,0 – seconds

RoadRelay 4 Feature Unlock elements

RoadRelay 4 Open Interface Specification	Rev 1.10.0
<p>Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.</p>	
32	

The device must request a new key for every UNLOCK. When unlocking, at least one of the first 3 elements must differ from the values returned from the seed request. An UNLOCK instruction is disallowed when in fleet mode.

2.4.47 WPB – Write Parameter Block

This command tells the RoadRelay to save all configurations, trip, leg, and panic stop data to permanent storage. That will prevent configuration changes from being lost when battery power is disconnected.

2.5 RoadRelay 4 File Stream Descriptions

2.5.1 Controlled cipher data - cdciphVID

2.5.1.1 Cipher data shall have a line identifier of ICIPH.

2.5.1.2 There shall be one line of cipher data in the file stream.

2.5.2 Controlled diagnostic stack data - cddsVID

The diagnostic stack stores information about RoadRelay 4 operation and fault detection. When the diagnostic stack area is full, it will discontinue the logging of data until reset via the RESET,DS command.

2.5.3 Controlled fault data - cdfaultVID.

2.5.3.1 Fault data shall have a line identifier of IF.

2.5.3.2 There shall be one line per fault.

2.5.3.3 The data shall be read from the accumulating data buffer.

2.5.4 Controlled gps data - cdgpsVID.

2.5.4.1 GPS data shall have a line identifier of IGPS.

2.5.4.2 There shall be one line per file.

2.5.4.3 The data shall be the most recent GPS information.

2.5.4.4 If the position data is invalid, and the RoadRelay 4 unit contains an integrated GPS board, the file shall be sent with no data in the IGPS elements. Else, an empty file stream shall be sent.

2.5.5 Controlled captured histogram data - cdhistoVID.

The histogram file contains the brake histogram and the engine speed/road speed histogram.

2.5.5.1 Brake histogram data shall have a line identifier of IBH. There is one line for all data.

2.5.5.2 Engine Speed/Road Speed histogram data shall have line identifiers of IESH.

The engine speed/road speed histogram has sixteen data lines. Each line represents an engine speed range. The data in a line is the amount of time the engine operated in that engine speed/road speed range. The line is time spent in each MPH range while engine speed was in the range 0 to 600 RPM. The second line is time spent in each MPH range

while the engine speed was in the range 601 to 700 RPM. Each additional line covers the next 100-RPM range, sixteen lines total.

2.5.5.3 The data shall be read from the captured-data buffer.

2.5.5.4 Example cdhistoVID file stream

The example shows histogram information.

```
START,cdhisto0,2001-04-02 09:59:32
IBH,54,22,13,2,0,4,3,2,5,16,2,1,0,0,0,0,0,0,0
IESH,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
IESH,601,0.05,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
IESH,701,0.09,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
...
IESH,2001,0,0.18,0,0,0.12,0,0,0,0.68,0,0,0,0,0,0,0
END,...
```

2.5.6 Controlled Preventative Maintenance elapsed interval data - cdpmeVID.

2.5.6.1 Elapsed interval data shall have a line identifier of IPME.

2.5.6.2 There shall be one line per file.

Note: Open Interface histograms will be summary data for all drivers. Some late 4.3 calibrations only provide data for driver "Other".

2.5.7 Controlled captured Route data - cdrouteVID.

2.5.7.1 Route data shall have a line identifier of IR.

2.5.7.2 There shall be one line per route segment.

2.5.7.3 The data shall be read from the captured-data buffer.

2.5.7.4 Example cdrouteVID file stream

The example shows route information.

```
START,cdroute0,2001-04-02 09:59:32
IR,555,8890,2001-03-28 06:49:32,128652,43.347290,-85.421009,...
IR,133,8890,2001-03-28 06:52:04,128652,43.347290,-85.421009,...
IR,133,8890,2001-03-28 10:28:32,128852,44.347290,-84.487261,...
...
IR,133,8890,2001-04-02 09:59:32,129670,43.347293,-85.421010,...
END,...
```

2.5.8 Controlled seed data - cdseedVID.

2.5.8.1 Seed data shall have a line identifier of ISEED.

2.5.8.2 There shall be one line of seed data in the file stream.

2.5.9 Controlled captured stop data - cdstopVID.

The stop file contains up to four stop records: three panic stop records and one road speed recorder record. Each stop record shall consist of a time data line immediately followed by seventy-five data samples.

- 2.5.9.1 There shall be one stop sample or time datum per line.
- 2.5.9.2 Panic stop time data shall have a line identifier of IPST.
- 2.5.9.3 Panic stop sample data shall have a line identifier of ISS.
- 2.5.9.4 Road speed recorder time data shall have a line identifier of IRSRT.
- 2.5.9.5 Road speed recorder stop data shall have a line identifier of ISS.
- 2.5.9.6 The data shall be read from the captured-data buffer.
- 2.5.9.7 Example cdstopVID file stream

The example shows stop information – a single panic stop and a RSR stop.

```
START,cdstop0,2001-04-02 09:59:32
IPST,2001-03-30 19:33:39
ISS,0,0,59.5,1345
ISS,0,0,59.5,1348
...
ISS,1,1,0,1188
IRSRT,2001-03-31 12:53:09
ISS,0,0,42.7,1545
ISS,0,0,42.6,1545
...
ISS,1,1,0,1288
END,...
```

2.5.10 Controlled captured trip data - cdtripVID.

- 2.5.10.1 Trip data shall have a line identifier of IT.
- 2.5.10.2 There shall be one line per driver.
- 2.5.10.3 The data shall be read from the captured-data buffer.
- 2.5.10.4 Example cdtripVID file stream

The example shows trip information with two drivers.

```
START,cdtrip0,2001-04-02 09:59:32
IT,8890,201.4,1369.2,18.5,0,78.5,2862,...
IT,Other,1.4,7.3,22.5,1,32.0,2286,...
END,...
```

2.5.11 Control files - controlVID

Control is used to initiate communication or to provide end-of-communication status.

2.5.12 Snapshot event log Information – sseventlogVID

This file stream shall contain the event log data as it appears in the diagnostics event log.

- 2.5.13 Snapshot RoadRelay 4 Information – ssrrinfoVID
- 2.5.13.1 The file shall have one line with an identifier of IRR.
- 2.5.13.2 The IRR line shall be directly preceded with a REM line with the following form: REM,APP,BL,RRPN,RRSN.
- 2.5.13.3 The file shall have one line with an identifier of IECM.
- 2.5.13.4 The IECM line shall be directly preceded with a REM line with the following form: REM,<ENG_TYPE>,ESN,WID,SSPH. The <ENG_TYPE> field will contain the identifier shown in the table for IECM (ex. COMPETITIVE)
- 2.5.13.5 The file shall optionally have one line with an identifier of IDID. If any IID responses have been received, the IDID information shall be shown.
- 2.5.13.6 The IDID line shall be directly preceded with a REM line with the following form: Port 1 ID, Port 2 ID.

2.5.13.7 Example ssrrinfoVID file stream

```
START,ssrrinfo0,2001-04-02 09:59:32
REM,APP,BL,RRPN,RRSN
IRR,4.4L00E,4.2L00B,4005942,13791774
REM,COMPETITIVE,ESN,WID,SSPH
IECM,0,"2KS53192",,
REM,Port 1 ID, Port 2 ID
IDID,,"DCU v1.0"
END,...
```

2.5.14 Snapshot Trip Information – sstripVID

All requirements are the same as cdtripVID, with the exception that the data is read from current trip data without capturing or resetting the data.

Note: sstrip is only available on later 4.3 calibrations.

3 Examples

3.1 Example showing a request to RoadRelay 4 for capture and retrieval of data.

Device sends control file stream to capture data.

```
START,control,2002-12-10 14:38:38
CAP
END,...
```

RoadRelay 4 responds with a control file stream indicating success.

```
START,controlA1099,2002-12-10 14:38:38
OK,0
END,...
```

Device sends control file stream to retrieve data.

START,control,2002-12-10 14:38:38

SND,cdtrip

END,...

RoadRelay 4 responds with two file streams - one with trip data and the other with a response to the original control file stream, indicating success.

START,tripA1099,2002-12-10 14:38:38

TI,...

END,...

START,controlA1099,2002-12-10 14:38:38

OK,0

END,...

Device sends control file stream to clear data.

START,control,2002-12-10 14:38:40

SND,cdtrip

END,...

RoadRelay 4 responds with a control file stream indicating success.

START,controlA1099,2002-12-10 14:38:41

OK,0

END,...

3.2 Example showing request to RoadRelay 4 to send data.

The example assumes someone is entering instructions using HyperTerminal.

Device sends command for specific snapshot file.

SND,ssrrinfo<cr>

RoadRelay 4 responds with file streams for data and OK response.

START,ssrrinfo0 ...

REM,APP,BL,RRPN,RRSN

IRR,4.4L00E,4.2L00B,4005942,13791774

REM,COMPETITIVE,ESN,WID,SSPH

IECM,0,"2KS53192",,

REM,Port 1 ID, Port 2 ID

IDID,,"DCU v1.0"

END,...

START,control0 ...

OK,0,No Errors

RoadRelay 4 Open Interface Specification

Rev 1.10.0

Cummins Confidential: Information contained within this document or generated as a result thereof is not to be disclosed to third parties or used for any purpose other than to promote Cummins' business interests.

END, ...

3.3 Example showing a change of configuration on a locked RoadRelay 4.

A configuration-locked RoadRelay 4, with default function and register banks, will have driver IDs enabled.

Device requests key:
START,control,...
SND,cdseed
END,...

The RoadRelay 4 determines the key will be 924. The encryption function will be 2 and the iteration register will be 4. Thus, to encrypt the key, 924 will be run through the operations F1,C6,H3,I4 with 1 iteration ($486 \Rightarrow 6 \bmod 3 + 1 \Rightarrow 1$).

$924 * 2 = 1848$	F1 means Multiply by [(1 st register digit mod 3) +1] $129 \Rightarrow 1 \bmod 3 + 1 \Rightarrow 2$
$1848 + 6 = 1854$	C6 means Add 1 st register digit $634 \Rightarrow 6$
$1854 * 2 = 3708$	H3 means Multiply by [(3 rd register digit mod 3) +1] $367 \Rightarrow 7 \bmod 3 + 1 \Rightarrow 2$
$3708 + 18 = 3726$	I4 means Add Sum of all register digits $486 \Rightarrow 4 + 8 + 6 = 18$

RoadRelay 4 replies with:
START,cdseed0,...
ISEED,3726,2,4
END,...

Device calculates original key by reversing above steps. It then sends UNLOCK to gain access. It encodes the key by using function 8 (D1,C9,B3,G7) and iteration register is 3 ($367 \Rightarrow 7 \bmod 3 + 1 \Rightarrow 2$).

$924 + 2 = 926$	D1 means Add 2 nd register digit $129 \Rightarrow 2$
$926 + 9 = 935$	C9 means Add 1 st register digit $991 \Rightarrow 9$
$935 + 367 = 1302$	B3 means Add all register digits 367
$1302 * 3 = 3906$	G7 means Multiply by [(2 nd register digit mod 3) +1] $753 \Rightarrow 5 \bmod 3 + 1 \Rightarrow 3$

2nd Iteration:

$3906 + 2 = 3908$
 $3908 + 9 = 3917$
 $3917 + 367 = 4284$
 $4284 * 3 = 12852$

To unlock RoadRelay 4 for 3 seconds and enable driver IDs, the device sends:
START,control,...

UNLOCK,12852,8,3,3
CMISC,,1
END,...

The RoadRelay 4 reverses the encryption steps to recover the original key and accepts the changes. At the end of 3 seconds it locks configurations.

START,control0,...
OK,0
END,...

3.4 Example showing a configuration change to RoadRelay 4.

Device sends control file stream to configure the engine over speed pop-up feature and route marker threshold.

START,control,2002-12-10 14:48:02
CPU,,,,,1,1600 Enable engine over speed pop-up above 1600 RPM
CR,,,50 Create route segment at least every 50 miles
END,...

RoadRelay 4 responds with a control file stream indicating success.

START,controlGI_376,2002-12-10 14:48:02
OK,0
END,...

3.5 Example showing request to RoadRelay 4 (rr85) using addressing.

The example assumes a base station (base102) is polling for in-range vehicles. It includes a Source ID and File Stream Destination in the START message.

The base station sends file stream requesting GPS position because it is a short response.

START,controlbase102,2002-11-04 16.49:48,rr85<cr>
SND,cdgps<cr>
END,...

RoadRelay 4 responds with file streams for data and OK response. The responses include the base station ID as the destination.

START,cdgpsrr85,2002-11-04 16.49:51,base102<cr>
IGPS,...
END,...

START,controlrr85,2002-11-04 16.49:51,base102<cr>
OK,0,No Errors
END,...