TM-102

Application Document

Feature Summary

The TM-102 includes the following features:

J1939 to RV-C Bridge
Automatically echoes J1939 data to the RV-C bus. It is partially bi-directional, as it also transmits PGN Requests to bridged components from the RV-C to the J1939 buses. Source addresses can be changed via a proprietary PGN. A special flag allows the bridging of all DM1 activity from the J1939 bus.

Chassis Motion Controller
Supports CHASSIS_MOBILITY_STATUS and CHASSIS_MOBILITY_COMMAND. A list of chassis locks is available via a proprietary PGN. Note that the chassis mobility status and suport for the J1939 genset are mutually exclusive features.

Generator RV-C Bridge
Acts as a bridge between an Onan QD Generator or a EPS J1939 genset and RV-C. Supports all RV-C PGNs for generator status and starting, as well as diagnostic messages. Supports most other generators, but with a reduced feature set.

SurgeGuard Transfer Switch RV-C Bridge
Acts as a bridge between a SurgeGuard transfer switch and RV-C. Supports most RV-C PGNs for transfer switches, including AC Points and diagnostic messages. Does not allow configuration of the SurgeGuard.

Tank Monitoring
Monitors water/waste tank levels using Barthtech pressure sensors. Supports configurable tank geometries with up to four interpolation points. Also supports a “factory default” tank geometry via a proprietary PGN.

LPG Tank Monitoring
Monitors LPG Tank level and reports via RV-C

Automatic Fresh Water Fill
Supports RV-C automatic fresh water fill, using one active-low discrete output. An optional input allows a shore connection to be detected.

Water Pump
Supports RV-C water pump functions using one (active-low or active-high) discrete output and a bypass detection input. Allows pump to be turned on or off.

Tile Heat Control
Supports RV-C floor heat functions.

Ambient Temperature and Thermostat
Broadcasts two ambient temperatures, based on internal and external sensors. The external sensor may be configured to support a thermostatic output, for example, for a bay heater.

Remote Switches
Supports switch inputs for generator, water pump, and water fill.

Automatic Genstart

Supports RV-C automatic genstart for battery charging, discrete input (e.g. thermostat), power loss, and scheduled runs. Supports quiet time and automatic disabling on coach movement. Battery charging is based on voltage over time, not on RV-C state-of-charge or other criteria. The 2010 RVIA standard for disabling the AGS on any manual activity is supported as an option.

System Clock

Includes a real-time clock, and supports RV-C system time PGNs.

Xanbus Bridge

Serves as a bridge between Xantrex RS Series inverter/chargers and RV-C. This bridge is specific to the inverter/charger, and is not a general purpose Xanbus node. If the J1939 Bridge (see below) is not activated, the unit can use the second CAN port as a bridge to a second Xanbus network.

Outback Bridge

Serves as a bridge between an Outback Inverter/Charger Monitor Panel and RV-C. The bridge consolidates the data from all the inverters in the application and presents them as a single device.

Chassis Battery Charging Bridge

Activates an output to drive a solenoid to connect the chassis and house batteries together when the charger is active. The feature can be used in tandem with the AutoGenStart to start the generator to recharge a low chassis battery. Requires a solenoid, e.g. Tyco KILOVAC EV200 Series

DC Source Monitor

Monitors a single DC Source (voltage only)

Awning Controller

Extends and retracts awning using discrete active high outputs.

Data Logging

Records certain events, which may be downloaded to a service tool via proprietary PGNs. Among other things, the log includes a house battery level reading every hour.

Serial Monitor

A special-purpose serial monitor provides certain network monitoring and control capabilities via an RS-232 serial port. The serial monitor is not available when the Onan Bridge is enabled.

Climate Control

Supports a dual-zone climate control system, with a single conventional furnace and two conventional air conditioners. Supports automatic AC power management, alternative AC units according to the availability of AC power.

Slide Control

Extends and retracts a simple slide room. Supports up to two slides, either electric or hydraulic.

Water Heater

Manages a conventional water heater. Monitors the error light from the heater and provides for automatic relighting as required. Support for a secondary electric element is included.

Water Pressure Sensor

Reports water pressure from a 200 PSI 0-5V sensor.

Battery Disconnect Solenoid Control

Controls a battery disconnect solenoid and monitors a main DC supply circuit.

EMS-to-RVC Bridge

Reads an input from an energy management system and sheds AC and Floor Heat loads accordingly.

General Specifications

Input Voltage	8 VDC - 18 VDC
Input Amperage	sub 100 mA
Temperature Range	-40 - 185 Deg F (Industrial)
External Dimensions	5.56” (L) x 3.8” (W) x 1.25” (H)
Environmental Limitations	Not sealed for exterior mounting.
Source Address	Static 250 (0xFA)
Default Source Address	Broadcasts using multiple DSAs. Internal errors are reported using 250 (0xFA)
internal Flash (code space)	256K
internal RAM	16K
external Flash (logging)	32 Mbit (4Mb x 8)
external SRAM	2 Mbit (128K x 16)
Non Volatile RAM (EEPROM)	512 bytes

Product ID

The TM-102 transmit PRODUCT_ID PGN (0xFEEB) data upon request. Details on this PGN are found in the RV-C Protocol Manual. The format of the data appears as:

SILVERLEAF*TM102-v.vv-V0*nnnnn*vin*

Where:

v.vv	product version number
nnnnn	product serial number (currently 00000 until we devise a method to add the numbers)
vin	vehicle identification number. This 17 byte field may be entered by using PROP_SET_UNIT_NUMBER described elsewhere in this manual.

Note that the “-V0” part of the string was formerly “-CC” which is misleading since we use the same code for all of our customers. This has been changed starting with version 1.19.

Versions

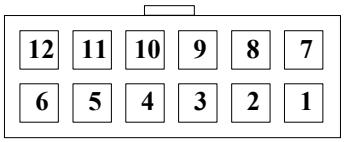
TBA

Connectors

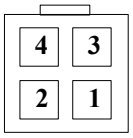
Connector Types

All diagrams are “wire-side” view.

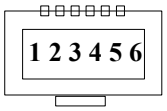
Molex 12-Pin
Receptacle - Molex 5557 Series. Part #39-01-2120
Strain Relief - 41995 Series. Part #15-04-0345
Crimp-on Connectors - 5556 Series. Part #39-00-0039

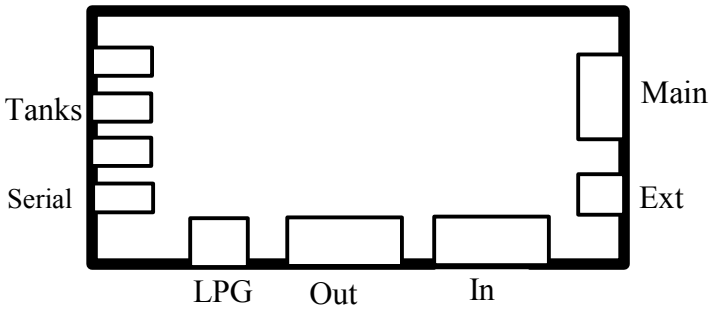


Molex 4-Pin
Receptacle - Molex 5569 Series. Part #39-30-1040
Strain Relief - 41995 Series. Part #15-04-0294
Crimp-on Connectors - 5556 Series. Part #39-00-0039



RJ-12
RJ-12 Connector available from multiple sources.





Connector Pinouts

Main Connector (“Main”) *12-pin Molex*

Pin	Designation	Type	Notes
1	GROUND	Ground	
2	J1939 COMMON	CAN	Attach to Chassis Bus
3	J1939 DATA +	CAN	Attach to Chassis Bus or Elite Power Data+
4	J1939 DATA -	CAN	Attach to Chassis Bus or Elite Power Data-
5	RV-C DATA +	CAN	Attach to RV-C Bus, Also Xanbus
6	RV-C DATA -	CAN	Attach to RV-C Bus, Also Xanbus
7	POWER	12V Power Input	Should be wired to always-hot house power source.
8	GEN COM TX/485+	RS-232 Transmit or RS-485 Data +	Attach to Onan Comm Receive/Data + or SurgeGuard 34520 Data+ Jumper controls whether port is RS232 or RS485
9	GEN COM RX/485-	RS-232 Receive or RS-485 Data -	Attach to Onan Comm Transmit/Data – or SurgeGuard 34520 Data- Jumper controls whether port is RS232 or RS485

Pin	Designation	Type	Notes
10	GEN COMMON	RS-232 Common	Attach to Onan Comm Common
11	Not Used		
12	Not Used		

Input Connector ("In") *12-pin Molex*

Pin	Designation	Type	Notes
1	PARK BRAKE	Active Low Input	Attach to Park Brake Signal
2	GEN SWITCH	Active Low Input	Attach to Remote Gen Start Momentary
3	FILL SWITCH	Active Low Input	Attach to Remote AutoFill Momentary
4	PUMP SWITCH	Active Low Input	Attach to Remote Water Pump Switch
5	BYPASS DETECT	Active Low Input	Attach to Water Pump Ground
6	GEN DEMAND 1	Active Low Input	Attach to Thermostat output or Gen Lock.
7	PUMP SWITCH or AC CURRENT DETECT	Active High Input	Attach to Remote Water Pump Switch or AC Current Switch
8	GEN RUNNING	Active High Input	Attach to Gen run signal (hourmeter)
9	WATER HEATER or BATTERY DISCONNECT SENSE	Active High Input	Attach to water heater status or to the House DC Power (to detect whether the disconnect has been bypassed)
10	WATER PRESSURE or LOAD_SHED	Active High Input	Attach to water pressure switch or energy management system
11	ENGINE RUN or CHARGEBRIDGE SENSE	Active High Input	Attach to Engine Run signal ("E" version only in v3.18+) or to the Charge Bridge solenoid coil to determine if the charge bridge is active or not (non "E" version v3.18+)
12	GEN DEMAND 2	Active High Input	Secondary thermostat input or Gen Lock

Output Connector ("Out") *12-pin Molex*

Pin	Designation	Type	Notes
1	ENTRY DOOR LOCK or THERMOSTAT CONTROL	Active Low Output	formerly SHIFT INHIBIT - discontinued and replaced with BLACK TANK FULL in v3.06 BLACK TANK FULL discontinued in v3.14 THERMOSTAT CONTROL added to "E" version only in v3.13 ENTRY DOOR LOCK implemented to "A" versioin only in v3.26
2	FILL VALVE	Active Low Output	Attach to Fill Solenoid Valve Input
3	PUMP CONTROL	Active Low Output	Attach to Water Pump Relay Input
4	THERMOSTAT CONTROL or BATTERY SOLENOID	Active Low Output	Attach to Heat Device for Thermostatic Control
5	GEN START	Active Low Output	Attach to Generator Start Input
6	GEN STOP	Active Low Output	Attach to Generator Stop Input

Pin	Designation	Type	Notes
7	PRIMARY FLOOR CONTROL or AWNING EXTEND or DISCONNECT_CLOSE	Active High Output	Attach to Tile Heat Relay Input or Awning Extend Switch or Battery Disconnect Solenoid
8	SECONDARY FLOOR CONTROL or AWNING RETRACT or DISCONNECT_OPEN	Active High Output	Attach to Tile Heat Relay Input or Awning Retract Switch or Battery Disconnect Solenoid
9	DC SENSE	Analog Input	
10	TILE TEMP	Analog Input	4kOhm - 12 kOhm range. 0-250 Ohm version optional.
11	GROUND		
12	RELAY PROTECT		Attach to the 12V Input on any or all relays attached to Out#1 - Out#6. Provides back-feed protection for the output driver.

LPG Sensor Connector ("LPG") *4-pin Molex*

Pin	Designation	Type	Notes
1	EXCITE +	Analog Input	Attach to Sensor Output
2	EXCITE -	Analog Input	Attach to Sensor Ground
3	SIGNAL +	Analog Input	Attach to Sensor Output
4	SIGNAL -	Analog Input	Attach to Sensor Ground

External Bus Connector ("EXT") *4-pin Molex*

Pin	Designation	Type	Notes
1	POWER	5V Power Output	Attach to Sensor Power Input
2	GROUND	Ground	Attach to Sensor Ground
3	SCL	I²C Communications	Attach to Sensor SCL
4	SDA	I²C Communications	Attach to Sensor SDA

Tank Sensor Connector ("TANK1, TANK2, TANK3") *RJ-12*

Pin	Designation	Type	Notes
1			
2	GROUND	Ground	Attach to Sensor Ground
3	POWER	5V Power Output	Attach to Sensor Power Input
4	SIGNAL	Analog Input	Attach to Sensor Signal Output
5			
6			

Tank 1 = Fresh

Tank 2 = Gray Waste
Tank 3 = Black Waste

Serial (SurgeGuard/Outback) Connector ("SERIAL") *RJ-12*

Pin	Designation	Type	Notes
1	POWER OUT	5V Power Output	
2	SERIAL TX	TTL Serial Transmit	RS-232 Transceiver Optional
3	SERIAL RX	TTL Serial Receive	RS-232 Transceiver Optional
4			
5	GROUND	Ground	
6			

If attached to a Surgeguard, an isolator adapter ("SGIB") is required between the TM-102 and the Surgeguard. Note that there is a pair of internal jumpers (JP6) which select whether this port operates at RS-232 or TTL signal levels. For Surgeguard, these jumpers must be set to TTL.

If attached to an Outback Inverter Panel, a serial adapter ("OIB") is required to adapt the wiring and provide the necessary power for the Outback port. For Outback the JP6 jumpers must be set to RS-232.

This port can also be used for a PC Serial connection if set to RS-232 and the Surgeguard feature is disabled. Although intended for SilverLeaf use, this port is also used as a diagnostic port for outputs of debugging information and stack dumps when the unit crashes.

IS-160 Support

The IS-160 board is an I/O expander that allows 16 additional inputs/outputs. It is connected to the External Bus Connector which uses the I²C bus for data transfers. Additional thermometer probes (up to 2) may be connected to the EXT ports on the IS-160 board. See the IS-160 Application Document for more details.

PGN Summary

PGN	Hex	I/O	
DM1 Diagnostics		Out	Reports each internal device with the same SA, but different DSA within the PGN.
FLOOR_HEAT_STATUS	1FEFC	Out	
FLOOR_HEAT_COMMAND	1FEFB	In	
GENERATOR_DEMAND_STATUS	1FF80	Out	
GENERATOR_DEMAND_COMMAND	1FFEF	In	
AGS_CRITERION_STATUS	1FEFE	Out	
AGS_CRITERION_COMMAND	1FEFD	In	
DATE_TIME_STATUS	1FFFF	Out	
SET_DATE_TIME_COMMAND	1FFFE	In	

PGN	Hex	I/O	
DC_SOURCE_STATUS_1	1FFFD	Both	Serves as a DC Source monitor for a single voltage input. Instance is configurable via proprietary PGN. The AGS features require an Instance to be configured for battery autocharging. This can be the internal Instance or any RV-C source.
COMMUNICATION_STATUS_1	1FFFA	Out	
COMMUNICATION_STATUS_2	1FFF9	Out	
COMMUNICATION_STATUS_3	1FFF8	Out	
CHASSIS_MOBILITY_STATUS	1FFF4	Out	
CHASSIS_MOBILITY_COMMAND	1FFF3	In	
GENERATOR_AC_STATUS_1	1FFDF	Out	
GENERATOR_STATUS_1	1FFDC	Out	
GENERATOR_STATUS_2	1FFDB	Out	
GENERATOR_COMMAND	1FFDA	In	
GENERATOR_START_CONFIG_STATUS	1FFD9	Out	
GENERATOR_START_CONFIG_COMMAND	1FFD8	In	
TANK_STATUS	1FFB7	Out	
TANK_CALIBRATION_COMMAND	1FFB6	In	
TANK_GEOMETRY_STATUS	1FFB5	Out	Allows up to four calibration points.
TANK_GEOMETRY_COMMAND	1FFB4	In	
WATER_PUMP_STATUS	1FFB3	Out	
WATER_PUMP_COMMAND	1FFB2	In	
AUTOFILL_STATUS	1FFB1	Out	
AUTOFILL_COMMAND	1FFB0	In	
ATS_AC_STATUS_1	1FFAD	Out	
ATS_STATUS	1FFAA	Out	
THERMOSTAT_AMBIENT_STATUS	1FF9C	Out	Two Instances. Instance values configurable via proprietary PGN.
THERMOSTAT_STATUS_1	1FFE2	Out	Always uses same instance as external temperature sensor
THERMOSTAT_COMMAND_1	1FEF9	In	
FURNACE_STATUS	1FFE4	Out	Reports status of THERMOSTAT_CONTROL output.
GENERAL_RESET	17FFA	In	

Propriety Operations Summary

PGN	Hex	I/O	

Configuration Items

Date/Time	Entire PGN	Standard	N/A
DC Source Instance		Proprietary	250
Generator Start Configuration	Entire PGN except Type.	Standard	TBA
(Reserved) DC SOC	Instance	Proprietary	1
(Reserved) DC SOC Table	Entire Table (Amp/Volt/SOC)	Proprietary	See Below
Tank Calibration	Entire PGN. Only supports a dry calibration. Precision is configurable for Barthtech Sensors only.	Standard	N/A
Tank Geometry	Up to four calibration points.	Standard Proprietary “Reset to Defaults”.	Per Model
MSC Tank Sensor Configuration	Number of Sensors Board Revision Dry Calibration	Standard Proprietary Standard	4 Rev B See Text
AutoFill Configuration	Fill Level, Run-After Time, Timeout	Proprietary	Per Model
Ambient Temperature Instances		Proprietary	Internal - 250 External - 249
Ambient Temperature Calibration		Proprietary	N/A
Thermostat Set Point		Standard	38 Deg F
Floor Heat	Day Mode Begin Time Day Mode Set Point Night Mode Begin Time Night Mode Set Point Primary Dwell Secondary Dwell	Standard	N/A
Automatic Genstart	Entire PGN, including all Criteria Max Run Time, Stop Criteria	Standard Proprietary	TBA
Climate Control Configuration	Number of Zones 50A Generator Installed Genstart Enabled Load Management Dwell Time Minimum Cycle Time	Proprietary	
Climate Control Set Points and Schedule	Up to Four Schedule Settings (Day, Night, Away, Store)	Standard	
Slide Room Configuration	Slide 1 Hydraulic/Electric Slide 2 Hydraulic/Electric	Proprietary	
Chassis Charge Bridge Configuration	Min, Max Charger Voltage Min Chassis Voltage Bridge Run Time	Proprietary	12.5 - 15.0 V 12.5 V 30 Min
J1939 Bridge	Source Addresses Bridged	Proprietary	SA 3, SA 16
Discrete Outputs	Number of Outputs Supported Base Internal Instance Base Instance	Proprietary	80 0 250

Features Enabled	Enable/Disable Surgeguard Bridge Enable/Disable Onan Bridge Enable/Disable Autofill Support Enable/Disable Water Pump Support Enable/Disable BarthTech Tank Support Enable/Disable Garnet Tank Support Enable/Disable LPG Tank Support Enable/Disable Floor Heat Support Enable/Disable AutoGen Support Enable/Disable Chassis Mobility Support Enable/Disable Ambient Temp Support Enable/Disable DC Source Support Enable/Disable J1939 Bridge Enable/Disable MSC Tank Support Enable/Disable PowerTech Support Enable/Disable Xanbus Support Enable/Disable Awning Support Enable/Disable Thermostat Output Support Enable/Disable Serial Monitor Enable/Disable Extended Serial Monitor (Reserved) Enable/Disable Battery SOC Meter Enable/Disable Climate Control Enable/Disable Slide Room Control Enable/Disable Water Heater Enable/Disable Outback Bridge Enable/Disable Chassis Charging Bridge Enable/Disable External AGS Activity Detection Enable/Disable Sec Water Pump Enable/Disable Outback on Gen Port Enable/Disable Water Pressure Sensor Enable/Disable RVIA 2010 Compliance Enable/Disable Water Pressure Switch Input Enable/Disable Pin 6 Gen Lock Enable/Disable Pin 12 Gen Lock Enable/Disable Charge Bridge AGS Enable/Disable DC Disconnect Enable/Disable J1939 Genset. Enable/Disable Load Shed Monitor Enable/Disable SurgeGuard 34520 Enable/Disable Elite Power Li-ion Battery Monitoring Enable/Disable Outback Auto Battery Topoff Enable/Disable Charge Bridge Sense Enable/Disable Entry Door Lock Output	Proprietary	Per Model

Maintained States

In the case of a power cycling, the TM-102 will maintain certain internal states, including control over external relays and devices.

Date/Time	All data is maintained.
AutoFill	All data is maintained. Valve condition is restored.
Water Pump	Pump condition is restored. Both secondary and primary pump.
Floor Heat	Operating Status, Operating Mode are maintained.
Automatic Genstart	Entire Status PGN is maintained.

Chassis Mobility	Lock Tables are maintained.
Climate Control	All Status PGNs are maintained.

Coach Model Identifications

On some PGN and proprietary commands that involves setting certain values depending on manufacturer's make and mode such as factory resets, etc. are listed here:

NOTE: Effective with TM102 version 1.20 and later, the coach specific factory reset will no longer be handled by the various reset fields in some PGN's described in this manual. The factory resets will be handled by the service tool such as Omniscope using scripts. Only the general defaults are applied in some situations (see GENERAL_RESET, PROP_RESET_AGS_DEFAULTS and PROP_RESET_TANK_GEOMETRY). This table is for information only on older versions (1.19 and before).

Manufacturer	*Model*	*Value*
Country Coach	2006 Intrigue	0
Western RV	2006 Alpine Limited	1
Country Coach	Affinity	2
Country Coach	45 Ft. H3	3
Country Coach	Lexa	4
Country Coach	Magna	5
Country Coach	40 FT. XL2	6
Country Coach	Allure	7
Country Coach	Inspire	8
Foretravel	All models	9
Newell	All models	10
Royale	All models	11
Country Coach	Rhapsody	12
Outlaw Conversions	All	13

System Configuration

System configuration is through a series of proprietary PGNs following the general RV-C guidelines. Certain PGNs are not supported when the unit is "Locked". Attempting to use those commands when the unit is "locked" will result in a NAK with response code 6 – Password Required.

PGNs Supported

Proprietary - Lock/Unlock

Name:	PROP_LOCK/PROP_UNLOCK	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0xD3 = Lock 0xD2 = Unlock
Byte 2-8:	Password (ASCII Text)	"LOCKIT!" to lock. "UNLOCK!" to unlock.

The unit will respond with a NAK with return code 6 if the data bytes are incorrect, or 0 if they are correct. Responds with PROP_REPORT_LOCK_STATUS.

General Reset

Name:	GENERAL_RESET	
PGN:	0x17FFA (0x17F00 + TM102 source address)	
Bit 1.1-1.2:	Reboot unit	Supported per RV-C
Bit 1.3-1.4:	Clear Faults	Supported per RV-C
Bit 1.5-1.6:	Reset to Factory Defaults	Supported per RV-C, uses byte 2 below
Byte 2:	Coach Model	See "Coach Model Identification" above (**obsolete**)

Unit must be "unlocked" to allow reset to factory defaults. Effective versions 1.20 and later, flag 1.5-1.6 will rewrite the entire NVRAM with generic defaults. The user should avoid using this flag as much as possible. Also Coach Model will no longer be used.

Proprietary - Configure DC Source and Ambient Temperature Instances

Name:	PROP_CONFIGURE_INSTANCE	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0x02 = Set Instance 0xDD = Request Instance Report
Byte 2:	Permanence	Always 0xFD - Permanent Setting
Byte 3:	Internal Instance	0 - DC Source 1 - Internal Temp Sensor 2 - External Temp Sensor #1 3 - External Temp Sensor #2 4 - External Temp Sensor #3 5 – Tile Temp Sensor 6 – Thermostat / Furnace Report (Bay Heat) 7 – Battery Temp Sensor (for Li-ion battery - uses minimum cell temperature for battery heater)
Byte 4:	Public Instance	Desired Instance for reports

The Thermostat will operate based on whichever temperature sensor Instance matches the Thermostat Instance. For example, to use the Tile Temp Sensor to control a basement vent, set both Instances to the same value. If the Thermostat instance does not match any of the sensors then it will look for a Ambient Temperature report on the RV-C bus with instance equal to the Thermostat Target instance (see PROP_ENABLE_FEATURE_2).

Unit must be “unlocked” to accept this command.

Proprietary - Calibrate Ambient Temperature

Name:	PROP_CALIBRATE_AMBIENT_TEMP	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	Always 0xF9
Byte 2:	Internal Instance	1 - Internal Temp Sensor 2 - External Temp Sensor #1 3 - External Temp Sensor #2 4 - External Temp Sensor #3 5 – Tile Temp Sensor
Byte 3,4:	Reference Temperature	

Proprietary - Enable/Disable Features

Name:	PROP_ENABLE_FEATURE	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0xF5 = Enable / Disable Feature 0xF4 = Request Feature Report
Byte 2-7:	Features	00 = Disable 01 = Enable 11 = No Change

2.1-2.2	Surgeguard Bridge
2.3-2.4	Onan Bridge
2.5-2.6	AutoFill
2.7-2.8	Water Pump
3.1-3.2	BarthTech Tank Support
3.3-3.4	Reserved
3.5-3.6	LPG Tank
3.7-3.8	Floor Heat
4.1-4.2	Automatic Genstart
4.3-4.4	Chassis Mobility Control
4.5-4.6	Ambient Temperature
4.7-4.8	DC Source Monitor
5.1-5.2	J1939 Bridge
5.3-5.4	MSC Tank Monitor
5.5-5.6	Non-RVC Generator
5.7-5.8	Xanbus Bridge
6.1-6.2	Awning
6.3-6.4	Thermostat Output Support
6.5-6.6	Serial Monitor
6.7-6.8	Extended Serial Monitor
7.1-7.2	Battery SOC Meter
7.3-7.4	Climate Control
7.5-7.6	Slide Room Control
7.7-7.8	Water Heater

Byte 8:	Board Revision	0x00 = Rev A 0x01 = Rev B (MSC Sensor Resistor Change)

Name:	PROP_ENABLE_FEATURE_2	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0xC3 = Enable / Disable Feature 0xC2 = Request Feature Report
Byte 2-6:	Features	00 = Disable 01 = Enable 11 = No Change

2.1-2.2	Enable/Disable Outback Bridge

2.3-2.4	Enable/Disable Chassis Charging Bridge
2.5-2.6	Enable/Disable AGS External Activity Detection
2.7-2.8	Enable/Disable Secondary Water Pump
3.1-3.2	Outback Uses Gen Port (00 = Outback on SERIAL port, 01 = Outback uses GEN COM port).
3.3-3.4	Enable/Disable Water Pressure Sensor
3.5-3.6	Enable/Disable RVIA 2010 Compliance
3.7-3.8	Enable/Disable Water Pressure Switch Input
4.1-4.2	Enable/Disable Pin 6 Gen Lock
4.3-4.4	Enable/Disable Pin 12 Gen Lock
4.5-4.6	Enable/Disable Charge Bridge AGS
4.7-4.8	Enable/Disable DC Disconnect
5.1-5.2	Enable/Disable J1939 Genset.
5.3-5.4	Enable/Disable Load Shed Monitor
5.5-5.6	Enable/Disable SurgeGuard 34520
5.7-5.8	Enable/Disable Elite Power Li-ion Battery Monitoring
6.1-6.2	Enable/Disable Outback Auto Battery Topoff
6.3-6.4	Enable/Disable Charge Bridge Sense
6.5-6.6	Enable/Disable Entry Door Lock Output

Byte 7:	Thermostat Target Zone	0-250. Target zone used for Thermostat
Byte8:	CAN Watchdog Timeout	0 = Not allowed 1 – 250 = 0.1 to 25.0 seconds..

The CAN Watchdog triggers after the indicated number of seconds in which no activity is seen on the

Note that the unit must be reset for configuration changes by PROP_ENABLE_FEATURE and PROP_ENABLE_FEATURE_2 to take effect. Unit must be “unlocked” to accept these command.

Proprietary - Request ADC Counts

Name:	PROP_REQUEST_ADC_COUNTS_1	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xEC = Request ADC Counts 1 Report

Name:	PROP_REQUEST_ADC_COUNTS_2	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xEB = Request ADC Counts 2 Report

Proprietary – Configure NVRAM Contents

Name:	PROP_NVRAM_CONFIGURE	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xCF = Configure NVRAM
Byte 2-3:	Address	Range from 0 to 0x1FF
Byte 4:	Data	byte to write

Unit must be “unlocked” to accept this command.

Proprietary – Request NVRAM Contents

Name:	PROP_REQUEST_NVRAM	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xCE = Request NVRAM Data
Byte 2-3:	Address	Range from 0 to 0x1FF
Byte 4:	Length	number of bytes, can be up to 250

PROP_REPORT_NVRAM will send multiple packets for length greater than 4.

Proprietary – Report NVRAM Contents

Name:	PROP_REPORT_NVRAM

PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xCD = Report NVRAM Data
Byte 2-3: Address Range from 0 to 0x1FF
Byte 4: Length Number of bytes (1 to 4) in next field
Byte 5-8: Data

Proprietary – Configure Output Pins
Name: PROP_CONFIGURE_OUTPUT_PIN
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xCC = Configure output pin
0xCB = Request output pin configuration
Format is identical to PROP_REPORT_OUTPUT_PIN. Unit must be "unlocked" to accept this command.

Proprietary – Configure Input Pins
Name: PROP_CONFIGURE_INPUT_PIN
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xC9 = Configure input pin
0xC8 = Request input pin configuration
Format is identical to PROP_REPORT_INPUT_PIN. Unit must be "unlocked" to accept this command. The unit may need to be power cycled for the updated configuration to take effect.

Proprietary – Configure DC Load PGN
Name: PROP_CONFIGURE_IOMANAGER
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xB5 = Configure DC Load PGN
Byte 2-4 See PROP_REPORT_IOMANAGER_CONFIG
Byte 5: Secondary Command 0x00 = Turn on/off all TM-102 outputs
0x01 = Turn on/off all IS160 #1 outputs
0x02 = Turn on/off all IS160 #2 outputs
0x03 = Turn on/off all IS160 #3 outputs
0x04 = Turn on/off all IS160 #4 outputs
0x10 = Turn on/off all outputs.
0x11 = Turn on/off all outputs in RV-C configured range.
Byte 6: Command Data 0x00 = Off
0x01 = On
Format is identical to PROP_REPORT_IOMANAGER_CONFIG, with the addition of the indicated secondary command. The secondary command merely provides a quick way to turn on or off every output for testing purposes. It does not enable or disable the outputs permanently.

PGNs Reported

Proprietary – Lock/Unlock Report
Name: PROP_REPORT_LOCK_STATUS
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xD0 = Lock Status Report
0xD1 = Request Lock Status
Byte 2: Status 0 = unlocked

1 = locked

Proprietary - Report Features
Name: PROP_REPORT_ENABLE_FEATURES
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xF0 = Feature Report
Byte 2-8: Features As per PROP_ENABLE_FEATURE

Proprietary - Enable/Disable Features
Name: PROP_REPORT_ENABLE_FEATURE_2
PGN: PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)
Byte 1: Operation 0xC1 = Report Features
Byte 2-8: Features As per PROP_ENABLE_FEATURE_2

Proprietary – Report Instances
Name: PROP_INSTANCE_REPORT
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xDE = Instance Report
Byte 2: DC Source Instance
Byte 3: Internal Ambient Temperature Instance
Byte 4: External Ambient Temperature #1 Instance
Byte 5: External Ambient Temperature #2 Instance
Byte 6: External Ambient Temperature #3 Instance
Byte 7: Tile Temp Sensor Instance
Byte 8: Thermostat (Bay Heater) Instance
See PROP_CONFIGURE_INSTANCE for more information

Name: PROP_INSTANCE_REPORT_2
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xAE = Instance Report
Byte 2: Battery Temp Instance
See PROP_CONFIGURE_INSTANCE for more information

Proprietary - Report ADC Counts
Name: PROP_REPORT_ADC_COUNTS_1
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xEA = ADC Counts 1 Report
Byte 2-3: Fresh Counts (ADC input 1)
Byte 4-5: Black Counts (ADC input 2)
Byte 6-7: Gray Counts (ADC input 3)

Name: PROP_REPORT_ADC_COUNTS_2
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xE9 = ADC Counts 2 Report
Byte 2-3: LPG Counts (ADC input 4)
Byte 4-5: Battery Counts (ADC input 5)
Byte 6-7: Floor Heat Counts (ADC input 6)

Proprietary – Report Output Pin Configuration
Name: PROP_REPORT_OUTPUT_PIN
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xCA = Report output pin configuration

Byte 2:	Output type	Sets output pins: 0 = Chassis shift inhibit 1 = Autofill 2 = Water Pump 3 = Thermostat, Chassis Battery Bridge 4 = Generator Start 5 = Generator Stop 6 = Floor Heat #1 7 = Floor Heat #2 8 = Awning Extend, DC Disconnect Close 9 = Awning Retract, DC Disconnect Open 10 = Slide #1 Extend 11 = Slide #1 Retract 12 = Slide #1 Pump 13 = Slide #2 Extend 14 = Slide #2 Retract 15 = Slide #2 Pump 16 = Water Heater 17 = A/C #1 Cool 18 = A/C #1 High Fan 19 = A/C #1 Low Fan 20 = A/C #2 Cool 21 = A/C #2 High Fan 22 = A/C #2 Low Fan 23 = LP Furnace 24 = Secondary Water Pump 25 = Water Heater AC Element 26 = AC #1 Heat Strip 27 = AC #2 Heat Strip
Byte 3:	Output pin #	0x00 to 0x07 = TM102 outputs 0x10 to 0x4F = IS-160 outputs

Proprietary – Report Input Pin Configuration

Name:	PROP_REPORT_INPUT_PIN	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xC7 = Report input pin configuration
Byte 2:	Input type	Sets input pins: 0 = Parking brake 1 = Autofill Manual Switch 2 = Water Pump Manual Switch 3 = Water Pump Bypass Detect 4 = reserved 5 = Generator Manual Switch 6 = Generator Demand #1 (i.e. thermostat) 7 = Generator Running (PowerTech) 8 = Water Heater Status 9 = Generator Demand #2 10 = Water Pressure Switch 11 = Engine Run / Charge Bridge Sense
Byte 3:	Input pin #	0x00 to 0x0B = TM102 inputs

Proprietary – Report Output General Configuration

Name:	PROP_REPORT_IOMANAGER_CONFIG	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xB4 = Report DC Load PGN configuration
Byte 2:	Base RV-C Instance	1-250.
Byte 3:	Base Internal Instance	0x00 = Internal TM-102 (Default) 0x10 = IS-160 Address 0, Pin 1 0x20 = IS-160 Address 1, Pin 1 0x30 = IS-160 Address 2, Pin 1 0x40 = IS-160 Address 3, Pin 1
Byte 4:	Number of Outputs	0 = Ignore all DC_LOAD_COMMANDs 1-80 = Number of pins to be controlled.

This PGN establishes the mapping of the DC_LOAD_COMMAND PGN (See the Digital I/O Manager section.) Output pin instances, whether internal or IS-160, can be controlled directly through that PGN, and are mapped to RV-C instances using this PGN. These maps are direct to the hardware, and are completely independent of the OUTPUT_PIN configurations detailed just above, which allow the *function* of pins to be modified. This PGN establishes a direct map between the RV-C instance and the hardware itself, with no regard to function.

Coach Serial Number

The coach serial number can be programmed into the TM-102 and is reported as the fourth element of the PRODUCT_ID. (This string is defined as "Unit Number" in RV-C.)

Proprietary - Set Unit Number

Name:	PROP_SET_UNIT_NUMBER	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	Always 0xE0 - Set Unit Number
Byte 2:	Packet Number	0 - 2
Byte 3-8:	Text	17-digit ASCII text string. Packet 0 is characters 0-5. Packet 1 is characters 6-11. Packet 2 is characters 12-16. Last byte is 0xFF.

Note that no equivalent REPORT exists. The unit number is reported through the PRODUCT_ID PGN. After each packet the TM-102 will respond with an ACK. After the third packet it will also respond with a PRODUCT_ID.

System Clock

This module also includes the core functions of the TM-102. Whereas most faults shall be reported using the Default Source Address of the appropriate software module - for example, an error in the genstart configuration would be reported using DSA 65 - faults that are not specific to a certain module shall be reported using DSA 250 (System Clock).

PGNs Supported

Set Date and Time
Name: SET_DATE_TIME_COMMAND
PGN: 0x1FFFE
The entire PGN is supported per RV-C

PGNs Reported

Date and Time
Name: DATE_TIME_STATUS
PGN: 0x1FFFF
The entire PGN is supported per RV-C. The TM-102 will serve as the “Time Master” unless a device with a higher source address makes a time broadcast. If three seconds pass with no higher priority clock detected, the TM-102 will resume being Time Master.

Communications Status 1, 2, 3
Name: COMMUNICATION_STATUS_1
COMMUNICATION_STATUS_2
COMMUNICATION_STATUS_3
PGN: 0x1FFFA, 0x1FFF9, 0x1FFF8
Supported on Request, per RV-C. Data field supported are TBA.

Suspect Parameters

The DSA for all DM1 reports is 250. The TM-102 reports both clock errors and general node problems. Only standard RV-C SPNs are supported (RV-C Application Layer Table 4)

J1939 to RV-C Bridge

The J1939 Bridge simply echoes messages with certain source addresses onto the RV-C bus using DSA 253. All messages from the indicated device are echoed, without regard to content. The exception is PGN 0x0000 (Torque Control), which is never echoed. Messages are sent with source address of the J1939 device, not the source address of the TM-102.

The unit also echoes destination-specific PGN Requests from the RV-C bus to the J1939 bus (for bridged addresses only).

When Bridge is enabled as a feature, it will also echo the Engine Idle Shutdown PGN (0x0FEE4) and Particulate Trap Status (0x0FD7) PGNs received from the J1939 port.

PGNs Supported

Proprietary - Configure J1939 Bridge

Name:	PROP_CONFIGURE_J1939_BRIDGE	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0xF8 = Start Bridging Indicated Address
		0xF7 = Cancel Bridging Indicated Address
		0xF6 = Request Bridge Report
Byte 2:	Address to Bridge	0x00 = Engine
		0x03 = Transmission
		0x10 = Transmission Retarder
Bit 3,1-3.2	Bridge All DM1s	0x00 = Stop
		0x01 = Start

Unit must be “unlocked” to change the address list. The addresses are not limited to the indicated values.

If the Bridge All DM1s flag is set, the unit will echo all DM1 activity on the J1939 bus to the RV-C bus. This setting is not kept in NVRAM. The unit will accept this command regardless of the whether the unit is unlocked. The Operation must be set to 0xF8 to set this flag.

PGNs Reported

Proprietary - J1939 Bridge Report

Name:	PROP_REPORT_J1939_BRIDGE	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xF1 = J1939 Report
Byte 2-8:	Source Addresses Bridged	

Suspect Parameters

The DSA for all DM1 reports is 253. This module has just one diagnostic SPN defined. If no J1939 data is available, an Yellow Lamp condition will be indicated. SPN = 9 - Node Network Connection, and FMI = 11 - Failure Not Identifiable.

Chassis Motion Controller

The Chassis Motion Controller requires a discrete output (Out#1 - SHIFT INHIBIT) to be attached to the transmission Range Inhibit. When this pin is grounded, the transmission can move. When the circuit is open, the transmission is immobilized. It requires a discrete input (In#1 - PARK BRAKE) from the park brake. The Chassis Motion Controller also requires access to the J1939 data stream from the engine and transmission.

No provisions for engine locking, ignition key status, or accessory switch status exist therefore they are not supported.

As a special provision to support certain not-completely-RV-C compliant devices, the TM-102 also listens on the RV-C line for PGN 0xFFF4, and rebroadcasts the data as PGN 0x1FFF4 (CHASSIS_MOBILITY_STATUS). This occurs automatically, even if the Chassis Mobility Controller is not enabled. Also, if this PGN is detected, or the unit sees a CHASSIS_MOBILITY_STATUS broadcast from another product with Park Brake data, this unit will not send the Park Brake status. (It will send the RPM / Speed data, if available.)

Starting in v2.11, an engine run input was added to the TM102. When it is active, the TM102 simulates 2000 RPMs with the CHASSIS_MOBILITY_STATUS message. The input has to be on for 5 seconds before the RPMs are updated. The input is ignored if J1939 data is present. Starting in v3.18 the engine run is only available in the “E” version.

PGNs Supported

Chassis Mobility Command

Name:	CHASSIS_MOBILITY_COMMAND	
PGN:	0x1FFF3	
Bit 2.1-2.2:	Transmission Command	Supported per RV-C
Bit 2.3-2.4:	Transmission Lock User Override	Supported per RV-C
Byte 4:	Default Source Address	Address of device locking transmission

Park Brake Command, Park Brake Lock Override, Engine Lock Command, and Engine Lock User Override are not supported.

The node shall request CHASSIS_MOBILITY_COMMAND before releasing the transmission lock. If any node responds with a lock on the transmission, or if a product that previously locked the transmission, has not subsequently unlocked it, and does not respond to the request - then the lock remains in place.

PGNs Reported

The support for this PGN is determined by several configuration values. Engine RPM and Vehicle Speed are provided if there is any data on the J1939 line and the J1939 Genset support is not enabled. The J1939 Bridge does not have to be repeating any data. You may activate the J1939 Bridge with no addresses enabled if you only want these two data items. The Park Brake and Transmission Lock are provided if the Chassis Mobility is enabled. To completely suppress the status, do not activate the Immobilizer and do not hook up the J1939 bus.

Chassis Mobility Status

Name:	CHASSIS_MOBILITY_STATUS	
PGN:	0x1FFF4	
Byte 1-2:	Engine RPMs	Supported per RV-C. Derived from J1939 Data. If J1939 Data unavailable, reports 0xFFFF.
Byte 3-4:	Vehicle Speed	Supported per RV-C. Derived from J1939 Data. If J1939 Data unavailable, reports 0xFFFF.
Bit 5.1-5.2:	Park Brake Status	Supported per RV-C. Derived from discrete input.
Bit 5.3-5.4:	Transmission Lock Status	Supported per RV-C.

Suspect Parameters

The DSA for all DM1 reports is 252. Specific SPNs are:

256	Engine RPMs
257	Vehicle Speed
258	Park Brake
259	Transmission Lock

If the unit detects motion despite the Park Brake or Transmission Lock, then a Red Lamp condition will be reported with the appropriate SPN and FMI = 7 - Mechanical System Not Responding. Lack of J1939 data will be an Yellow Lamp, SPN = 9 - Node Network Connection, and FMI = 11 - Failure Not Identifiable.

Generator RV-C Bridge

Currently, four generator bridges are supported in TM-102: The Onan QD Series, the Generic RV-C and the Generic Non-RV-C (formerly “PowerTech”) generators, plus since **v.2.17**, the EPS J1939 genset controller.

The Onan generator is connected via the main RS-232 port (Main#8, Main#9, Main#10) and two discrete outputs for Start and Stop activations (Out#5, Out#6). The bridge serves as a full-featured RV-C Generator, including Generator Start functions.

The Generic generators only uses the Start and Stop activations (Out#5, Out#6). The Generic RV-C generator is mainly used with the Extended Serial Monitor to output generator data via serial port. It also allows the use of the AGS.

The EPS genset support is automatic, if the Immobilizer is disabled. (If the Immobilizer is enabled, it will interpret the genset J1939 data as engine data.) If no genset is attached to the J1939, the unit will behave like a Non-RV-C genset.

It should be noted that the GENERATOR_AC_STATUS data is taken only from the generator data. Additional data may be available from the Surgeguard transfer switch, but that data is treated separately.

PGNs Supported

Generator Command

Name:	GENERATOR_COMMAND
PGN:	0x1FFDA

Byte 1: Command Supported per RV-C
Most applications should start the generator by indicating demand to the automatic genstart controller. This PGN is supported for troubleshooting only.

Generator Starter Configuration Command (Onan generators)
Name: GENERATOR_START_CONFIG_COMMAND
PGN: 0x1FFD8
Byte 1: Generator Type 1 = Crank / Run
2, 3 = Crank / Stop
4 = Run
5 = Crank / Stop w/ run input tied to crank.
Byte 2: Generator PreCrank Time Supported per RV-C. Default 10 sec
Byte 3: Generator Max Crank Time Supported per RV-C. Default 10 sec
Byte 4: Generator Stop Time Supported per RV-C. Default 10 sec

The Generator Type determines how the GEN START and GEN STOP outputs should be connected.

Type	***GEN START***	***GEN STOP***	***Notes***
1	Crank	Run	"Run" is activated on a Start command, deactivated on a Stop command. If the start fails, the Run is kept on to prime the fuel system.
2, 3, 5	Crank	Stop	These are all implemented the same, except #5 ignores the run input until the full cranking time has expired.
4	Run	N/A	"Run" is activated on a Start command, deactivated on a Stop command. It remains on regardless of whether the genset starts.

Proprietary - Reset Generator Runtime
Name: PROP_RESET_GENERATOR_RUNTIME
PGN: PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)
Byte 1: Operation 0xE1 = Reset Engine Runtime
Byte 2-5: Engine Run Time Supported per RV-C
This will report as GENERATOR_STATUS_1. Unit must be "unlocked" to accept this command.

PGNs Reported

Generator AC Status
Name: GENERATOR_AC_STATUS_1
PGN: 0x1FFDF
Byte 1: Instance Always 0x11 - Generator 1, Line 1
Onan QD and EPS
Byte 2-3: RMS Voltage Supported per RV-C
EPS
Byte 3-4: RMS Current Supported per RV-C
Onan QD and EPS
Byte 6-7: Frequency Supported per RV-C
RMS Current and the various Fault flags are not supported.

Name: GENERATOR_AC_STATUS_3
PGN: 0x1FFDD

Generator Status
Name: GENERATOR_STATUS_1
PGN: 0x1FFDC
Byte 1: Status Supported per RV-C
Byte 2-5: Engine Run Time Supported per RV-C
Onan QD
Byte 6: Engine Load Supported per RV-C. Onan Only
Onan QD and EPS
Byte 7-8: Start Battery Voltage Supported per RV-C

Name: GENERATOR_STATUS_2
PGN: 0x1FFDB
Onan QD
Bit 1.1-1.2 Temperature Shutdown Switch Supported per RV-C
Bit 1.3-1.4 Oil Pressure Shutdown Switch Supported per RV-C
Bit 1.7-1.8 Caution Light Supported per RV-C
Onan QD and EPS
Byte 2 Engine Coolant Temperature Supported per RV-C
Byte 4-5 Engine RPM Supported per RV-C
The various flags are derived from Onan diagnostic messages. In addition, these faults will trigger a DM1.

Generator Starter Configuration Status
Name: GENERATOR_START_CONFIG_STATUS
PGN: 0x1FFD9
See GENERATOR_START_CONFIG_COMMAND for details.

Suspect Parameters

The DSA for all DM1 reports is 64. Specific SPNs are per RV-C. Communications failure is given by SPN=13, FMI=11. Onan generator also reports these additional DM1 messages based on the fault codes received:

Onan Generator Faults

Fault	Description	SPN	FMI	Notes
1	High Temperature	274	0	Red Lamp
2	Low Oil Pressure	264	1	Red Lamp
3	Service Check Fault	275	11	Red Lamp
11	Overcurrent Fault	1-17-1	0	Red Lamp
12	Inverter Overvoltage	1-17-0	0	Red Lamp
13	Inverter Undervoltage	1-17-0	1	Red Lamp
14	Inverter Overfrequency	1-17-2	0	Red Lamp
15	Inverter Underfrequency	1-17-2	1	Red Lamp
17	Fuel Pump Fault	271	11	Red Lamp
18	Glow Plug Fault	272	11	Red Lamp
19	Actuator Fault	276	11	Red Lamp
21	Solenoid Fault	277	11	Red Lamp
22	Actuator Overload	278	11	Red Lamp
23	Cutoff Switch Fault	279	11	Red Lamp
24	Temperature Sender Fault	263	2	Red Lamp

Fault	Description	SPN	FMI	Notes
25	Speed Above Target	265	0	Red Lamp
26	Speed Below Target	265	1	Red Lamp
27	PMA Sense Fault	280	11	Red Lamp
28	DC Sense Fault	281	11	Red Lamp
29	Battery Volts High	258	0	Red Lamp
31	Overspeed Fault	265	0	Red Lamp
32	Cranking Speed Low	282	1	Red Lamp
33	Coolant Temperature High	263	0	Red Lamp
34	Inverter Temperature High	283	1	Red Lamp
35	EEPROM Error	4	12	Red Lamp
36	Engine Stop Fault	284	11	Red Lamp
37	Invalid Configuration	3	13	Red Lamp
38	Overcurrent Fault	1-17-1	0	Red Lamp
39	Battery Volts Low	258	1	Red Lamp
42	Processor Fault	1	12	Red Lamp
43	Processor Fault	1	12	Red Lamp
46	Power Supply Fault	5	11	Red Lamp

EPS Generator Faults

EPS SPN	RV-C SPN	FMA	Lamp	Description
100	264	1	RED	Low Oil Pressure. (1L, 2S)
100	264	7	AMBER	Oil Pressure Sender Open.
100	264	17	AMBER	Oil Pressure < 20 PSI. 30s start lockout. 1 s delay
100	264	18	RED	Oil Pressure < 7 PSI. 30s start lockout. 10 s delay
110	263	0	RED	Coolant too hot – Coolant Switch. (1L, 4S)
110	263	5	RED	Water temperature sensor error – break in circuit. (2L, 4S)
110	263	6	RED	Water temperature sensor error – short in circuit. (2L, 5S)
110	263	7	AMBER	Engine Coolant Temperature Sender Open.
110	263	15	RED	Coolant too hot – Coolant Sensor. (1L, 6S)
110	263	15	AMBER	Engine Coolant Temperature > 220 F
110	263	16	RED	Engine Coolant Temperature > 225 F
111	289	1	AMBER	Low Coolant Level Switch Closed.
111	289	1	RED	Low Coolant Level Switch Closed. 90s delay.
158	258	16	AMBER	Battery Voltage > 15 V
158	258	18	AMBER	Battery Voltage <12.2 V. 30s start lockout.
167	290	2	RED	Alternator charging signal fault. (2L, 6S)
167	290	31	RED	Charging / Alternator fault. (1L, 3S)
190	265	1	RED	Engine Stalled.
190	265	7	RED	Speed sensor error. (2L, 1S)
190	265	8	RED	Magnetic Speed Sensor Failure.
190	265	16	RED	Overspeed -- Engine Speed > 2070 RPM. (1L, 1S)
190	265	16	AMBER	Engine Speed >1950 RPM. 3s delay.
190	265	18	AMBER	Engine Speed <1750 RPM. 30s start lockout. 3s delay.
190	265	31	RED	Engine Failed to Start. 30s power-up lockout.
633	276	11	RED	Actuator error. (2L, 2S)
701	284	14	RED	Remote Stop Activated. (1L, 5S)
1675	273	31	RED	Starter error. (1L, 7S)
2440	275	1	RED	Possible Generator Failure. 10 min delay.
2440	275	18	AMBER	Possible Generator Failure. (RMS VOLT < 50)

SurgeGuard Transfer Switch RV-C Bridge

The Transfer Switch Bridge features require connection to a Surgeguard transfer switch, which is connected via the secondary RS-232 port (which in turn is connected to a SGIB isolator board). The TM-102 can only read information from the Surgeguard, and thus only supports the relevant status PGNs, but no configuration or commands.

PGNs Reported

The AC status is reported only at the output point. The status is reported separately for each output leg.

AC Status

Name:	ATS_AC_STATUS_1	
PGN:	0x1FFAD	
Byte 1:	Instance	Leg 1 - 0x79 (01111001) Leg 2 - 0xF9 (11111001) ATS Instance 1, Output Only
Byte 2-3:	RMS Voltage	Supported per RV-C
Byte 4-5:	RMS Current	Supported per RV-C
Byte 6-7:	Frequency	Supported per RV-C
Bit 8.1-8.2:	Fault - Open Ground	Supported per RV-C
Bit 8.3-8.4:	Fault - Open Neutral	Supported per RV-C
Bit 8.5-8.6:	Fault - Reverse Polarity	Supported per RV-C
Bit 8.7-8.8:	Fault - Ground Fault	Supported per RV-C

Name:	ATS_AC_STATUS_3	
PGN:	0x1FFAB	
Byte 1:	Instance	Leg 1 - 0x79 (01111001) Leg 2 - 0xF9 (11111001) ATS Instance 1, Output Only
Bit 2.1-2.2:	Waveform	Always 0 (Sinewave)
Bits 2.3-2.6:	Phase Status	Supported per RV-C
Byte 8.7-8.8:	Complementary Leg	Supported per RV-C

Name:	ATS_AC_STATUS_4	
PGN:	0x1FF85	
Byte 1:	Instance	Leg 1 - 0x79 (01111001) Leg 2 - 0xF9 (11111001) ATS Instance 1, Output Only
Byte 2:	Voltage Fault	Supported per RV-C
Bit 3.1-3.2:	Fault – Surge Protection	Supported per RV-C
Bit 3.3-3.4:	Fault – High Frequency	Supported per RV-C
Bit 3.5-3.6:	Fault – Low Frequency	Supported per RV-C
Bit 3.7-3.8:	Bypass Mode Active	Supported per RV-C

ATS Status

Name:	ATS_STATUS	
PGN:	0x1FFAA	
Byte 1:	Instance	Always 1
Byte 2:	Source In Use	0 = Generator 1 = Shore Power 253 = No Source Active
Bit 3.1-3.2	Mode	Always 00 = Automatic

Suspect Parameters

The DSA for all DM1 reports is 79. Note that AC faults are not reported via DM1, but only with the PGNs listed above. Other faults are as follows:

Communication loss with the Surgeguard

SPN	MSB = 1, ISB = 1, LSB = 1	Instance #1, Standard SPN 9 = Node Communications
FMI = 11		Failure Not Identifiable.

Note that this is only transmitted if no data from the SurgeGuard is detected, but the Inverter shows an AC input. (The Surgeguard does not transmit when no AC power is available.)

Blown Fuse on Surgeguard

SPN	MSB = 2, ISB = 1, LSB = 0	Leg 1 Output Fuse
	LSB = 1	Leg 2 Output Fuse
FMI = 5		Open Circuit

MSC Tank Sensor Manager

Allows the use of MSC non-contact tank sensors, in packages of up to 12 sensors. See also the proprietary configuration for how to set the board revision. (The board revision affects the calibration for MSC sensors.) MSC sensors require a dry calibration, and the Tank Calibration Command sets the tank size, dry calibration, and the number of sensors in the package. The dry offset can be done with the sensors not plugged in. (The TM-102 will automatically perform a dry calibrate on its initial startup, and this is not usually necessary in the field.)

PGNs Supported

Tank Calibration Command

Name:	TANK_CALIBRATION_COMMAND	
PGN:	0x1FFB6	
Byte 1:	Instance	Supported per RV-C. Always 0, 1, or 2.
Byte 2:	Relative Level	If 0, resets the Dry Calibrate value.
Byte 3:	Relative Precision	Number of Sensors in the Package. 1-12.
Byte 6-7:	Tank Size	Supported per RV-C

Proprietary - Reset Tank Defaults

Name:	PROP_RESET_TANK_GEOMETRY	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0xF3 = Reset Tank Defaults
Byte 2:	Coach Model	See “Coach Model Identification” above (**obsolete**). Effective versions 1.20 and above, this will rewrite the NVRAM with generic defaults. The user should avoid using this as much as possible.

Unit must be “unlocked” to accept this command.

PGNs Reported

Tank Status

Name:	TANK_STATUS	
PGN:	0x1FFB7	
Byte 1:	Instance	Supported per RV-C. Always 0, 1, or 2.
Byte 2:	Relative Level	Supported per RV-C
Byte 3:	Relative Precision	Number of Sensors in the package. 1-20.
Byte 4-5:	Absolute Level	Supported per RV-C

Byte 6-7: Tank Size Supported per RV-C

Suspect Parameters

The DSA for all DM1 reports is 72.

Sensor Failures
SPN MSB = 1, ISB = Instance, LSB = 0 Specific SPN 0 = Absolute Level
FMI = 3 (High) or 4 (Low)

Sensor Specifications

A MSC sensor string is essentially a bunch of resistors in parallel. When a sensor is active it is 2Kohm. When it is not activated it is 250Kohm.

The following tables show the approximate ADC counts expected from the MSC sensors at various levels. These tables assume no offset. Values will differ from this based on the dry offset. A typical offset will change the values +/- 3 counts.

Rev. A 51.1 Ω Resistors R4, R35, R86	**Rev. B, C** 18.2 Ω Resistors R4, R35, R86

	Sensor Resistance (ohms)	***Rev. A ADC Counts***	***Rev. B ADC Counts***	***Rev. B typical***
Empty	62.5K	1023 - 988	1023 - 997	1002
25 %	1.953K	987 - 964	996 - 988	992
50 %	992	963 - 941	987 - 979	984
75 %	665	940 - 920	978 - 971	975
Full	500	919 - 0	970 - 0	967
Minimum alarm		890	890	
Maximum alarm		None	None	

	Sensor Resistance (ohms)	***Rev. A ADC Counts***	***Rev. B ADC Counts***
Empty	25K	N/A	1023 - 996
10 %	1.866K	N/A	995 - 988
20 %	969	N/A	987 - 979
30 %	654	N/A	978 - 970
40 %	494	N/A	969 - 962
50 %	397	N/A	961 - 954

	Sensor Resistance (ohms)	***Rev. A ADC Counts***	***Rev. B ADC Counts***
60 %	332	N/A	953 - 946
70 %	285	N/A	945 - 938
80 %	250	N/A	937 - 930
90 %	222	N/A	929 - 922
Full	200	N/A	921 - 0
Minimum alarm		N/A	890
Maximum alarm		None	None

Catcon Tank Monitoring

Note that this feature should not be enabled at the same time as the MSC sensors. Both features use the same PGNs, and no provisions are made to share.

PGNs Supported

Tank Calibration Command

Name:	TANK_CALIBRATION_COMMAND	
PGN:	0x1FFB6	
Byte 1:	Instance	Supported per RV-C. Always 0, 1, or 2.
Byte 2:	Relative Level	Supported per RV-C
Byte 3:	Relative Precision	Supported per RV-C
Byte 4-5:	Absolute Level	Supported per RV-C
Byte 6-7:	Tank Size	Supported per RV-C

If Relative Precision is transmitted with Relative Level set to 0xFF, then the node shall update its internal configuration to report using that Precision. If both Relative Level and Precision are included, then the message is interpreted to mean the tank is currently exactly that full.

Tank Geometry Configuration

Name:	TANK_GEOMETRY_COMMAND	
PGN:	0x1FFB4	
Byte 1:	Instance	Supported per RV-C. Always 0, 1, or 2.
Byte 2:	Number of Entries	Always 4
Byte 3:	Point 1 - Relative Level	Supported per RV-C
Byte 4:	Point 1 - Relative Precision	Always 100
Byte 5-6:	Point 1 - Table Entry	0 = 0” from Empty 1 bit = 0.1” from Empty
Byte 7-10:	Point 2	As for Point 1
Byte 11-14:	Point 3	As for Point 1
Byte 15-18:	Point 4	As for Point 1
Byte 19:	Counts Per Inch	Range 0 - 250 CPI

This is a slight deviation from the RV-C standard, which does not include the Counts Per Inch. The points must be sent in order from lowest to highest, with the first point Zero and the last point 100. If fewer lookup points are desired, repeat the last point as required to fill the table.

Proprietary - Reset Tank Defaults

Name: PROP_RESET_TANK_GEOMETRY

PGN: PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)
Byte 1: Operation 0xF3 = Reset Tank Defaults
Byte 2: Coach Model See "Coach Model Identification" above (**obsolete**). Effective versions 1.20 and above, this will rewrite the NVRAM with generic defaults. The user should avoid using this as much as possible.
Unit must be "unlocked" to accept this command.

Proprietary - Calibrate Tank ADC Counts
Name: PROP_CALIBRATE_TANK_ADC_COUNTS
PGN: PDU_F = 239, PDU_S = Destination (0xEFFA)
Byte 1: Operation 0x9F = Calibrate Tank ADC Counts
Byte 2: Tank Instance 0,1,2 (Fresh, Black, Gray)
Byte 3-4 Empty ADC Counts Raw ADC Value – Catcon limited to 0 - 250
Byte 5-6: Reserved for Full ADC Counts

Unit must be "unlocked" to accept this command.

PGNs Reported

Tank Status
Name: TANK_STATUS
PGN: 0x1FFB7
Byte 1: Instance Supported per RV-C. Always 0, 1, or 2.
Byte 2: Relative Level Supported per RV-C
Byte 3: Relative Precision Supported per RV-C
Byte 4-5: Absolute Level Supported per RV-C
Byte 6-7: Tank Size Supported per RV-C
Note that Relative Precision is configurable.

Tank Geometry Configuration
Name: TANK_GEOMETRY_STATUS
PGN: 0x1FFB5
See TANK_GEOMETRY_COMMAND for details.

Proprietary - Tank ADC Counts Report
Name: PROP_TANK_CALIBRATION_ADC_COUNTS_REPORT
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0x9E = Tank ADC Counts Report
Byte 2: Tank Instance 0,1,2 (Fresh, Black, Gray)
Byte 3-4: Empty ADC Counts Raw ADC Value – Catcon limited to 0 - 250
Byte 5-6: Reserved for Full ADC Counts

Suspect Parameters

The DSA for all DM1 reports is 72.

Sensor Failures
SPN MSB = 1, ISB = Instance, LSB = 0 Specific SPN 0 = Absolute Level
FMI = 3 (High Voltage) or 4 (Low Voltage)

Sensor Specifications

Pressure Sensors

	Catcon Voltage	***Catcon ADC Counts***	***Kavlico Voltage***	***Kavlico ADC Counts***
Dry Offset	0.15 V	30	0.49 V	97
Resolution (counts/inch)	0.11 V	24	0.26 V	10

	Voltage	***Catcon ADC Counts***	***Kavlico ADC Counts***
Minimum Alarm	.05 V	10	10
Maximum Alarm	4.8 V	982	982
Empty fail low	.10 V	20	20
Empty fail high	.25 V	51	51

Garnet Sensors

Dry Offset	0
Resolution (counts/inch)	98
Zero Level	0”
One-Quarter	2.5”
Three-Quarters	7.5”
Full	10.0”

LPG Tank Monitoring

The Low Pressure Gas (LPG) tank may be monitored with the following PGN's. The only differences between the LPG and water tanks are the instances. LPG is assigned with instance value of 3.

PGNs Supported

Tank Calibration Command
Name: TANK_CALIBRATION_COMMAND
PGN: 0x1FFB6
Byte 1: Instance — Always 3.
Byte 2: Relative Level — Supported per RV-C
Byte 3: Relative Precision — Supported per RV-C
Byte 6-7: Tank Size — Supported per RV-C
Relative Precision is not configurable. Absolute Level is ignored. The LPG Tank can only be calibrated at Empty and Full. In either case Relative Precision can be any valid non-zero value, and Relative Level is either zero (empty) or equal to the Relative Precision. Any other value will abort the calibration, and the module will respond with a NAK (5 = Request Out of Range).

Proprietary - Reset Tank Defaults

Name:	PROP_RESET_TANK_GEOMETRY	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0xF3 = Reset Tank Defaults
Byte 2:	Coach Model	See "Coach Model Identification" above (**obsolete**). Effective versions 1.20 and above, this will rewrite the NVRAM with generic defaults. The user should avoid using this as much as possible.
Byte 3:	Sensor Type	0 = 0-90 Ohm 1 = 35-240 Ohm

Unit must be "unlocked" to accept this command.

Proprietary - Calibrate Tank ADC Counts

Name:	PROP_CALIBRATE_TANK_ADC_COUNTS	
PGN:	PDU_F = 239, PDU_S = Destination (0xEFFA)	
Byte 1:	Operation	0x9F = Calibrate Tank ADC Counts
Byte 2:	Tank Instance	3 - LP
Byte 3-4	Empty ADC Counts	Raw ADC Value
Byte 5-6:	Full ADC Counts	Raw ADC Value

Unit must be "unlocked" to accept this command.

PGNs Reported

Tank Status

Name:	TANK_STATUS	
PGN:	0x1FFB7	
Byte 1:	Instance	Always 3.
Byte 2:	Relative Level	Supported per RV-C
Byte 3:	Relative Precision	Always 100
Byte 4-5:	Absolute Level	Supported per RV-C
Byte 6-7:	Tank Size	Supported per RV-C

Proprietary - Tank ADC Counts Report

Name:	PROP_TANK_CALIBRATION_ADC_COUNTS_REPORT	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0x9E = Tank ADC Counts Report
Byte 2:	Tank Instance	3 - LP
Byte 3-4:	Empty ADC Counts	Raw ADC Value
Byte 5-6:	Full ADC Counts	Raw ADC Value

Suspect Parameters

The DSA for all DM1 reports is 73.

Sensor Failures

SPN MSB = 1, ISB = 3, LSB = 0 Specific SPN 0 = Absolute Level
FMI = 3 (High Voltage) or 4 (Low Voltage)

Sensor Specifications

0 - 90 Ohm Sensor

	Resistance	***Voltage***	***ADC Counts***
Empty	0 ohms	0 V	0
Full	90 ohms	1.02 V	317
Minimum Alarm	None		
Maximum Alarm		1.13 V 1.24V v2.20+	350 385 v2.20+

35 - 240 Ohm Sensor

	Resistance	***Voltage***	***ADC Counts***
Empty	240 ohms	2.73 V	557
Full	35 ohms	.74 V	152
Minimum Alarm			100
Maximum Alarm			600

Black Tank Full Warning

The Black Tank Full Warning is a discrete output (Out#1 – BLACK TANK FULL) that can be connected to a smart toilet. The toilet can use this warning to prevent overfilling the black tank. The warning output turns on based on a programmable black tank level.

PGNs Supported

Proprietary – AutoFill Configuration
Name: PROP_CONFIGURE_AUTOFILL
PGN: PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)
Byte 1: Operation Always 0xEE - AutoFill Configuration
Byte 2-7: Reserved for Autofill (see Autofill feature for details)
Byte 8: Black Tank Warning Level Percent, per RV-C

PGNs Reported

Proprietary – Report AutoFill Configuration
Name: PROP_CONFIGURE_AUTOFILL_REPORT
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation Always 0xED - AutoFill Configuration Report
Byte 2-7: Reserved for Autofill (see Autofill feature for details)
Byte 8: Black Tank Warning Level Percent, per RV-C

Automatic Fresh Water Fill

Automatic Fresh Water Fill requires a discrete output to be connected to an appropriate

solenoid valve (to divert water from the shore to the tank), and a relay controlling the water pump. (Out#2 - FILL VALVE, Out#3 - PUMP CONTROL). When activated, the fill diverts water to the tank and stops the water pump if it is on. It then reverses the process when the fill is complete.

A remote switch may be added to trigger the AutoFill. This should be a momentary switch, attached to In#3 - FILL SWITCH.

PGNs Supported

AutoFill Command

Name:	AUTOFILL_COMMAND	
PGN:	0x1FFB0	
Bit 1.1-1.2:	Command	00 = Stop, 01 = Start
Bit 1.3-1.4	Manual Valve Control	00 = Close, 01 = Open

Using the Manual Valve Control automatically ends the AutoFill process.

Proprietary – AutoFill Configuration

Name:	PROP_CONFIGURE_AUTOFILL	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	Always 0xEE - AutoFill Configuration
Byte 2:	Level Cutoff	Percent, See RV-C Table 2.2
Byte 3:	Run-After Time	0 = 0 secs. 1 bit = 1 sec.
Byte 4:	Timeout	0 = 0 min. 1 bit = 1 min
Byte 5:	Auto Start Level	Percent, See RV-C Table 2.2
Byte 6.1-6.2:	Pump On Cancels Fill	00 = Does not Cancel Fill, 01 = Cancels Fill
Byte 6.3-6.4:	Pump Bypass Disables Fill	00 = Does not Disable Fill, 01 = Disables Fill
Byte 6.5-6.6:	Ignore Pump	00 = Turns off pump before fill, 01 = Pump unaffected
Byte 6.7-6.8:	Check water pressure	00 = Ignore water pressure, 01 = Check water pressure
Byte 7:	Extended Run-After Time	0 = 0 min. 1 bit = 1 min.
Byte 8:	Black Tank Warning Level	Percent, per RV-C

The AutoFill will keep the valve open until the Cutoff Level is reached in the Fresh Tank. It will continue to keep the valve open for the indicated Run-After and Extended Run-After Times. Note that the run-after time is expressed in minutes and seconds, which the total delay is 60*minutes + seconds. (If the tank is already full, it will open the valve for the duration specified in the Run-After Times.) If no change in the tank level is noted for the indicated Timeout minutes, the fill operation is aborted. The Auto Fill will turn on if the level drops below the Auto Start Level. If the Auto Start Level is zero, the auto start is disabled. This PGN should trigger a PROP_CONFIGURE_AUTOFILL_REPORT.

If the check water pressure setting is enabled, the autofill will only turn on if the water pressure input has been active in the last 2 minutes.

PGNs Reported

AutoFill Status

Name:	AUTOFILL_STATUS	
PGN:	0x1FFB1	
Bit 1.1, 1.2:	Operating Status	00 = Off, 01 = On
Bit 1.3, 1.4:	Valve Status	00 = Closed 01 = Open
Bit 1.5-1.8:	Last Operation	Supported per RV-C

Proprietary – Report AutoFill Configuration

Name:	PROP_CONFIGURE_AUTOFILL_REPORT	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	Always 0xED - AutoFill Configuration Report
Byte 2:	Level Cutoff	Percent, See RV-C Table 2.2
Byte 3:	Run-After Time	0 = 0 secs. 1 bit = 1 sec.
Byte 4:	Timeout	0 = 0 min. 1 bit = 1 min
Byte 5:	Auto Start Level	Percent, See RV-C Table 2.2
Byte 6.1-6.2:	Pump On Cancels Fill	00 = Does not Cancel Fill, 01 = Cancels Fill
Byte 6.3-6.4:	Pump Bypass Disables Fill	00 = Does not Disable Fill, 01 = Disables Fill
Byte 6.5-6.6:	Ignore Pump	00 = Turns off pump before fill, 01 = Pump unaffected
Byte 6.7-6.8:	Check water pressure	00 = Ignore water pressure, 01 = Check water pressure
Byte 7:	Extended Run-After Time	0 = 0 min. 1 bit = 1 min.
Byte 8:	Black Tank Warning Level	Percent, per RV-C

Suspect Parameters

The DSA for all DM1 reports is 128. Ordinary timeouts are reported via the Last Operation datum in the AUTOFILL_STATUS PGN. The lack of a valid fresh tank level reading should trigger a DM1. This is reported as SPN = 258 and FMI = 11 (Failure Not Identifiable). If the pump bypass is on and the fill is set to cancel if the pump bypass is on, then a Yellow DM1 should be triggered with SPN = 257 and FMI = 11. The technician should consult the Fresh Tank device for further information.

Water Pump

The water pump functions use one active-low discrete output to control a relay powering the pump (PUMP CONTROL) and an optional input to detect whether the pump control has been bypassed (BYPASS DETECT). A remote switch may be added to turn the pump on or off. This can be a momentary switch, attached to PUMP SWITCH, or a constant-on input, analogous to the GEN DEMAND 1 input.

To allow interoperability with non-RV-C multiplexing equipment there are alternative implementations of the pump I/O logic. Such systems typically act like a momentary input, latching output relay, and there may be other switches controlling the output. The following table describes the operations based on the I/O values. The Output Switching and Relay Type are configurable using the proprietary configuration PGN.

Input Type :	***Demand***	***Demand***	***Momentary***	***Momentary***
Output Relay Type :	***Latching***	***Standard***	***Latching***	***Standard***
PUMP SWITCH	Is pump on?	Turns pump on/off	Is pump on?	Turns pump on/off
BYPASS DETECT	N/A	Is pump running?	N/A	Is pump running?
PUMP CONTROL	500 msec pulse	Constant on/off	500 msec pulse	Constant on/off

PGNs Supported

Water Pump Command
Name: WATER_PUMP_COMMAND
PGN: 0x1FFB2
Bit 1.1-1.2: Command 00 = Turn Off, 01 = Turn On
No other data is supported.

Proprietary – Configure Water Pump
Name: PROP_CONFIGURE_WATER_PUMP_CONTROL
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xD6 = Configure Water Pump
0xD5 = Request Water Pump Configuration
Format is identical to PROP_REPORT_WATER_PUMP_CONTROL. Unit must be "unlocked" to accept this command. It is recommended to reboot the TM-102 to set up the pump properly.

PGNs Reported

Water Pump Status
Name: WATER_PUMP_STATUS
PGN: 0x1FFB3
Bit 1.1-1.2: Operating Status 00 = Off, 01 = On (Standby or Running)
Bit 1.5-1.6: Water Hookup Detected 00 = not detected, 01 = water pressure detected in the last 2 minutes.
Byte 2-3: Current System Pressure Supported by RV-C
For the unit to be Off, both the Pump Control and the Bypass Detect values must be "Off". If either shows the pump to be on, then it will show "On".

Proprietary – Report Water Pump Configuration
Name: PROP_REPORT_WATER_PUMP_CONTROL
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xD4 = Report Pump Configuration
Bit 2.1-2.2: Input Switching 0 = Momentary "Switch" (i.e. 500 msec pulse)
1 = Constant "Demand"
Bit 2.3-2.4: Output Relay Type 0 = Standard Relay Output
1 = Latching Relay (Status fed back thru Pump Input)
Bit 3.1-3.2: Enable Bypass Detect 0 = Ignore bypass input
1 = Check bypass for DM1 reports
Byte 4 Implementation 0 = Internal Implementation
1 = External RV-C – DC Load PGN
2 = External RV-C – DC Dimmer PGN
3 = External RV-C – Water Pump PGN
Byte 5 RV-C Instance Instance used for external RV-C implementations

The Enable Bypass Detect flag is useful for some customers who do not have the pump bypass connected to the input.

The Input Switch requires the Internal Implementation (type 0). The Output Relay Type and Enable Bypass Detect apply only to Internal Implementations.

In external implementations of types 1 and 2, the water pump status will mirror the DC Load/Dimmer instance. In type 3 implementation, the TM-102 does not send or receive water

pump commands, but the Autofill feature will send commands as required. Disabling the Water Pump in the main configuration is the equivalent to setting the Implementation type to 3.

When changing the Implementation Type, the TM102 must be reset.

Suspect Parameters

The DSA for all DM1 reports is 127.

If the Bypass and the Pump Control do not agree on the state of the pump, then a DM1 shall be broadcast. The node will report SPN = 256 - Pump, and FMI = 7 - Mechanical System Not Responding.

If the Bypass indicates the pump is On, while the Pump Control indicates Off, then an Yellow Lamp condition will be indicated by the DM1. The service tool or display should display this as "Pump Bypass Detected".

If the Bypass indicates the pump is Off, while the Pump Control indicates On, then a Red Lamp condition will be indicated by the DM1. The service tool or display should display this as "Pump Relay Not Responding".

Secondary Water Pump

The secondary water pump requires the use of the IS-160, and has limited functionality. It uses a single ordinary relay controlled by the IS-160, and has no provisions for latching relays, external switches, or bypass detection.

The Secondary Water Pump requires the Water Pump to be enabled, and use implementation type 0 (Internal Implementation).

Since RV-C assumes a single water pump, control of this device requires a proprietary commands.

PGNs Supported

Prop Secondary Water Pump Command

Name:	PROP_SEC_PUMP_COMMAND	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xB7
Bit 2.1-2.2:	Command	00 = Turn Off, 01 = Turn On

This PGN always triggers a PROP_SEC_PUMP_STATUS report, even if the Command field is 11 (0x03 - No Action).

PGNs Reported

Prop Secondary Water Pump Status

Name: PROP_SEC_PUMP_STATUS

PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xB6
Bit 2.1-2.2: Status 00 = Off, 01 = On

Suspect Parameters

The secondary water pump has no diagnostic report.

Water Pressure Sensor

The TM102 assumes a 200 PSI 0-5V Honeywell-type sensor. If enabled, the device automatically looks for the sensor on the first unused tank port. (That is, the first tank port with tank size zero.)

PGNs Reported

Water Pump Status
Name: WATER_PUMP_STATUS
PGN: 0x1FFB3
Byte 2-3 Current System Pressure per RV-C.

This PGN is sent by itself every 5000 ms if no water pump is enabled. If a pump is enabled, the value is included in the WATER_PUMP_STATUS PGN as outlined under Water Pump.

Tile Heat Control

The Tile Heat Control is compatible with Goldheat floor heating products. The Goldheat temperature sensor is attached to pins Out#10 and Out#11 (TILE TEMP + and GROUND). The Goldheat control relays are Out#7 and Out#8 (PRIMARY and SECONDARY FLOOR CONTROL)

The unit supports two floor mats, ordinarily with only one temperature input and set point. This is accomplished by the use of two “dwell” settings, one for each mat. If a Sensor Multiplexer is used, the system can support two temperature sensors. In the ordinary case the Instance is always 1. In the two zone case, the Instances are 1 and 2.

In the two zone case, the Time Modes and Set Points are always the same for both zones. However, each zone has its own Operating Mode, Schedule Mode, and Current Set Point. Thus the user can set different levels for each mat manually, but can only schedule them at the same level within the same time periods. Note that one mat may be on the schedule, while the other is not.

For more information on the Sensor Multiplexer and the specific operation of the TM-102 in Dual-Zone mode, consult the Sensor Multiplexer Application Document.

PGNs Supported

Floor Heat Command
Name: FLOOR_HEAT_COMMAND

PGN:	1FEFB	
Byte 1:	Instance	1 or 2
Bit 2.1-2.2:	Operating Mode	00 = Automatic, 01 = Manual
Bit 2.3-2.4:	Operating Status	00 = Off, 01 = On
*Bit 2.5-2.6:	Schedule Mode	00 = Manual, 01 = Scheduled Set Point Changes
Byte 3,4:	Set Point	Supported per RV-C

Note: Byte 5 - Dead Band is not supported.
* Not official RV-C.

All of these settings are unique for each zone, if multiplexed.

Proprietary – Configure Floor Heat
Name: PROP_CONFIGURE_FLOOR_HEAT_1
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xE6 = Configure Floor Heat 1
Format is identical to PROP_REPORT_FLOOR_HEAT_1.

Name: PROP_CONFIGURE_FLOOR_HEAT_2
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xE5 = Configure Floor Heat 2
Format is identical to PROP_REPORT_FLOOR_HEAT_2.

Name: PROP_CONFIGURE_FLOOR_HEAT_3
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xBD = Configure Floor Heat 3
Format is identical to PROP_REPORT_FLOOR_HEAT_3.

Name: PROP_CONFIGURE_FLOOR_HEAT_4
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xBC = Configure Floor Heat 4
Format is identical to PROP_REPORT_FLOOR_HEAT_4.

Name: PROP_REQUEST_FLOOR_HEAT
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xE4 = Request Floor Heat Configuration Report
The TM-102 will reply to this PGN with PROP_REPORT_FLOOR_HEAT_1, PROP_REPORT_FLOOR_HEAT_2, PROP_REPORT_FLOOR_HEAT_3 and PROP_REPORT_FLOOR_HEAT_4.

To put the mats into “Storage” mode, put the set point to a suitably low number and put the unit in Manual Schedule Mode. To turn Off altogether, set Status to Off. (Setting Status to On and Mode to Manual will turn on the heat elements.)

If Set Point is included and the unit is in Scheduled Mode, the set point will be changed at the next day/night mode change.

In single-sensor mode, the controller waits for the measured temperature to fall below the set point. It then triggers each floor output for the configured dwell time. At the end of the longer of the two dwell periods it again checks the heat level and repeats the process if necessary.

Most implementations will use just two Time Modes - “Day” and “Night”. The unit supports up to four Time Modes, allowing for a “Morning”,”Day”,”Evening”,”Night” cycle. To disable the use of

unwanted time modes, set the mode start to an invalid hour or minute.

PGNs Reported

Floor Heat Status

Name:	FLOOR_HEAT_STATUS	
PGN:	1FEFC	
Byte 1:	Instance	1 or 2
Bit 2.1-2.2:	Operating Mode	00 = Automatic, 01 = Manual
Bit 2.3-2.4:	Operating Status	00 = Off, 01 = On
Bit 2.5-2.6:	Heat Element Status	00 = Off, 01 = On
*Bit 2.7-2.8:	Schedule Mode	00 = Manual, 01 = Scheduled Set Point Changes
Byte 3,4:	Measured Temperature	Supported per RV-C
Byte 5,6:	Set Point	Supported per RV-C
*Bit 8.1-8.2:	Secondary Element Status	00 = Off, 01 = On

* Not official RV-C.

Proprietary – Report Floor Heat Configuration

Name:	PROP_REPORT_FLOOR_HEAT_1	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xE3 = Report Floor Heat Configuration
Byte 2:	Mode 1 (Day / Morning) Begin Hour	0 - 23
Byte 3:	Mode 1 (Day / Morning) Begin Minute	0 – 59
Byte 4:	Mode 2 (Night / Away) Begin Hour	0 - 23
Byte 5:	Mode 2 (Night / Away) Begin Minute	0 - 59

Name:	PROP_REPORT_FLOOR_HEAT_2	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xE2 = Report Floor Heat Configuration
Byte 2,3:	Mode 1 Set Point	Supported per RV-C
Byte 4,5	Mode 2 Set Point	Supported per RV-C
Byte 6:	Primary Dwell Time	0 – 1250 Sec. 1 bit = 5 Sec
Byte 7:	Secondary Dwell Time	0 – 1250 Sec. 1 bit = 5 Sec
Bit 8.1-8.2	Dual Temperature Input	0 = Single Sensor Input 1 = Dual Sensor Input using Sensor Multiplexer

Name:	PROP_REPORT_FLOOR_HEAT_3	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xBB = Report Floor Heat Configuration
Byte 2:	Mode 3 (Evening) Begin Hour	0 - 23, Invalid values disable the mode.
Byte 3:	Mode 3 (Evening) Begin Minute	0 – 59, Invalid values disable the mode.
Byte 4:	Mode 4 (Night) Begin Hour	0 - 23, Invalid values disable the mode.
Byte 5:	Mode 4 (Night) Begin Minute	0 - 59, Invalid values disable the mode.

Name:	PROP_REPORT_FLOOR_HEAT_4	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xBA = Report Floor Heat Configuration
Byte 2,3:	Mode 3 Set Point	Supported per RV-C
Byte 4,5	Mode 4 Set Point	Supported per RV-C

Note that all of the proprietary configuration settings apply to mode Instances. When in Dual Input mode only the primary dwell time is used.

Suspect Parameters

The DSA for all DM1 reports is 97. The only SPN supported is for a fault in the temperature sensor, for which the SPN is constructed as MSB = 1, ISB = 1 (or 2 if Dual Mode), and LSB = 0. The FMI is either 0 or 1 (Above/Below Normal Range).

Ambient Temperature, Thermostat Control

The TM-102 contains an internal temperature sensor, and optionally an external sensor may be attached (Connector TEMP). These items are reported as simple Thermostat instances. The Instance numbers are configured via the proprietary PGN indicated in the Configuration section above. Setting either sensor to Instance = 0 will disable the sensor and all reports, including DM1. Default instance values are:

Internal sensor	250	
External #1 sensor	249	
External #2 sensor	248	(with IS-160 board attached)
External #3 sensor	247	(with IS-160 board attached)

Calibration is provided via the proprietary PGN detailed in the Configuration section above.

PGNs Supported

Thermostat Command

Name:	THERMOSTAT_COMMAND_1	
PGN:	0x1FEF9	
Byte 1:	Instance	Supported per RV-C *pre v2.03:* Always same as External Temp Sensor.
Bits 2.1-2.4:	Operating Mode	0 = Off. 2 = Heat.
Byte 4-5:	Set Point	Supported per RV-C. Default is 38 Deg F.

Furnace Command

Name:	FURNACE_COMMAND	
PGN:	0x1FFE3	
Byte 1:	Instance	Supported per RV-C *pre v2.03:* Always same as External Temp Sensor.
Byte 5:	Dead Band	Supported per RV-C. Default is 1 Deg C.

Note that you cannot directly control the Heat Output Level or operating mode of the "Furnace" via this command. To force the THERMOSTAT_CONTROL on, use the Themostat Set Point. To force it off, use the Thermostat Operating Mode.

PGNs Reported

Thermostat Status

Name:	THERMOSTAT_STATUS_1	
PGN:	0x1FFE2	
Byte 1:	Instance	Supported per RV-C *pre v2.03:* Always same as External Temp Sensor.

Bits 2.1-2.4:	Operating Mode	0 = Off. 2 = Heat.
Byte 4-5:	Set Point	Supported per RV-C. Default is 38 Deg F.

Furnace Status

Name:	FURNACE_STATUS	
PGN:	0x1FFE4	
Byte 1:	Instance	Supported per RV-C *pre v2.03:* Always same as External Temp Sensor.
Byte 4:	Heat Output Level	0 = Off. 200 = On. Shows the THERMOSTAT_CONTROL output.
Byte 5:	Dead Band	Supported per RV-C. Default is 1.0 Deg C.

Ambient Temperature Status

Name:	THERMOSTAT_AMBIENT_STATUS	
PGN:	0x1FF9C	
Byte 1:	Instance	Supported per RV-C
Byte 2-3:	Ambient Temperature	Supported per RV-C

Suspect Parameters

The DSA for all DM1 reports is 88.

The only SPN supported is for a fault in the temperature sensor with a Red Lamp, for which the SPN is constructed as MSB = 1, ISB = Instance, and LSB = 2. The FMI is 11.

Climate Control

The TM-102 can be used as a full climate control system, supporting two temperature zones. Each zone has a external temperature sensor and an air conditioner associated with it, while the two zones share a single furnace. The zones are always given Instance 1 and 2.

The TM-102 currently supports conventional air conditioners such as the RV Products 8000 series with Hi and Lo Fan and Condenser inputs. It supports conventional furnaces such as the Suburban NT series.

All units are controlled through the IS-160 I/O Expander, using the outputs described in the Connectors section of that document. The system does not use the internal temperature sensor, which may be used for a Thermostat Control per the previous section. These two systems are completely independent of each other.

The system also provides Automatic Genstart, triggering a start as required for cooling and maintaining the generator demand as appropriate.

When two zones are enabled and only 30A power is available, the module will alternate the use of each air conditioner to prevent overloading the power input. This feature is controlled by the proprietary configuration PGN indicated below.

This AC load management operates by running one A/C for a specified amount of time (“dwell”) or until it reaches the desired temperature. If the “demand gap”, i.e. the difference between the desired and actual temperature, is less than the demand gap of the other zone, the unit then switches to run the other zone. Otherwise it continues until the demand gap is less than

the gap for the other zone, and then it switches. The process is then repeated.

Note that the demand gap is calculated for the "active" zone by comparing the actual temperature with the *stopping* temperature for the zone - i.e. the bottom of the dead band - while the value for alternate zone is the difference between the actual temperature and the *trigger* temperature - i.e. the top of the dead band.

A dwell parameter is intended to prevent excessive cycling of the air conditioners.

When two air conditioners are installed the system is programmed to avoid starting both simultaneously. Regardless of the power source, the second A/C will not be started for five seconds after the first, to reduce the peak load as the compressor start. When no power source is detected, the relays controlling the A/Cs will remain open (off). When A/C power is detected the system will wait five seconds before starting each A/C in turn. (More time is allowed if the power source is a generator, as indicated below in the discussion of generator settling time.)

For heat, the unit works in two distinct modes, set in the FURNACE_COMMMAND PGN. In LP Furnace mode, only a single LP furnace is used for heat, and it only responds to Zone 1 data. In AC Heat Strip mode it responds to both zones, activating the corresponding Heat Strip output and Lo Fan output for each AC.

PGNs Supported

Thermostat Command

Name:	THERMOSTAT_COMMAND_1	
PGN:	0x1FEF9	
Byte 1:	Instance	Always 1 or 2
Bits 2.1-2.4:	Operating Mode	0 = Off. 1 = Cool. 2 = Heat. 3 = Auto. 4 = Fan
Bits 2.5-2.6	Fan Mode	Supported per RV-C.
Bits 2.7-2.8	Schedule Mode	Supported per RV-C.
Byte 3:	Fan Speed	0 = Off. 100 = Lo. 200 = High.
Byte 4-5:	Set Point Heat	Supported per RV-C.
Byte 6-7:	Set Point Cool	Supported per RV-C.

Note that if the Operating Mode is 4 (Fan), the Fan will come on to cool the coach per the Set Point Cool. If the Fan Mode is On, the Fan will stay on full-time, regardless of the temperature.

Name:	THERMOSTAT_COMMAND_2	
PGN:	0x1FEF8	
Byte 1:	Instance	Always 1 or 2
Byte 2:	Current Schedule Instance	Supported per RV-C.

If the Schedule Instance is set to 251, the unit will scan the Schedule for the most appropriate schedule instance and use that value. This is effectively a "Return to Normal Program", if also accompanied by a THERMOSTAT_COMMAND_1 setting the Schedule Mode to Enabled.

Themostat Schedule Command

Name:	THERMOSTAT_SCHEDULE_COMMAND_1	
PGN:	0x1FEF5	
Byte 1:	Instance	Always 1 or 2
Byte 2:	Schedule Mode Instance	0 = "Night"

		1 = “Daytime” 2 = “Away” 250 = “Storage”
Byte 3:	Start Hour	Supported per RV-C.
Byte 4:	Start Minute	Supported per RV-C.
Byte 5-6:	Set Point Heat	Supported per RV-C.
Byte 7-8:	Set Point Cool	Supported per RV-C.

Only four schedule modes are available. When using Storage or Away modes, the command should also include a THERMOSTAT_COMMAND_1 setting the Schedule Mode to Disabled. The default starting times are 08:00 for “Daytime” and 21:00 for “Night”.

Furnace Command

Name:	FURNACE_COMMAND	
PGN:	0x1FFE3	
Byte 1:	Instance	Always 1 or 2
Bits 2.3-2.8	Heat Source	0 = LP Furnace, 1 = AC Heat Strip This setting affects both zones simultaneously.
Byte 5:	Dead Band	Supported per RV-C. Default is 1 Deg C.

Air Conditioner Command

Name:	AIR_CONDITIONER_COMMAND	
PGN:	0x1FFE0	
Byte 1:	Instance	Always 1 or 2
Byte 7:	Dead Band	Supported per RV-C. Default is 1 Deg C.

Note that you cannot directly control the Heat Output Level or operating mode of the Furnace or Air Conditioner via this command. To force the Furnace or Air Conditioner On, use the Themostat Set Point. To force them off, use the Thermostat Operating Mode.

Proprietary – Configure Climate Control

Name:	PROP_CONFIGURE_CLIMATE_CONTROL	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xDC = Configure Climate Control 0xDB = Request Climate Control Configuration

Format is identical to PROP_REPORT_CLIMATE_CONTROL below, except it does not include the series of flags in Byte Eight. Unit must be “unlocked” to accept this command.

PGNs Reported

Thermostat Status

Name:	THERMOSTAT_STATUS_1	
PGN:	0x1FFE2	
Byte 1:	Instance	Always 1 or 2
Bits 2.1-2.4:	Operating Mode	0 = Off. 1 = Cool. 2 = Heat. 3 = Auto. 4 = Fan
Bits 2.5-2.6	Fan Mode	Supported per RV-C.
Bits 2.7-2.8	Schedule Mode	Supported per RV-C.
Byte 4-5:	Set Point Heat	Supported per RV-C.
Byte 6-7:	Set Point Cool	Supported per RV-C.

Name:	THERMOSTAT_STATUS_2
PGN:	0x1FEFA

Byte 1:	Instance	Always 1 or 2
Byte 2:	Current Schedule Instance	Supported per RV-C.

Ambient Temperature Status

Name:	THERMOSTAT_AMBIENT_STATUS	
PGN:	0x1FF9C	
Byte 1:	Instance	Supported per RV-C
Byte 2-3:	Ambient Temperature	Supported per RV-C

Themostat Schedule Status

Name:	THERMOSTAT_SCHEDULE_STATUS_1	
PGN:	0x1FEF7	
Byte 1:	Instance	Always 1 or 2
Byte 2:	Schedule Mode Instance	0 = “Night” 1 = “Daytime” 2 = “Away” 250 = “Storage”
Byte 3:	Start Hour	Supported per RV-C.
Byte 4:	Start Minute	Supported per RV-C.
Byte 5-6:	Set Point Heat	Supported per RV-C.
Byte 7-8:	Set Point Cool	Supported per RV-C.

Only four schedule modes are available. When using Storage or Away modes, the command should also include a THERMOSTAT_COMMAND_1 setting the Schedule Mode to Disabled.

Furnace Status

Name:	FURNACE_STATUS	
PGN:	0x1FFE4	
Byte 1:	Instance	Always 1.
Bits 2.3-2.8	Heat Source	0 = LP Furnace, 1 = AC Heat Strip
Byte 4:	Heat Output Level	0 = Off. 200 = On.
Byte 5:	Dead Band	Supported per RV-C. Default is 1.0 Deg C.

Air Conditioner Status

Name:	AIR_CONDITIONER_STATUS	
PGN:	0x1FFE1	
Byte 1:	Instance	Always 1 or 2
Byte 5:	Fan Speed	0 = Off. 100 = Lo. 200 = High.
Byte 6:	Air Conditioning Output Level	0 = Off. 200 = On.
Byte 7:	Dead Band	Supported per RV-C. Default is 1.0 Deg C.

Proprietary – Report Climate Control Configuration

Name:	PROP_REPORT_CLIMATE_CONTROL	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xDA = Report Climate Control Configuration
Byte 2:	Number of Zones	Always 1 or 2.
Byte 3:	Load Management Dwell	0 – 1250 Sec. 1 bit = 5 Sec
Byte 4:	Dead Band Under AGS	Suppored per RV-C Dead Band
Byte 5:	Generator Settling Time	0 – 1250 Sec. 1 bit = 5 Sec
Bit 6.1-6.3	Max A/C Units - Generator	0 - 3 A/C units. 1 bit = 1 A/C unit
Bit 6.4-6.6	Max A/C Units - Shore	0 - 3 A/C units. 1 bit = 1 A/C unit
Bit 6.7-6.8	Auto Genstart Enabled	0 - Off, 1 - On. Default is on.

Bit 7.1-7.4	Load Management Mode - Generator	
		0 - Normal Mode (Alternate Zones)
		1 - Zone 1 Only
		2 - Zone 2 Only
Bit 7.5-7.8	Load Management Mode - Shore Power	
		0 - Normal Mode (Alternate Zones)
		1 - Zone 1 Only
		2 - Zone 2 Only
Bit 8.1-8.2	Load Management Flag	0 - Load Management Inactive
		1 - Load Management Active (Normal Mode)
Bit 8.3-8.4	Genset Settling Flag	0 - Normal Mode
		1 - A/C Waiting for Genset to Settle.
Bit 8.5-8.6	AGS Demand Flag	0 - AGS Off or Standby
		1 - Generator Power Currently Demanded
Bit 8.7-8.8	No. of LPG Furnaces	0 - One Furnace, Zone 1 controls it
		1 - Two Furnaces, one for each zone.

Load Management Dwell reduces the cycling for each A/C unit. When in normal load management mode, the active zone is not allowed to switch for at least the dwell period. After that much time has elapsed, the system is allowed to switch to the other zone. (However, if the active zone reaches the stop point before the alternate zone reaches its start point, the active zone will shut down.)

The Dead Band Under Genset replaces the normal A/C dead band when the Genstart is active. (If the generator is running manually, the dead band is the setting in AIR_CONDITIONER_COMMAND). This should normally be larger than the normal dead band to reduce the number of starts and stops on the generator.

The Generator Settling Time is the amount of time in which the A/Cs are forced to stay off after the generator is started. This Settling Time is invoked under any circumstances that the generator is started - even manually. Upon detecting a manual or automatic start, the A/Cs shall be turned off and prevented from turning on until the Settling Time has passed. If set to zero, A/C operations are not interrupted upon a genstart.

The Load Management Modes allow the user to selectively turn off one or more zones instead of alternating between the two zones.

The Load Management Flag indicates whether the system is actively managing the loads - i.e. the Load Management Mode for the current power source is “Normal” and the maximum number of A/C units is less than the number of zones enabled. The Genset Settling Flag indicates that the A/Cs are suppressed while waiting for the generator to “settle”. The AGS Demand flag is analogous to the other AGS Criteria Demand Flags.

Suspect Parameters

The DSA for all DM1 reports is 89.

The only SPN supported is for a fault in the temperature sensor with a Red Lamp, for which the SPN is constructed as MSB = 1, ISB = Instance, LSB = 2 and FMI = 11.

Automatic Genstart

The AGS module conforms to the (proposed) RV-C specification, with several proprietary extensions. It supports both external demands and internal criteria to control generator activity, and has several proprietary extensions to the standard criteria. The module also supports a single discrete input (GEN DEMAND 1 or GEN DEMAND 2) which can indicate demand from a non-RV-C external device such as an air conditioner. The TM-102 only supports one external demand, not including user inputs. The AGS is a single-instance device with DSA 65.

If the module detects the generator turning off without a command from this module, it will set the External Activity flag and refuse to start the generator. The flag can be reset by the GENERATOR_DEMAND_COMMAND, or it will reset automatically at midnight or when it sees the generator started externally.

If the module detects coach movement, i.e. Vehicle Speed in excess of 2 mph, then it may disable all AGS criteria. The DISABLE_ON_MOVE flag in the proprietary configuration PGN controls whether the criteria are disabled.

If the RVIA 2010 compliance flag is set, the TM102 sets the external activity flag whenever there is a manual start or stop. This effectively disables the autogenstart on any manual event.

PGNs Supported

Generator Demand Command

Name:	GENERATOR_DEMAND_COMMAND	
PGN:	1FEFF	
Bit 1.1-1.2:	Generator Demand	00 = No Demand, 01 = Generator Demanded
Bit 1.3-1.4:	Quiet Time Override	00 = Respect QT, 01 = Override QT
Bit 1.5-1.6:	External Activity Reset	00 = No Action, 01 = Reset External Activity Flag
Bit 1.7-1.8:	Manual Override	00 = Normal Demand, 01 = Override all demands.
Bit 2.1-2.2:	Generator Lock	00 = Normal, 01 = Genstart disabled
Byte 3-6:	Set Quiet Time	Supported per RV-C
Byte 7:	Minimum Cycle Time	Supported per RV-C

When a user triggers a start through a control panel, the panel should set Bit 1.5-1.6 to 01 to reset the External Activity flag. Other products should respect the External Activity and Manual Override flags by setting those fields to zero.

When this command is received to end demand, the module will send a request for this PGN. Any device that still has a demand for power must respond within 3 seconds or the generator will stop. (Assuming no internal demand exists and the manual override flag is not set.)

If the Manual Override flag is set on a Start Demand action, the node will start the generator and set the internal MO flag. If the unit is already in Quiet Time, it will automatically also set the Quiet Time Override flag. If the MO flag is set on a Stop Demand action, the node will stop the generator, but it will NOT set the internal MO flag. Thus the generator may restart if another node or criterion demands it.

To prevent the generator from starting for any reason, set the Generator Lock flag. Ideally this is done as a Stop Demand, with Manual Override as well.

AGS Criterion Command

Name:	AGS_CRITERION_COMMAND	
PGN:	1FEFD	
Byte 1:	Instance	See below
Bit 2.1-2.2:	Command	Always 00 = Add/Edit Criterion or 11 = No Action
Bit 2.3-2.4	Active Status	00 = Deactivate, 01 = Activate
Byte 3:	Criterion Type	See below

The AGS has predetermined criteria which can be reconfigured or deactivated, but not deleted or added to. The Instance and Type of each criterion is as follows:

Instance	Type
1	0 = DC Voltage Threshold
2	0 = DC Voltage Threshold or Charge Bridge
3	3 = Ambient Temperature
4	4 = Transfer Switch AC Point Voltage
11	5 = Quiet Time
5	250 = DC Voltage Topoff
6	249 = Scheduled Exercise
7	248 = External Input (GEN SWITCH)
8	248 = External Input (GEN DEMAND 1 OR GEN DEMAND 2)
9	1 = DC State of Charge
10	247 = DC State of Charge Topoff

AGS Criterion Command - Type 0

Byte 4:	DC Instance	1 = House Battery (either internal or from charger.) Any other value must match DC Source Instance
Byte 5-6:	Voltage Threshold	Supported per RV-C
Byte 7:	Time Under Threshold	1 bit = 5 sec, 0 – 1250 sec this differs from RV-C spec which is 1 bit = 6 sec

If the DC Instance does not match the DC Source instance the unit will use the house battery by default. This may be either a value from an external charger or the TM-102 DC Source. Note that when using the Voltage AGS without a charger the Stop Criteria should be set to Time Only.

Starting with v3.17, the Voltage AGS will not operate if shore power is detected. This may be detected from a transfer switch or charger. If neither of these is available the AGS will still operate.

(v 1.88+) If the Charge Bridge AGS is enabled, Instance 2 is automatically set to Charge Bridge AGS. This will cause it to ignore the DC Instance setting and look at the Chassis Battery voltage defined by the Charge Bridge feature. The run time will be the same as the Charge Bridge duration, regardless of the charger status. The instance will also enable or disable whenever Instance 1 is enabled or disabled.

AGS Criterion Command - Type 3

Byte 4:	Thermostat Instance	1-250 = Internal or networked temp instance. 0 = TM-200 Slave Mode
Byte 5-6:	Ambient Temp Threshold	Supported per RV-C. Must be > 0 deg F
Byte 7:	Time Under Threshold	1 bit = 5 sec, 0 – 1250 sec this differs from RV-C spec which is 1 bit = 6 sec
Byte 8:	Dead Band	0 = 0 Deg C, 1 bit = .1 Deg C. *RV-C does not currently support this datum.*

There is a special build that allows the unit to use a tile heat temperature sensor instead of a AC102 sensor. This is not a feature of the production builds.

In the TM200 Slave Mode, the unit monitors the proprietary demand level messages used by the TM200 to communicate demand level. If any of up to four zones has a demand for air conditioning the criterion triggers a demand. The remaining fields are ignored.

AGS Criterion Command - Type 4

Byte 4:	ATS Instance	Always 0xF9 (Surgeguard Output Leg #1)
Byte 5-6:	RMS Voltage Threshold	Supported per RV-C
Byte 7:	Time Under Threshold	1 bit = 5 sec, 0 – 1250 sec this differs from RV-C spec which is 1 bit = 6 sec

AGS Criterion Command - Type 5

Byte 4:	reserved	
Byte 5:	Quiet Time Begin Hour	Supported per RV-C
Byte 6:	Quiet Time Begin Minute	Supported per RV-C
Byte 7:	Quiet Time End Hour	Supported per RV-C
Byte 8:	Quiet Time End Minute	Supported per RV-C

AGS Criterion Command - Type 248 External Input

This proprietary format triggers demand based on the status of the discrete input. Note that for the generator demand inputs, there are two choices: GEN DEMAND 1 and GEN DEMAND 2. The first one is active low while the second is active high input. One or the other or both may be used at the same time.

Gen Demand requires the input be held for at least 5 seconds before activating. Starting in v2.20, the Gen Switch input uses a configurable input delay using the following format:

Byte 4:	Switch Delay	1 bit = 0.25 sec, 0 – 62.5 seconds requires holding button this long to activate

AGS Criterion Command - Type 249 Scheduled Exercise

Bit 4.1-4.2:	Sunday	00 = No Start on Sunday. 01 = Start on Sunday
Bit 4.3-4.4:	Monday	As Above
Bit 4.4-4.6:	Tuesday	As Above
Bit 4.7-4.8:	Wednesday	As Above
Bit 5.1-5.2:	Thursday	As Above
Bit 5.3-5.4:	Friday	As Above
Bit 5.5-5.6:	Saturday	As Above
Byte 6:	Start Hour	Same Format as Quiet Time Hour
Byte 7:	Start Minute	Same Format as Quiet Time Minute
Byte 8:	Run Time	0 = 0 Min. 1 bit = 5 Min. Max = 1250 Min

AGS Criterion Command - Type 250 DC Voltage Topoff

Byte 4:	DC Instance	Should be set to Inverter DC Input Instance or DC Source Monitor Instance (See Below)
Byte 5-6:	Voltage Threshold	Supported per RV-C
Byte 7:	Run Time	0 = 0 Min, 1 bit = 1 Min

Starting with v3.17, the DC Voltage Topoff will not operate if shore power is detected. This may be detected from a transfer switch or charger. If neither of these is available the Topoff will still operate.

AGS Criterion Command - Type 1

Byte 4:	DC Instance	Always 0x01 (Main House Battery)
Byte 5:	Start SOC Threshold	Pct, Supported per RV-C
Byte 6:	Stop SOC Threshold	Pct, Supported per RV-C ***added in v3.33***
Byte 7:	Time Under Threshold	1 bit = 5 sec, 0 – 1250 sec this differs from RV-C spec which is 1 bit = 6 sec

AGS Criterion Command - Type 247 DC SOC Topoff

Byte 4:	DC Instance	Always 0x01 (Main House Battery)
Byte 5:	Start SOC Threshold	Pct, Supported per RV-C
Byte 7:	Run Time	0 = 0 Min, 1 bit = 1 Min

Proprietary - Configure AGS Stop Criteria

Name:	PROP_CONFIGURE_AGS_STOP	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0xF2 = Configure AGS Stop Criteria 0xE7 = Request AGS Stop Criteria
Byte 2-3:	Max Run Time	0 = 0 Min, 1 bit = 1 min
Bit 4.1 - 4.4:	DC Voltage Stop Criterion	00 = Main Charger Reaches Float 01 = Dual Charger - One Float, One Absorb 02 = Main Charger Reaches Absorb, Plus Time 03 = Run Time Only 04 = 100% State Of Charge 05 = State Of Charge Stop Setting (Stop SOC Threshold)
Bit 4.5-4.6:	Disable-On-Movement	00 = Do Not Disable on Coach Movement 01 = Disable All Criteria on Coach Movement
Byte 5:	Reserved (Main Charger Instance)	
Byte 6:	Reserved (Second Charger Instance)	
Byte 7-8	Plus Time	0 = 0 Min, 1 bit = 1 Min

Unit must be “unlocked” to accept this command, except the Max Run Time, which can be changed without unlocking the unit.

Name:	PROP_CONFIGURE_AGS_STOP_2	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0x7E = Configure AGS Stop Criteria 2
Byte 2-3:	Max Run Time Max Limit	Max Run Time cannot be set above this value 0 = 0 Min, 1 bit = 1 min, Default = 800 min

Proprietary - Reset AGS Defaults

Name:	PROP_RESET_AGS_DEFAULTS	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0xE8 = Reset AGS Defaults
Byte 2:	Coach Model	See “Coach Model Identification” above (**obsolete**). Effective versions 1.20 and above, this will rewrite the NVRAM with generic defaults. The user should avoid using this as much as possible.

Unit must be “unlocked” to accept this command.

PGNs Reported

Generator Demand Status

Name:	GENERATOR_DEMAND_STATUS	
PGN:	0x1FF80	
Bit 1.1-1.2:	Generator Demand	00 = No Demand, 01 = Generator Demanded
Bit 1.3-1.4:	Internal Demand	00 = No Demand, 01 = Demand from AGS Criteria
Bit 1.5-1.6:	Network Demand	00 = No Demand, 01 = Demand from RV-C Command
Bit 1.7-1.8:	External Activity	00 = Normal, 01 = External Activity Detected
Bit 2.1-2.2:	Manual Override	00 = Normal Operation, 01 = Manual Operation.
Bit 2.3-2.4:	Quiet Time	00 = Normal Operation, 01 = Now in Quiet Time
Bit 2.5-2.6:	Quiet Time Override	00 = Normal Operation, 01 = Quiet Time Ignored
Bit 2.7-2.8:	Generator Lock	00 = Normal Operation, 01 = Genstart Disabled by command or Gen Lock Input
Byte 3-6:	Quiet Time	Supported per RV-C
Byte 7:	Minimum Cycle Time	Supported per RV-C

AGS Criterion Status

Name:	AGS_CRITERION_STATUS	
PGN:	1FEFE	
Byte 1:	Instance	See below
Bit 2.1-2.2:	Demand Status	00 = Not Currently Demanding Genset 01 = Demanding Genset
Bit 2.3-2.4	Active Status	00 = Deactivate, 01 = Activate
Byte 3:	Criterion Type	See below

The remainder of this PGN is determined by the Criterion Type, and is identical to the AGS_CRITERION_COMMAND variants listed above.

AGS Criterion Status

Name:	AGS_CRITERION_STATUS_2	
PGN:	TBA by RVIA. Temporarily using 0x17003.	
Byte 1:	Instance	See below
Byte 2:	Criterion Type	See below
Byte 3-4:	Threshold Counter	0 = Target value not within threshold. 1-65530 = Seconds under threshold.

This PGN is sent only for Instances 1-4. It is not valid for the Exerciser, Topoff, External Demand, or External Switch.

Proprietary - Report AGS Stop Criteria

Name:	PROP_REPORT_AGS_STOP	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xEF = AGS Stop Criteria Report

The remainder of this PGN is identical to PROP_CONFIGURE_AGS_STOP

Name:	PROP_REPORT_AGS_STOP_2	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0x7F = AGS Stop Criteria Report 2

The remainder of this PGN is identical to PROP_CONFIGURE_AGS_STOP_2

Suspect Parameters

The DSA for all DM1 reports is 65. The SPNs are multi-instance. Valid SPNs are:

Invalid Configuration
MSB = 1 ISB = Instance LSB = 0 AGS Configuration
FMI = 13 - Bad Intelligent Device or Component

Data Not Available
MSB = 1 ISB = Instance LSB = 1 AGS Data Input
FMI = 11 - Failure Not Identifiable
This would be used if, for example, the DC Source Instance used in Criterion 1 was unavailable.

DC Source Monitor

Note that the Instance for the DC Source is set via a proprietary message detailed above. If other DC Source Monitoring devices are attached to the same Instance but have a higher device priority, this module will stop broadcasting.

PGNs Reported

DC Source Status

Name:	DC_SOURCE_STATUS_1	
PGN:	0x1FFFD	
Byte 1:	Instance	As configured.
Byte 2:	Device Priority	20 = Voltmeter
Byte 3-4:	DC Voltage	Supported per RV-C

The DC voltage will be from the A/D converter input DC SENSE.

Charger Status

Name:	CHARGER_STATUS	
PGN:	0x1FFC7	
Byte 1:	Instance	Always 1
Byte 2-3:	Charge Voltage	Supported per RV-C
Byte 7:	Operating State	

If no charger is on the network then the TM102 can send CHARGER_STATUS with the operating state determined from the house battery voltage.

Current Charge State	Next State
Not Charging	Go to Bulk if V > 12.5
Bulk	Go to Absorption if V > 14 Go to Not Charging if V < 12.5
Absorption	***v1.00 – v3.06*** Go to Float if V < 14 ***v3.07+*** Go to Float if V < 13.6, Go to Float if V =13.6 – 13.9 for 60 seconds (This prevents premature float detection if absorption volts is fluctuating)
Float	Go to Absorption if V > 14 Go to Not Charging if V < 12.5

Starting in v3.17, the charge state may be determined based on House Battery voltage that is broadcast from another device.

Suspect Parameters

The DSA for all DM1 reports is 69. There are no diagnostic SPNs. The DM1 will always be sent with all lamps off and no errors.

Battery State of Charge

This feature combines voltage and amperage information from an RV-C inverter (see below) to provide a battery State-of-Charge (SOC) value.

PGNs Supported

(Reserved) *Proprietary – Configure SOC Table*
Name: PROP_CONFIGURE_SOC_TABLE
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xC6 = Configure SOC Table
0xC5 = Request SOC Table Report
Format is identical to PROP_REPORT_SOC_TABLE. Unit must be “unlocked” to accept this command.

PGNs Reported

(Reserved) *DC Source Status*
Name: DC_SOURCE_STATUS_2
PGN: 0x1FFFC
Byte 1: Instance As configured.
Byte 2: Device Priority 120 = SOC Device
Byte 5: State-of-Charge Supported per RV-C

The Instance generally is not the same as the DC Source Monitor Instance.

The SOC is calculated using a downloadable table of voltage and amperage values. This table is downloaded using proprietary PGNs detailed above. The table consists of an arbitrary number of voltage and amperage levels, with a reference SOC percentage for each amp/volt point.

For example, the table might look like:

	13.8 V	**12.5 V**	**11.9 V**	**11.2 V**
0 A	100%	60%	40%	20%
50 A	100%	80%	60%	30%
150 A	100%	90%	70%	50%

A reading of 12.2V and 100A would result in a value of 75%.

(Reserved) *Proprietary – Report SOC Table*

Name:	PROP_REPORT_SOC_TABLE	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xC4 = Report SOC Table
Byte 2:	Number of Voltage Points	Min = 2
Byte 3:	Number of Amperage Pts.	Min = 2
Byte 4,5	Voltage Point 1	Per RV-C Table 2.2
Byte 6,7	Voltage Point 2	Per RV-C Table 2.2
. . .	. . .	
Byte a,a+1	Amperage Point 1	Per RV-C Table 2.2
Byte a+2,a+3	Amperage Point 2	Per RV-C Table 2.2
. . .	. . .	
Byte b	SOC Point (V1,A1)	Percent SOC, Per RV-C Table 2.2
Byte b+1	SOC Point (V1,A2)	Percent SOC, Per RV-C Table 2.2
Byte b+2	SOC Point (V1,A3)	Percent SOC, Per RV-C Table 2.2
. . .	. . .	
Byte c	SOC Point (V2, A1)	Percent SOC, Per RV-C Table 2.2
Byte c+1	SOC Point (V2, A2)	Percent SOC, Per RV-C Table 2.2
Byte c+2	SOC Point (V2, A3)	Percent SOC, Per RV-C Table 2.2
. . .	. . .	

PROP_CONFIGURE_SOC_TABLE and PROP_REPORT_SOC_TABLE requires use of the Long Message Format. If the table includes X voltage points and Y amperage points, it will use 3+2*X+2*Y+X*Y bytes to transmit.

Suspect Parameters

The DSA for all DM1 reports is 70.

If the State-of-Charge feature is enabled, but no RV-C inverter is found to provide the amperage data, a DM1 will be sent with red lamp, SPN 9, FMI 2 (Network Connection, Erratic or Invalid). If the table used for calculation is misprogrammed, it will send a red lamp, SPN 3, FMI 13, (Node Configuration, Out of Calibration).

RV-C Inverter Support

By default the TM-102 will parse data from any RV-C inverter on the main data bus. This data may be used to update or override the DC Source Monitor, provide data for the Extended Serial Monitor, and provide data for the State of Charge calculator. Up to two inverters may be monitored, with arbitrary Instance values.

Xanbus Bridge

A Xantrex Inverter/Charger is connected via RV-C port to provide AC/DC electrical information. This uses the Xanbus RV-C protocol described in a separate documentation. Selected data is translated into the following standard RV-C PGN's.

The inverter/charger may have two instances. The Xantrex inverter with Xanbus instance of zero will be considered RV-C Instance 1. All other Xantrex inverters will have an RV-C Instance of 2. There is no support for a three or more inverter system.

In the case that two inverters on the same RV-C port have the same Xanbus instance, the Xanbus source address will be compared – the lowest address will be assigned to RV-C Instance 1, the next higher address will be RV-C Instance 2. The Xanbus ID field will also be checked so that if a third ID in the name PGN is found, the TM-102 will reset all inverters back to the initial state and start over on the Xanbus name parsing. This will allow the customer to replace inverters while still connected. Leaving the third or more inverter online should be discouraged as it will continue to reset the inverter instance setups indefinitely.

If the J1939 Bridge, Chassis Mobility, or J1939 Genset are not active, the TM-102 will search for a Xantrex inverter on the second CAN port. Previous to v3.17, the TM-102 only looked to see if J1939 Bridge was active. This inverter will automatically be assigned RV-C Instance 2.

There will be a 5 second delay after receiving the first inverter name PGN for the first time before parsing and processing data. However, if a second inverter came online, parsing and data processing may begin immediately. This delay will reduce confusion between two inverter's data until the instances are established.

NOTE: For inverter/charger AC status and commands, the instance field is configured in the following format:

bit 1-4:	RV-C Instance	As configured
bit 5-6:	Line	0 = Line 1 1 = Line 2
bit 7-8:	Input/Output	0 = Input 1 = Output

PGNs Supported

Charger Command

Name:	CHARGER_COMMAND		
PGN:	0x1FFC5		
Byte 1:	Instance	As configured.	
Byte 2:	Status	0 = Disable 1 = Enable 2 = Start Equalization	
Bit 3.1-3.2:	Default State on Power-Up	00 = Charger Disabled 01 = Charger Enabled	
Bit 3.3-3.4:	Auto Recharge Enable	00 = Auto recharge disabled 01 = Auto recharge enabled	***FSW only***
Bit 3.5-3.8:	Force Charge	00 = Force charge off 01 = Force charge to bulk 02 = Force charge to float	***FSW only***

Auto recharge reinitializes charging if battery voltage drops below a certain voltage.

Name:	CHARGER_CONFIGURATION_COMMAND	
PGN:	0x1FFC4	
Byte 1:	Instance	As configured.
Byte 2:	Charging Algorithm	0 = Constant Voltage 2 = 3-Stage

		3 = 2-Stage 4 = Trickle	
Byte 3:	Charger Mode	0 = Stand-alone 1 = Primary 2 = Secondary	
Byte 5-6:	Battery Bank Size	Supported per RV-C	
Bit 7.1-7.4:	Battery Type	0 = Flooded 1 = Gel 2 = AGM	
Byte 8:	Max Charging Current	Supported per RV-C	

Name:	CHARGER_CONFIGURATION_COMMAND_2		
PGN:	0x1FF95		
Byte 1:	Instance	As configured.	
Byte 2:	Max Charging Rate	Supported per RV-C	
Byte 5:	Default Battery Temperature	Supported per RV-C	***FSW only***
Byte 6-7:	Recharge Voltage	Supported per RV-C	***FSW only***

Name:	CHARGER_CONFIGURATION_COMMAND_3		***FSW only***
PGN:	0x1FECB		
Byte 1:	Instance	As configured.	
Byte 2-3:	Bulk Voltage	Supported per RV-C	
Byte 4-5:	Absorption Voltage	Supported per RV-C	
Byte 6-7:	Float Voltage	Supported per RV-C	
Byte 8:	Temperature Compensation Constant	0 – 250 mV/K	

Name:	CHARGER_EQUALIZATION_CONFIGURATION_COMMAND	
PGN:	0x1FF97	
Byte 1:	Instance	As configured.
Byte 2-3:	Equalization Voltage	Supported per RV-C
Byte 4-5:	Equalization Time	0 = 0 Minutes

Inverter Command

Name:	INVERTER_COMMAND	
PGN:	0x1FFD3	
Byte 1:	Instance	As configured.
Bit 2.1-2.2:	Inverter Enable	Supported per RV-C
Bit 2.3-2.4:	Load Sense Enable	Supported per RV-C

IName:	INVERTER_CONFIGURATION_COMMAND_1	
PGN:	0x1FFD0	
Byte 1:	Instance	As configured.
Byte 2-3:	Load Sense Power Threshold	0 = 0 watts 1 bit = 1 watt
Byte 4-5:	Load Sense Interval	0 = 0 seconds 1 bit = 0.5 second
Byte 6-7:	Min DC Shutdown Voltage	Supported per RV-C

Name:	INVERTER_CONFIGURATION_COMMAND_2	
PGN:	0x1FFCF	
Byte 1:	Instance	As configured.

Byte 2-3:	Max DC Shutdown Voltage	Supported per RV-C
Byte 4-5:	Min DC Warning Voltage	Supported per RV-C
Byte 6-7:	Max DC Warning Voltage	Supported per RV-C

Name:	INVERTER_CONFIGURATION_COMMAND_3	***FSW only***
PGN:	0x1FECD	
Byte 1:	Instance	As configured.
Byte 2-3:	DC Source shutdown delay	0 = 0 sec 1 bit = 0.5 sec
Byte 4:	Stack Mode	0 = Stand-alone 1 = Master 2 = Slave 3 = Line 2 Master (for series stacking)

Name:	INVERTER_CONFIGURATION_COMMAND_4	***FSW only***
PGN:	0x1FEBE	
Byte 1:	Instance	As configured.
Byte 4-5:	Absorption Time	1 bit = 1 minute

Name:	INVERTER_ACFAULT_CONFIG_COMMAND_1	
PGN:	0x1FF8C	
Byte 1:	Instance	As configured.
Byte 3:	Low Output Voltage Level	0 = 0 volts 1 bit = 1 volt
Byte 4:	High Output Voltage Level	0 = 0 volts 1 bit = 1 volt

Name:	INVERTER_ACFAULT_CONFIG_COMMAND_2	
PGN:	0x1FF8B	
Byte 1:	Instance	As configured.
Byte 2:	High Output Frequency Limit	0 = 0 Hz 1 bit = 1 Hz
Byte 3:	Low Output Frequency Limit	0 = 0 Hz 1 bit = 1 Hz

Proprietary – Reset Xantrex Inverter

Name:	PROP_RESET_XANTREX_INVERTER	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0xDF = Reset Xantrex Inverter
Byte 2:	Inverter Instance	0x01 = Inverter 1, 0x02 = Inverter 2
Bit 3.1-3.2:	Reboot Inverter	
Bit 3.3-3.4:	Restore Factory Defaults	
Bit 3.5-3.6:	Clear Faults	
Bit 3.7-3.8:	Restore OEM Defaults	
Byte 4:	OEM code	TBA
Bit 5.1-5.2:	Clear Warnings	

Unit must be “unlocked” to allow reset to factory defaults

Proprietary – Configure Xantrex Inverter

Name:	PROP_CONFIGURE_XANTREX_INVERTER	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0xAD = Configure Xantrex Inverter

Byte 2:	Inverter Instance	0x01 = Inverter 1, 0x02 = Inverter 2
Byte 3:	Device Number	0 – 250, **Used only by Freedom SW3012** used by Xanbus to identify inverters in stacking mode
Byte 4:	Desired Operating Mode	0 = Standby 1 = Operating
Byte 5:	AC Input Association	This matches Xanbus AC Source Identifier **Used only by Freedom SW3012** 0 = Invalid, 1 = None, 2 = Anonymous, 3 – 18 = Shore 1 – Shore 16, 19 – 34 = Gen 1 – Gen 16, 35 – 50 = AC 1 – AC16, 51 – 66 = AC Load 1 – AC Load 16, 67 – 82 = Grid 1 – Grid 16, 252 = All

PGNs Reported

DC Source Status

Name:	DC_SOURCE_STATUS_1	
PGN:	0x1FFFD	
Byte 1:	Instance	Always 1 = Main House Battery
Byte 2:	Device Priority	100 = Inverter/Charger
Byte 3-4:	DC Voltage	Supported per RV-C
Byte 5-8:	DC Current	Supported per RV-C

This PGN is only reported once, regardless of how many inverters attached. The DC voltage and current are reported in the following manner:

- If no inverter is found, it will revert to default broadcasting (see DC Source Monitor)
- If one inverter is found, the voltage and amperage will be reported
- If two inverters are found, the DC voltage is the average of the two inverters and the DC current is the sum of both inverter's amperage.
- No broadcast if a higher Device Priority is found.

For individual voltage and current measured at the inverter, use INVERTER_DC_STATUS.

Charger Status

Name:	CHARGER_STATUS		
PGN:	0x1FFC7		
Byte 1:	Instance	As configured.	
Byte 2-3:	Charge Voltage	Supported per RV-C	
Byte 4-5:	Charge Current	Supported per RV-C	
Byte 6:	Percent Charge Current	Supported per RV-C	
Byte 7:	Operating State		
Bit 8.1-8.2:	Default State on Power-Up	00 = Charger Disabled 01 = Charger Enabled	
Bit 8.3-8.4:	Auto Recharge Enable	00 = Auto recharge disabled 01 = Auto recharge enabled	***FSW only***
Bit 8.5-8.8:	Force Charge	00 = Force charge off 01 = Force charge to bulk 02 = Force charge to float	***FSW only***

Name:	CHARGER_CONFIGURATION_STATUS		
PGN:	0x1FFC6		
Byte 1:	Instance	As configured.	
Byte 2:	Charging Algorithm	0 = Constant Voltage 2 = 3-Stage 3 = 2-Stage 4 = Trickle	
Byte 3:	Charger Mode	0 = Stand-alone 1 = Primary 2 = Secondary	
Bit 4.1-4.2:	Battery Sensor Present	Supported per RV-C	
Bit 4.5-4.8:	Battery Type	0 = Flooded 1 = Gel 2 = AGM	
Byte 5-6:	Battery Bank Size	Supported per RV-C	
Byte 7-8:	Max Charging Current	Supported per RV-C	

Name:	CHARGER_CONFIGURATION_STATUS_2		
PGN:	0x1FF96		
Byte 1:	Instance	As configured.	
Byte 2:	Max Charging Rate	Supported per RV-C	
Byte 5:	Default Battery Temperature	Supported per RV-C	***FSW only***
Byte 6-7:	Recharge Voltage	Supported per RV-C	***FSW only***

Name:	CHARGER_CONFIGURATION_STATUS_3		***FSW only***
PGN:	0x1FECC		
Byte 1:	Instance	As configured.	
Byte 2-3:	Bulk Voltage	Supported per RV-C	
Byte 4-5:	Absorption Voltage	Supported per RV-C	
Byte 6-7:	Float Voltage	Supported per RV-C	
Byte 8:	Temperature Compensation Constant	0 – 250 mV/K	

Name:	CHARGER_CONFIGURATION_STATUS_4		***FSW only***
PGN:	0x1FEBF		
Byte 1:	Instance	As configured.	
Byte 4-5:	Absorption Time	1 bit = 1 minute	

Name:	CHARGER_EQUALIZATION_STATUS	
PGN:	0x1FF99	
Byte 1:	Instance	As configured.
Byte 2-3:	Time Remaining	0 = 0 Minutes 1 bit = 1 minute
Bit 4.1-4.2:	Pre-Charging status	0 = Pre-Charging not in process 1 = Charging battery to prepare for equalization

Name:	CHARGER_EQUALIZATION_CONFIGURATION_STATUS	
PGN:	0x1FF98	
Byte 1:	Instance	As configured.
Byte 2-3:	Equalization Voltage	Supported per RV-C
Byte 4-5:	Equalization Time	0 = 0 Minutes 1 bit = i minute

Name:	CHARGER_AC_STATUS_1	
PGN:	0x1FFCA	
Byte 1:	Instance	As configured.
Byte 2-3:	RMS Input Voltage	Supported per RV-C
Byte 4-5:	RMS Input Current	Supported per RV-C
Byte 6-7:	Input Frequency	Supported per RV-C

Name:	CHARGER_AC_STATUS_2	
PGN:	0x1FFC9	
Byte 1:	Instance	As configured.
Byte 2-3:	Peak Input Voltage	Supported per RV-C
Byte 4-5:	Peak Input Current	Supported per RV-C
Byte 8:	Capacity	Supported per RV-C

Inverter Status

Name:	INVERTER_STATUS	
PGN:	0x1FFD4	
Byte 1:	Instance	As configured.
Byte 2:	Status	0 = Disabled 1 = Invert 2 = AC Passthru 3 = APS Only 4 = Load Sensex
Bit 3.1-3.2:	Battery Sensor Present	Supported per RV-C
Bit 3.3-3.4:	Load Sense Enabled	Supported per RV-C

Name:	INVERTER_CONFIGURATION_STATUS_1	
PGN:	0x1FFD2	
Byte 1:	Instance	As configured.
Byte 2-3:	Load Sense Power Threshold	0 = 0 watts 1 bit = 1 watt
Byte 4-5:	Load Sense Interval	0 = 0 seconds 1 bit = 0.5 second
Byte 6-7:	Min DC Shutdown Voltage	Supported per RV-C

Name:	INVERTER_CONFIGURATION_STATUS_2	
PGN:	0x1FFD1	
Byte 1:	Instance	As configured.
Byte 2-3:	Max DC Shutdown Voltage	Supported per RV-C
Byte 4-5:	Min DC Warning Voltage	Supported per RV-C
Byte 6-7:	Max DC Warning Voltage	Supported per RV-C

Name:	INVERTER_CONFIGURATION_STATUS_3	***FSW only***
PGN:	0x1FECE	
Byte 1:	Instance	As configured.
Byte 2-3:	DC Source shutdown delay	0 = 0 sec 1 bit = 0.5 sec
Byte 4:	Stack Mode	0 = Stand-alone 1 = Master 2 = Slave 3 = Line 2 Master (for series stacking)

Name:	INVERTER_AC_STATUS_1	
PGN:	0x1FFD7	
Byte 1:	Instance	As configured.
Byte 2-3:	RMS Output Voltage	Supported per RV-C
Byte 4-5:	RMS Output Current	Supported per RV-C
Byte 6-7:	Output Frequency	Supported per RV-C

Name:	INVERTER_AC_STATUS_2	
PGN:	0x1FFD6	
Byte 1:	Instance	As configured.
Byte 2-3:	Peak Output Voltage	Supported per RV-C
Byte 4-5:	Peak Output Current	Supported per RV-C

Name:	INVERTER_ACFAULT_CONFIG_STATUS_1	
PGN:	0x1FF8E	
Byte 1:	Instance	As configured.
Byte 3:	Low Output Voltage Level	0 = 0 volts 1 bit = 1 volt
Byte 4:	High Output Voltage Level	0 = 0 volts 1 bit = 1 volt

Name:	INVERTER_ACFAULT_CONFIG_STATUS_2	
PGN:	0x1FF8D	
Byte 1:	Instance	As configured.
Byte 2:	High Output Frequency Limit	0 = 0 Hz 1 bit = 1 Hz
Byte 3:	Low Output Frequency Limit	0 = 0 Hz 1 bit = 1 Hz

Name:	INVERTER_DC_STATUS	
PGN:	0x1FEE8 (TBA – submitted to RVIA)	
Byte 1:	Instance	As configured.
Byte 2-3:	DC Voltage	Supported per RV-C
Byte 4-5:	DC Current	Supported per RV-C

DC voltage and amperage is measured at the inverter. See also DC_SOURCE_STATUS_1.

Name:	INVERTER_STATISTICS_STATUS	
PGN:	0x1FFCE	
Byte 1:	Instance	As configured.
Byte 8-9:	Lowest DC Voltage	Supported per RV-C
Byte 10-11:	Highest DC Voltage	Supported per RV-C
Byte 12-13:	Lowest AC Input Voltage	Supported per RV-C
Byte 14-15:	Highest AC Input Voltage	Supported per RV-C
Byte 16-17:	Lowest AC Output Voltage	Supported per RV-C
Byte 18-19:	Highest AC Output Voltage	Supported per RV-C

Proprietary – Xantrex Inverter Configuration

Name:	PROP_XANTREX_INVERTER_CONFIGURATION_REPORT	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEFFA)	
Byte 1:	Operation	0xAC = Xantrex Inverter Configuration Report
Byte 2:	Inverter Instance	0x01 = Inverter 1, 0x02 = Inverter 2

Byte 3:	Device Number	0 – 250, **Used only by Freedom SW3012** used by Xanbus to identify inverters in stacking mode
Byte 4:	Desired Operating Mode	0 = Standby 1 = Operating
Byte 5:	AC Input Association	This matches Xanbus AC Source Identifier **Used only by Freedom SW3012** 0 = Invalid, 1 = None, 2 = Anonymous, 3 – 18 = Shore 1 – Shore 16, 19 – 34 = Gen 1 – Gen 16, 35 – 50 = AC 1 – AC16, 51 – 66 = AC Load 1 – AC Load 16, 67 – 82 = Grid 1 – Grid 16, 252 = All

Suspect Parameters

The DSA for all DM1 reports is 66 for the primary inverter and 67 for the secondary inverter. The following DM1 messages are sent whenever the fault and warning status changes as well as DM1 requests.

RS Series Inverter Faults

Fault	Description	SPN	FMI	Notes
W0	FET1 Over Temperature Warning	2-X-0	0	Yellow Lamp
W1	FET2 Over Temperature Warning	2-X-1	0	Yellow Lamp
W2	DC Bulk Capacitor Over Temperature	3-X-0	0	Yellow Lamp
W3	Transformer Over Temperature Warning	3-X-1	0	Yellow Lamp
W4	Battery Over Temperature Warning	1-X-2	0	Yellow Lamp
W5	Ambient Over Temperature Warning	3-X-2	0	Yellow Lamp
W6	AC Overload Warning (AC OUPUT)	0x81-ACO-1	0	Yellow Lamp
W7	Auto Restart After Fault Feature Enabled.	0-0-3	14	Yellow Lamp
W8	Equalization Enabled Warning	3-X-4	14	Yellow Lamp
W9	Battery Temperature Sensor Not Present	1-X-2	5	Yellow Lamp
W10	Battery Temperature Sensor Shorted	1-X-2	6	Yellow Lamp
W11	DC Over Voltage Warning	1-X-0	0	Yellow Lamp
W12	DC Under Voltage Warning	1-X-0	1	Yellow Lamp
W13	AC Over Voltage Warning (AC Line 1 input)	0x81-ACI1-0	0	Yellow Lamp
W14	AC Under Voltage Warning (AC Line 1 input)	0x81-ACI1-0	1	Yellow Lamp
W15	AC Over Voltage Warning (AC Line 2 input)	0x81-ACI2-0	0	Yellow Lamp
W16	AC Under Voltage Warning (AC Line 2 input)	0x81-ACI2-0	1	Yellow Lamp
W18	Cannot equalize	3-X-4	2	Yellow Lamp
W19	Equalization terminated abnormally	3-X-4	11	Yellow Lamp
W500	Lost network connection	0-1-1	11	Yellow Lamp
W501	Non-volatile memory warning	0-0-4	11	Yellow Lamp
F0	FET1 Over Temperature Shutdown	2-X-0	0	Red Lamp
F2	FET2 Over Temperature Shutdown	2-X-1	0	Red Lamp
F3	Transformer Over Temperature Shutdown	3-X-1	0	Red Lamp
F4	Battery Over Temperature Shutdown	1-X-2	0	Red Lamp
F5	Ambient Over Temperature Shutdown	3-X-2	0	Red Lamp
F6	AC Overload Shutdown (AC OUTPUT)	0x81-ACO-1	0	Red Lamp
F7	AC Overload (PEAK CURRENT) Shutdown (AC OUTPUT)	0x82-ACO-0	0	Red Lamp
F8	Neutral loss shutdown	0x81-ACO-4	5	Red Lamp
F9	DC Over Voltage Shutdown	1-X-0	0	Red Lamp
F10	DC Under Voltage Immediate Shutdown	1-X-0	1	Red Lamp
F11	DC Under Voltage Shutdown	1-X-0	1	Red Lamp
F12	AC Over Voltage Shutdown (AC Line 1 input)	0x81-ACI1-0	0	Red Lamp
F13	AC Under Voltage Shutdown (AC Line 1 input)	0x81-ACI1-0	1	Red Lamp
F14	AC Over Voltage Shutdown (AC Line 2 input)	0x81-ACI2-0	0	Red Lamp
F15	AC Under Voltage Shutdown (AC Line 2 input)	0x81-ACI2-0	1	Red Lamp

RS Series Inverter Faults

F16	AC Over Frequency Shutdown (AC Line 1 input)	0x81-ACI1-2	0	Red Lamp
F17	AC Under Frequency Shutdown (AC Line 1 input)	0x81-ACI1-2	1	Red Lamp
F18	AC Over Frequency Shutdown (AC Line 2 input)	0x81-ACI2-2	0	Red Lamp
F19	AC Under Frequency Shutdown (AC Line 2 input)	0x81-ACI2-2	1	Red Lamp
F23	AC Over Voltage Shutdown (Inverter AC output)	0x81-ACO-0	0	Red Lamp
F24	AC Under Voltage Shutdown (Inverter AC output)	0x81-ACO-0	1	Red Lamp
F25	Auxiliary Power Supply Over Voltage Shutdown	0x84-X-0	0	Red Lamp
F26	Auxiliary Power Supply Under Voltage Shutdown	0x84-X-1	1	Red Lamp
F29	AC Backfeed Shutdown	1-X-7	11	Red Lamp
F30	Battery Under Temperature Fault	1-X-2	1	Red Lamp
F40	No IPC communication	0-1-5	11	Red Lamp
F41	Dead battery charger timeout	3-X-3	11	Red Lamp
F500	* Silicon Serial ID Failure	0-1-2	11	Red Lamp
F502	Watchdog reset error	0-1-3	11	Red Lamp
F505	* Controller fault	0-0-1	12	Red Lamp
F506	Wrong fault identifier	0-0-0	11	Red Lamp
F507	* Wrong identifier	0-0-4	11	Red Lamp
F508	* Invalid interrupt	0-1-4	11	Red Lamp

* Xantrex documentation is unclear on what this item means.

Freedom SW Series Inverter Faults

Fault	Description	SPN	FMI	Notes
W44	Battery Over Temperature	1-X-2	0	Yellow Lamp
W48	DC Under Voltage	1-X-0	1	Yellow Lamp
W49	DC Over Voltage	1-X-0	0	Yellow Lamp
W57	FET1 Over Temperature	2-X-0	0	Yellow Lamp
W58	FET2 Over Temperature	2-X-1	0	Yellow Lamp
W68	Transformer Over Temperature	3-X-1	0	Yellow Lamp
W69	AGS not connected	NA	NA	NA
W93	Battery Temperature Sensor Error	1-X-2	11	Yellow Lamp
W95	Equalization terminated abnormally	3-X-4	11	Yellow Lamp
W96	Canot Equalize	3-X-4	2	Yellow Lamp
F1	AC Output under voltage	0x81-ACO-0	1	Red Lamp
F2	AC Output over voltage	0x81-ACO-0	0	Red Lamp
F17	Relays Welded (AC Backfeed)	1-X-7	11	Red Lamp
F44	Battery Over Temperature	1-X-2	0	Red Lamp
F47	DC Under Voltage (Immediate)	1-X-0	1	Red Lamp
F48	DC Under Voltage (Fault)	1-X-0	1	Red Lamp
F49	DC Over Voltage	1-X-0	0	Red Lamp
F57	FET1 Over Temperature	2-X-0	0	Red Lamp
F58	FET2 Over Temperature	2-X-1	0	Red Lamp
F63	Power Board Temp unreadable	4-X-2	2	Red Lamp
F64	AC Overload	0x81-ACO-1	0	Red Lamp
F68	Transformer Over Temperature	3-X-1	0	Red Lamp
F69	External Sync Failed	4-X-0	2	Red Lamp
F70	Unique Device # Needed	3-X-7	2	Red Lamp
F71	Too Many Masters	3-X-7	2	Red Lamp
F72	Check AC Association	NA	NA	NA
F73	Transformer Temp Unreadable	3-X-1	2	Red Lamp
F74	Other Unit Invert Fault	NA	NA	NA
F75	Master Inverter Lost	4-X-0	2	Red Lamp
F85	Power Board Over Temperature	4-X-2	0	Red Lamp
F87	Multi-Unit Freq Mismatch	0x81-ACO-2	19	Red Lamp *added v3.07*

W = Warnings
F = Faults
X = Inverter Instance

ACI1, ACI2 = AC Input Instance
ACO = AC Output Instance
DC = DC Instance

Outback Inverter Bridge

Outback inverters are connected to the TM-102 through the Outback Mate control panel. There are 3 types of Mate panels – Mate, Mate2M, and Mate3. Differences in these panels and how they are connected to the TM102 are outlined below:

	Mate	***Mate2M***	***Mate3***
	1st gen, rarely used	2nd gen, used most often	3rd gen, started using in 2016
Serial connection	RS232, primary or secondary TM102 serial port	RS232, primary or secondary TM102 serial port	TTL, secondary TM102 serial port
Interface Board	MS706	MS706	MS???
TM102 Software	"A" v1.26+ "E" v3.05+	"A" v1.26+ "E" v3.05+	"A" v3.33+ "E" not supported
Max Charger Current Setting	Not supported	"A" v3.33+ "E" not supported	"A" v3.33+ "E" not supported
Charger Hi/Low Logic	Not supported	HI = Gen AC limit Lo = Grid AC limit LO/HI mode switches between Gen/Grid inputs	LO/HI mode sets both Gen and Grid AC to appropriate limit

The interface is limited in scope, and cannot completely eliminate the Mate control panel. If multiple Outback Inverters are used, they may be connected together using a "hub". This hub consolidates all the inverters into one "virtual" inverter. All data is combined, and total or average values are reported as appropriate. Controls all operate on the entire inverter bank simultaneously.

The system uses Instance 1 to represent the combined "virtual" inverter. The Line Instances are always 0 (Line 1).

Starting with v3.05 software, the TM102 can support the FlexMax charge controller. This controller is used to connect a solar array to a battery bank for charging. The FlexMax communicates over the same network as the Outback inverter/charger. The TM102 can obtain the solar volts and amps from it.

PGNs Supported

Charger Command

Name:	CHARGER_COMMAND	
PGN:	0x1FFC5	
Byte 1:	Instance	Always 1
Byte 2:	Status	0 = Disable 1 = Enable

Proprietary – OutBack Charger Command

Name:	PROP_OUTBACK_COMMAND	
PGN:	PDU_F = 239, PDU_S = 250 (Source Address) (0xEF##)	
Byte 1:	Operation	0xB9 = OUTBACK_COMMAND
Byte 2:	Charger Mode	0: Charger Disabled 1:LO AC current limited 2: HI AC current limited
Byte 4:	LO current limit setting	0-250 AC Amps *(10A only for v3.07 and earlier)*
Byte 5:	HI current limit setting	0-250 AC Amps *(30A only for v3.07 and earlier)*
Byte 6:	Auto Battery Topoff Pct	Pct, per RV-C
Byte 7:	Topoff Float Time	1 bit = 5 minutes, 0 – 1250 min (0 - 20.83 hours)

Placing values in Bytes 4 and/or 5 will set the current limit, a value of 0xFF will not change settings. Similarly, putting a valid value in Byte 2 (0, 1, or 2) will change the HI/LO state. Sending this PGN with no valid value will merely prompt for a PROP_OUTBACK_STATUS response from the tm102. *Versions prior to v3.08 will only support Lo of 10A and High of 30A. V3.08 and later supports any setting.*

For the Mate2M panel, the LO/HI charging modes switch the inverter inputs between “Grid” and “Gen”. Each has a separate current limit setting. The LO current setting sets the “Grid” limit and the HI current setting sets the “Gen” limit. The Mate3 panel does not allow us to switch between “Grid” and “Gen” inputs, so instead the TM102 sets both the Grid and Gen to the current limit we want. For example, sending a charger mode of LO sets both Grid and Gen to the LO current limit setting. Sending a charger mode of HI sets both Grid and Gen to the HI current limit.

The Auto Battery Topoff feature is used to automatically keep the battery charged based on the battery SOC (state-of-Charge). When this feature is enabled, the TM102 will turn off the charger when the battery SOC reaches 100% and has spent the required amount of time float charging (see Topoff Float Time). The charger will be turned back on when the battery SOC drops to the Auto Battery Topoff Percent (Default = 90%). This feature was added in v3.17 and requires the Elite Power Battery monitoring system. The float timer requirement was added in v3.18.

Name:	CHARGER_CONFIGURATION_COMMAND	***v3.33+ “A” only***
PGN:	0x1FFC4	
Byte 1:	Instance	Always 1
Byte 8:	Max Charging Current	Supported per RV-C, Outback settable 0-14 A

Inverter Command

Name:	INVERTER_COMMAND	
PGN:	0x1FFD3	
Byte 1:	Instance	Always 1
Bit 2.1-2.2:	Inverter Enable	Supported per RV-C
Bit 2.3-2.4:	Load Sense Enable	Supported per RV-C

PGNs Reported

DC Source Status

Name:	DC_SOURCE_STATUS_1	
PGN:	0x1FFFD	
Byte 1:	Instance	Always 1 = Main House Battery

Byte 2:	Device Priority	100 = Inverter/Charger
Byte 3-4:	DC Voltage	Average over the Bank. Supported per RV-C

This PGN takes priority over the DC Source Monitor if that device is set to Instance 1.

Name:	DC_SOURCE_STATUS_1	***FlexMax only v3.05+***
PGN:	0x1FFFD	
Byte 1:	Instance	4 = Solar
Byte 2:	Device Priority	100 = Inverter/Charger
Byte 3-4:	DC Voltage	Supported per RV-C
Byte 5-8:	DC Current	Supported per RV-C

This PGN sent only if a FlexMax system is connected.

Charger Status

Name:	CHARGER_STATUS	
PGN:	0x1FFC7	
Byte 1:	Instance	Always 1
Byte 2-3:	Charge Voltage	Average over the Bank. Supported per RV-C
Byte 4-5:	Charge Current	Total over the Bank. Supported per RV-C
Byte 7:	Operating State	

Name:	CHARGER_AC_STATUS_1	
PGN:	0x1FFCA	
Byte 1:	Instance	Always 1 (Input Line 0, Charger 1)
Byte 2-3:	RMS Input Voltage	Average over the Bank. Supported per RV-C
Byte 4-5:	RMS Input Current	Total over the Bank. Supported per RV-C

Name:	CHARGER_CONFIGURATION_STATUS	***v3.33+ "A" only***
PGN:	0x1FFC6	
Byte 1:	Instance	Always 1
Byte 7-8:	Max Charging Current	Supported per RV-C, Outback range 0-14 A

Proprietary – OutBack Charger Status

Name:	PROP_OUTBACK_STATUS	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xB8 = OUTBACK_STATUS
Byte 3:	Number of OutBacks, 1-4: Maximum 4 inverters	

The remainder of this PGN is the same format as PROP_OUTBACK_COMMAND.

Inverter Status

Name:	INVERTER_STATUS	
PGN:	0x1FFD4	
Byte 1:	Instance	Always 1
Byte 2:	Status	0 = Disabled 1 = Invert 2 = AC Passthru 3 = APS Only 4 = Load Sense

Name:	INVERTER_AC_STATUS_1
PGN:	0x1FFD7

Byte 1:	Instance	Always 0x41 (Output Line 0, Inverter 1)
Byte 2-3:	RMS Output Voltage	Average over the Bank. Supported per RV-C
Byte 4-5:	RMS Output Current	Total over the Bank. Supported per RV-C

Name:	INVERTER_DC_STATUS	
PGN:	0x1FEE8	
Byte 1:	Instance	Always 1
Byte 2-3:	DC Voltage	Average over the Bank.
Byte 4-5:	DC Current	Total over the Bank.

DC voltage and amperage is measured at the inverter. See also DC_SOURCE_STATUS_1.

Suspect Parameters

The DSA for all DM1 reports is 66. Instance is always 1, Line Instance always 0.

Loss of communications with the control panel should trigger SPN 9, FMI 11. Since the Inverter is a multi-instance device, the full SPN is MSB 0, ISB 1, LSBits 9. This is a Red fault.

Chassis Battery Charging Bridge

This device controls the BATTERY SOLENOID output pin, according to whether charging is available. This device is intended to ensure that the chassis battery remains charged when the coach is not being driven regularly, and to charge the house batteries off of the alternator.

The output is activated to charge the chassis from the house upon the following conditions:

1. The Charger is On and providing charge (positive charging amps) *****.
2. The Charger Voltage is between the minimum and maximum voltages given in the configuration. Default values are Minimum 12.5V, Maximum 15.0V.
3. The Chassis Battery is below configured minimum. (Default 12.5V.)
4. The engine is not running. (RPM is zero).
5. All of the above are met for at least 30 seconds.

Or, to charge the house batteries off of the alternator, when

1. The engine RPMs exceeds the set minimum.
2. The Chassis Battery is above the configured minimum (Default 13.2V).
3. House Battery Percent below the configured minimum (Default 90%).
   Condition only used when Elite Power System is used on TM102E v3.11+
4. All of the above are met for at least 30 seconds.

When charging house to chassis, the output is deactivated when either:

1. The charger is no longer charging. (Charge amperage is zero, or status is not On.) *****
2. The configured amount of time has passed. (The default is 30 minutes.)
3. The engine is started. (RPM is non-zero.)
4. The charger voltage is no longer in the configured range.

When charging chassis to house, the output is deactivated when either:

1. The engine is stopped.
2. The chassis voltage descends below the configured amount. This Cutoff voltage is typically less then the voltage at which bridging starts.
3. House battery percent is 90% or higher.
   Condition only used when Elite Power System is used on TM102E v3.11+

** - Charge current requirement eliminated for external RV-C charger (Magnum) in v1.89 and altogether in v3.04. Charger state and current requirement eliminated for Outback in v2.23. If no charger is available, these requirements are ignored starting in v3.17.*

If engine data is not available the unit will still function, but with a Yellow-Fault DM1.

This device assumes that the DC Source input is the chassis battery, regardless of how the DC Source is actually configured. Charger Instance 1 is the only charger monitored. In addition to monitoring the charger (Outback or Xantrex), it also monitors DC_SOURCE_STATUS_1, Instance 1, and if it sees a negative (charging) current, it considers the charger to be on.

Starting with v1.87, if the unit sees an external charger in Standby mode, when the chassis battery falls below the threshold it will attempt to turn on the charger. This compensates for the Magnum "Full Charge" mode, in which the charger goes to "sleep" after four hours if the batteries are well charged. This feature requires the Magnum Interface (TM502) version 1.03 or higher.

Starting with v2.11, an engine run input was added to the TM102. This can be used if there is no connection to the J1939 bus for engine rpm. When the engine run input is activated the TM102 generates an engine RPM of 2000 so that the charge bridge can operate correctly. Starting in v3.18 the engine run input is only available for the "E" version.

PGNs Supported

Proprietary - Charging Bridge Configuration

Name:	PROP_CONFIG_CHARGEBRIDGE_1	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xC0 = Configure Charge Bridge 0xBF = Request Charge Bridge Report
Byte 2-3:	Minimum Charge Voltage	Per RV-C. Minimum voltage required
Byte 4-5:	Maximum Charge Voltage	Per RV-C. Maximum voltage required
Byte 6-7:	Minimum Chassis Voltage	Per RV-C. Minimum chassis voltage tolerated
Bits 8.1-8.6:	Run Time	0 = 0 min. 1 bit = 1 minute. Max = 60 Min

Name:	PROP_CONFIG_CHARGEBRIDGE_2	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xB1 = Configure Charge Bridge 0xB0 = Request Charge Bridge Report
Byte 2-3:	Minimum Engine RPM	Per RV-C. 1 bit = 1/8 rpm. 0 = Disabled
Byte 4-5:	Minimum Chassis Voltage	Per RV-C. Chassis voltage needed to start bridging.
Byte 6-7:	Cutoff Voltage	Per RV-C. Chassis voltage at which bridging is cut off.
Byte 8:	Minimum House Batt Pct	Per RV-C. Chassis bridges to charge house if house

battery pct drops below this value. *TM102E v3.11+*

Note that you cannot manually override the operation of the bridge, or disable it through these PGNs. If you wish to disable this feature you must do so through the main TM-102 configuration PGN (PROP_ENABLE_FEATURE_2).

PGNs Reported

Proprietary - Charging Bridge Configuration Report
Name: PROP_REPORT_CHARGEBRIDGE_1
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xBE = Charge Bridge Report
Byte 8.7-8.8 Status 00 = Inactive
01 = Active
Remaining fields are identical to PROP_CONFIG_CHARGEBRIDGE_1.

Name: PROP_REPORT_CHARGEBRIDGE_2
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xAF = Charge Bridge Report
Fields are identical to PROP_CONFIG_CHARGEBRIDGE_2.

DC Disconnect Status (v.2.13+)
Name: DC_DISCONNECT_STATUS
PGN: 0x1FED0
Byte 1: Instance Always 0x03 House/Chassis Bridge
Bits 2.1-2.2 Status 00 = Inactive, 01 = Active

This PGN is sent whenever the PROP_REPORT_CHARGEBRIDGE_1 is sent, on status change, and also when directly requested. Note that the same PGN is used for the House Battery Disconnect feature.

Suspect Parameters

The DSA for all DM1 reports is 139 (DC Disconnect/Bridge), previous to v3.17 the DSA was 71 (Chassis Battery SOC). If the charge bridge sense input is used and the charge bridge activates without seeing feedback on this input, a Red condition will be reported, with MSB:1, ISB:3, LSB:7 (Charge Bridge Solenoid) FMI 7 (Mech. Failure). For v3.17-v3.18 the fault was reported with SPN: 256.

House Battery Disconnect (v2.13+)

This feature controls a solenoid using two outputs, and also monitors one active high input to sense whether the solenoid has been manually bypassed. This feature is incompatible with the Water Heater, Awning, and Slide Room features.

The unit functions by energizing either the DISCONNECT_OPEN or DISCONNECT_CLOSE output for one second. It monitors the BATTERY DISCONNECT SENSE input to determine the actual status of the solenoid.

PGNs Supported

DC Disconnect Command

Name:	DC_DISCONNECT_COMMAND	
PGN:	0x1FECF	
Byte 1:	Instance	Always 0x01 House Battery Disconnect
Bits 2.1-2.2	Command	00 = Disconnect Batteries 01 = Connect Batteries

PGNs Reported

DC Disconnect Status (v.2.13+)

Name:	DC_DISCONNECT_STATUS	
PGN:	0x1FED0	
Byte 1:	Instance	Always 0x01 House Battery Disconnect
Bits 2.1-2.2	Status	00 = Disconnected, 01 = Connected
Bits 2.3-2.5	Last Command	00 = Disconnect, 01 = Connect
Bits 2.5-2.6	Bypass Detect	00 = No bypass, 01 = System control is bypassed

This PGN is sent on request, on change, and every five seconds.

Awning

The Awning is controlled through pins Out#7 (extend) and Out#8 (retract). These are doubled by the Tile heat so the awning control feature cannot be enabled if the tile heat is.

The Awning is a multi-instance device since there can be many awnings on a coach. The TM102 only supports one awning which is instance 1.

PGNs Supported

Awning Command

Name:	AWNING_COMMAND	
PGN:	0x1FEF2	
Byte 1:	Instance	Always 1 (main patio awning)
Byte 3:	Motion	00 = Stop, 01 = Extend, 02 = Retract

The “Extend” and “Retract” commands must be repeated every 100 ms to keep the awning in motion. If a longer gap occurs, the awning should stop automatically for safety. The “Stop” command does not need to be repeated, but it should certainly be sent to stop the motion.

PGNs Reported

Awning Status

Name:	AWNING_STATUS	
PGN:	0x1FEF3	
Byte 1:	Instance	Always 1 (main patio awning)
Byte 2:	Motion	0 = No motion, 01 = Extending, 02 = Retracting

Suspect Parameters

The DSA for all DM1 reports is 130.

There are no diagnostic SPNs. The DM1 will always be sent with all lamps off and no errors.

Water Heater (requires Special Build)

The TM-102 can control a single conventional water heater. Control is limited to turning the unit off and on, and monitoring the status light for errors. If the heater "flames out", the TM-102 will pause for five seconds, then restart the heater. It will repeat this up to five times before generating a "Failure to Ignite" flag. It will reset the counter if the heater stays on for more than one minute. It will reset the flag when a WATER_HEATER_COMMAND is received (regardless of the mode selected in that PGN.).

In Gas+Electric mode, the unit powers the gas burner controller and also powers the electric element.

PGNs Supported

Water Heater Command

Name:	WATERHEATER_COMMAND	
PGN:	0x1FFF6	
Byte 1:	Instance	Always 1
Byte 2:	Mode	0 = Off, 1 = Gas, 3 = Gas+Electric

Prop - Water Heater Configuration

Name:	PROP_CONFIG_WATERHEATER	
PGN:	0xEFFA	
Byte 1:	Operation	0xB3 = Configure Water Heater
Byte 2:	Ignition Time	0 - 250, Seconds to allow for ignition.
Byte 3:	Number of Retries	0 - 250, Number of Retries before reporting Fault
Byte 4:	Pause Between Retries	0 - 250, Seconds to allow between retries.

PGNs Reported

Water Heater Status

Name:	WATERHEATER_STATUS	
PGN:	0x1FFF7	
Byte 1:	Instance	Always 1
Byte 2:	Mode	0 = Off, 1 = Gas, 3 = Gas+Electric
Bit 8.1-8.2	Failure to Ignite Status	0 = No Failure. 1 = Unit cannot ignite.

Prop - Water Heater Configuration

Name:	PROP_CONFIG_WATERHEATER	
PGN:	0xEF##	
Byte 1:	Operation	0xB2 = Report Water Heater Configuration

Format is identical to PROP_CONFIG_WATERHEATER.

Suspect Parameters

The DSA for all DM1 reports is 101. The DM1 will be sent with a Yellow Lamp if the Failure to Ignite flag is active with MSB = 1, ISB = 1, LSB = 6 and FMI = 7.

Slide Control

The Slide is controlled through a very simple interface, using the IS-160 I/O Expander. The TM102 only supports two slide instances, which are always 1 and 2.

The unit can be configured for two types of slides. In the Electric Slide, the unit runs only Extend and Retract outputs. In the Hydraulic Slide, the unit also runs a output, starting the pump as necessary for either extension or retraction. (The timing of the pump output may be slightly ahead or behind the extend/retract output to provide smoother action.)

PGNs Supported

Slide Command

Name:	SLIDE_COMMAND	
PGN:	0x1FFE7	
Byte 1:	Instance	Always 1 or 2
Byte 3:	Motion	00 = Stop, 01 = Extend, 02 = Retract

The “Extend” and “Retract” commands must be repeated every 100 ms to keep the slide in motion. If a longer gap occurs, the slide shall stop automatically for safety. The “Stop” command does not need to be repeated, but it should certainly be sent to stop the motion.

Proprietary – Configure Slide Rooms

Name:	PROP_CONFIGURE_SLIDE_ROOM_CONTROL	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xD9 = Configure Slide Room Configuration 0xD8 = Request Slide Room Configuration Report

Format is identical to PROP_REPORT_SLIDE_ROOM_CONTROL. Unit must be “unlocked” to accept this command.

PGNs Reported

Slide Status

Name:	SLIDE_STATUS	
PGN:	0x1FFE8	
Byte 1:	Instance	Always 1 or 2
Byte 2:	Motion	0 = No motion, 01 = Extending, 02 = Retracting

Proprietary – Report Slide Rooms Configuration

Name:	PROP_REPORT_SLIDE_ROOM_CONTROL	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xD7 = Report Slide Room Configuration
Byte 2:	Room 1 Configuration	0 = Disabled. 1 = Hydraulic. 2 = Electric

Byte 3:	Room 2 Configuration	0 = Disabled. 1 = Hydraulic. 2 = Electric

Suspect Parameters

The DSA for all DM1 reports is 84. There are no diagnostic SPNs. The DM1 will always be sent with all lamps off and no errors.

Load Shed / TM200 Power Management Support

The unit supports a TM200 in slave mode to allow the unit to be fully functional in lieu of a smart transfer switch. The feature looks at input pin 7 (AC Current Detect) and 10 (EMS Load Shed Signal) as well as the generator run signal.

PGNs Reported

Powershare Permission

Name:	PROP_POWERSHARE_PERMISSION	
PGN:	0xEF67	
Byte 1:	Operation	Always 0xF4 - Power Sharing Permission
Bit 2.1-2.4	Zone 1 A/C Max Level	0 = Load Shed Signal Detected. 3 = Ok
Bit 2.5-2.8	Zone 2 A/C Max Level	0 = Load Shed Signal Detected. 3 = Ok
Bit 3.1-3.4	Zone 3 A/C Max Level	0 = Load Shed Signal Detected. 3 = Ok
Bit 3.5-3.8	Zone 4 A/C Max Level	0 = Load Shed Signal Detected. 3 = Ok
Bit 4.1-4.4	Zone 5 A/C Max Level	0 = Load Shed Signal Detected. 3 = Ok
Bit 4.5-4.8	Zone 6 A/C Max Level	0 = Load Shed Signal Detected. 3 = Ok

This is sent every second.

ATS Status

Name:	ATS_STATUS	
PGN:	0x1FFAA	
Byte 1:	Instance	Always 1
Byte 2:	Source In Use	0 = Generator (Based on run signal) 1 = Shore Power

AC Status

Name:	ATS_AC_STATUS_1	
PGN:	0x1FFAD	
Byte 1:	Instance	Always 0x79 (01111001) ATS Instance 1, Leg 1, Output Only
Byte 2-3:	RMS Voltage	Always 2400 (120 V) Supported per RV-C

These two are sent every second if the AC Sense input is active, and is not sent otherwise.

SurgeGuard Model 34520 Surge Protection Support

This feature enables the TM102 to connect to a Surgeguard surge protector (model 34520). It connects over the primary serial port jumpered for RS485. The serial interface is read only so the TM-102 can only read information from the Surgeguard, and thus only supports the relevant status PGNs, but no configuration or commands.

PGNs Reported

The AC status is reported using the Generic AC Source PGNs. The AC status is reported separately for each leg.

AC Status

Name:	GENERIC_AC_STATUS_1	
PGN:	0x1FEBB	
Byte 1:	Instance	Leg 1 - 0x11 Leg 2 - 0x21 Shore power only
Byte 2-3:	RMS Voltage	Supported per RV-C
Byte 4-5:	RMS Current	Supported per RV-C
Bit 8.5-8.6:	Fault - Reverse Polarity	Supported per RV-C
Name:	GENERIC_AC_STATUS_4	
PGN:	0x1FEB8	
Byte 1:	Instance	Leg 1 - 0x11 Leg 2 - 0x21 Shore power only
Byte 2:	Voltage Fault	Supported per RV-C 0 – Voltage OK 2 – Low Voltage (< 102V) 3 – High Voltage (> 132V)

Suspect Parameters

The DSA for all DM1 reports is 78 (AC Fault Protection System). Note that AC faults are not reported via DM1, but only with the PGNs listed above.

Elite Power Lithium ion Battery Management Support

The unit supports a Lithium Ion Battery Management system from Elite Power Solutions. The TM102 connects to the Elite Power system's proprietary CAN communications port using it's second CAN port (port normally used for J1939). The CAN bus is 500Kbps and uses the standard format CAN packet. For more information on the Elite Power system's proprietary protocol, see their CAN bus specification.

PGNs Supported

Elite Power System Configuration

Name:	PROP_CONFIGURE_ELITE_POWER
PGN:	PDU_F = 239, PDU_S = 250 (0xEFFA)

Byte 1:	Operation	Always 0xA6
Byte 2:	Battery Amperage Scaling Factor	1 – 250, factor multiplied to amperage Elite Power System is sending the TM102
Byte 3.1-3.4:	Number of Packs	1 – 3 packs in system

TM102 should respond with PROP_ELITE_POWER_CONFIGURATION_REPORT.

Li-Ion Battery Cell Status

Name:	PROP_REQUEST_LITHIUM_ION_BATTERY_CELL_STATUS	
PGN:	PDU_F = 239, PDU_S = 250 (0xEFFA)	
Byte 1:	Operation	0xA3 = Pack 1 Cell Status Request 0x93 = Pack 2 Cell Status Request 0x83 = Pack 3 Cell Status Request
Byte 2:	Cell Number	1 – 32 cells, 0 = request all cells

TM102 should respond with PROP_LITHIUM_ION_BATTERY_CELL_STATUS.

Li-Ion Battery Pack Status

Name:	PROP_REQUEST_LITHIUM_ION_BATTERY_PACK_STATUS	
PGN:	PDU_F = 239, PDU_S = 250 (0xEFFA)	
Byte 1:	Operation	0xA4 = Pack 1 Status Request 0x94 = Pack 2 Status Request 0x84 = Pack 3 Status Request

TM102 should respond with PROP_LITHIUM_ION_BATTERY_PACK_STATUS_1, PROP_LITHIUM_ION_BATTERY_PACK_STATUS_2, and PROP_LITHIUM_ION_BATTERY_PACK_STATUS_3.

PGNs Reported

DC Source Status

Name:	DC_SOURCE_STATUS_1	
PGN:	0x1FFFD	
Byte 1:	Instance	As configured.
Byte 2:	Device Priority	120 = SOC Device
Byte 3-4:	DC Voltage	Supported per RV-C
Byte 5-8:	DC Current	Supported per RV-C

Name:	DC_SOURCE_STATUS_2	
PGN:	0x1FFFC	
Byte 1:	Instance	As configured.
Byte 2:	Device Priority	120 = SOC Device
Byte 3-4:	DC Temperature	Supported per RV-C
Byte 5:	State-of-Charge	Supported per RV-C

Ambient Temperature Status

Name:	THERMOSTAT_AMBIENT_STATUS	
PGN:	0x1FF9C	
Byte 1:	Instance	As configured using PROP_CONFIGURE_INSTANCE
Byte 2-3:	Battery Temperature	Supported per RV-C

Battery temperature can be reported using THERMOSTAT_AMBIENT_STATUS so it can be used to control a battery heater.

Elite Power System Configuration

Name:	PROP_ELITE_POWER_CONFIGURATION_REPORT	
PGN:	PDU_F = 239, PDU_S = 250 (0xEFFA)	
Byte 1:	Operation	Always 0xA7

Format is identical to PROP_CONFIGURE_ELITE_POWER.

Li-Ion Battery Cell Status

Name:	PROP_LITHIUM_ION_BATTERY_CELL_STATUS	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xA0 = Pack 1 Cell Status 0x90 = Pack 2 Cell Status 0x80 = Pack 3 Cell Status
Byte 2:	Cell Number	1 – 32 cells
Byte 3-4:	Cell Voltage	0.001V / bit, this is not RV-C standard
Byte 5-6:	Cell Temperature	Supported per RV-C

Li-Ion Battery Pack Status

Name:	PROP_LITHIUM_ION_BATTERY_PACK_STATUS_1	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xA1 = Pack 1 Status 1 0x91 = Pack 2 Status 1 0x81 = Pack 3 Status 1
Byte 2:	Official Cell Count	Specified cell count
Byte 3:	Observed Cell Count	Actual number of cells found on scan of pack
Byte 4:	Average Cell Temperature	Deg F
Byte 5:	Maximum Cell Temperature	Deg F
Byte 6:	Minimum Cell Temperature	Deg F
Byte 7:	Max Cell Temp Index	Index number of cell with highest temperature

Name:	PROP_LITHIUM_ION_BATTERY_PACK_STATUS_2	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xA2 = Pack 1 Status 2 0x92 = Pack 2 Status 2 0x82 = Pack 3 Status 2
Byte 2-3:	Maximum Cell Voltage	0.001V / bit, this is not RV-C standard
Byte 4:	Max Cell Voltage Index	Index number of cell with highest voltage
Byte 5-6:	Minimum Cell Voltage	0.001V / bit, this is not RV-C standard
Byte 7:	Min Cell Voltage Index	Index number of cell with lowest voltage

Name:	PROP_LITHIUM_ION_BATTERY_PACK_STATUS_3	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	0xA8 = Pack 1 Status 3 0x98 = Pack 2 Status 3 0x88 = Pack 3 Status 3
Byte 2-3:	Pack Voltage	0.001V / bit, this is not RV-C standard
Byte 4-5:	Pack Current	0.05 A / bit, Supported per RV-C
Byte 6:	Pack Capacity (SOC)	0.5% / bit, Supported per RV-C

Name:	PROP_LITHIUM_ION_BATTERY_PACK_ALERT_STATUS	
PGN:	PDU_F = 239, PDU_S = 250 (0xEFFA)	
Byte 1:	Operation	0xA5 = Pack 1 Alert Status 0x95 = Pack 2 Alert Status 0x85 = Pack 3 Alert Status
Byte 2.1-2.2:	Alert Active	0 = No Alerts active, 1 = Alert Active
Byte 2.3-2.4:	Cell Temperature High Alarm	0 = Alert off, 1 = Alert on
Byte 2.5-2.6:	Pack Voltage High Alarm	0 = Alert off, 1 = Alert on
Byte 2.7-2.8:	Pack Voltage High Warning	0 = Alert off, 1 = Alert on
Byte 3.1-3.2:	Pack Voltage Low Alarm	0 = Alert off, 1 = Alert on
Byte 3.3-3.4:	Pack Voltage Low Warning	0 = Alert off, 1 = Alert on
Byte 3.5-3.6:	Pack Current High Alarm	0 = Alert off, 1 = Alert on
Byte 3.7-3.8:	Pack Current High Warning	0 = Alert off, 1 = Alert on
Byte 4.1-4.2:	Pack to Chassis Connection	0 = Alert off, 1 = Alert on
Byte 4.3-4.4:	Pack to Cell Comm Error	0 = Alert off, 1 = Alert on
Byte 4.5-4.6:	System Error	0 = Alert off, 1 = Alert on
Byte 4.7-4.8:	EMS Comm Error	0 = Alert off, 1 = Alert on, *This alert not produced by Elite System, but produced by the TM102 when it cannot communicate with the Elite interface.*

PROP_LITHIUM_ION_BATTERY_PACK_ALERT_STATUS should be broadcast every 5 seconds to itself (0xFA) and on change.

Index	Alert	Synopsis
1	Pack Normal	Active when no other valid alerts
2	Cell Temperature High Alarm	Active when cell temperature exceeds max defined temperature for a cell
3	Pack Voltage High Alarm	Active when pack voltage exceeds the max defined voltage for the pack
4	Pack Voltage High Warning	Active when pack voltage is off the scale - higher than high voltage setting, but less than the max defined voltage for the pack
5	Pack Voltage Low Alarm	Active when pack voltage below the minimum defined voltage for the pack
6	Pack Voltage Low Warning	Active when pack voltage is off the scale - lower than the low voltage setting, but higher than the minimum defined voltage for the pack
7	Pack Current High Alarm	Active when pack current exceeds the max defined current for the pack
8	Pack Current High Warning	Active when pack current is off the scale – higher than the high current setting, but less than the max defined current for the pack
9	Pack to Chassis Connection	Active when a pack to chassis connection has been detected
10	Pack to Cell Comm Error	Active when the observed cell count by the system is different than the official cell count. The most common cause for this is a communication error.

11	System Error	Software detected condition that has not been defined

Suspect Parameters

The DSA for all DM1 reports is 70.

If the Elite Power Battery Management feature is enabled, and there is no data detected on the secondary CAN bus, a DM1 will be sent with red lamp, SPN 9. FMI 11 (Node Connection, Failure Not Identifiable). If there is data detected on the secondary CAN bus, but we get a "Pack to Cell Comm Error" from the Elite system, a DM1 will be sent with red lamp, SPN 13, FMI 11 (Internal Subnetwork Communications, Failure Not Identifiable).

Trimark Entry Door Lock Output

The first output of the TM102 (ENTRY DOOR LOCK) may be used to indicate whether the entry door is locked or not. The TM102 looks for the PGN_LOCK_STATUS (instance = 1) message on the RV-C network and turns on the output if it sees the door is locked and turns off the output if the door is unlocked. If the door status is not found (after 1 minute), the output will default to off. In addition, the TM102 looks for the PGN_CHASSIS_MOBILITY_STATUS message and if it sees the park brake is disengaged, it keeps the output off.

This feature is currently only available on the "A" version!

PGNs Supported

Request Entry Door Lock Status

Name:	PROP_REQUEST_DOOR_LOCK_STATUS	
PGN:	PDU_F = 239, PDU_S = 250 (0xEFFA)	
Byte 1:	Operation	Always 0x9D
Byte 2:	Instance	1 = Entry Door

PGNs Reported

Entry Door Lock Status

Name:	PROP_DOOR_LOCK_STATUS	
PGN:	PDU_F = 239, PDU_S = Destination (0xEF##)	
Byte 1:	Operation	Always 0x9C
Byte 2:	Instance	1 = Entry Door
Byte 3:	Door Lock Status	0 = Unlocked, 1 = Locked, 253 = Unknown
Byte 4.1-4.2:	Door Lock Output	0 = Off, 1 = On

Data Logging

Access to data logging commands is through a "virtual data terminal" protocol that uses the

Proprietary PGN. The node serves as a terminal host, and data is transferred as ASCII text to a proprietary terminal program. The commands and responses available for to access the data log are documented in the PM-002 documentation.

Text Transfers are only supported to and from Source Address 253 (RV-L Bridge!). As with all messages, the TM-102 uses Source Address 250.

Proprietary - Text Transfer
Name: RVC_TERMINAL
PGN: PDU_F = 0x17E, PDU_S = Destination Address (0x17E##)
Byte 1-8 Character

This PGN is NEVER sent as a Long Message PGN. If the character is 0xFF, then it should be ignored. Strings are not null-terminated. Control characters such as 0x0D (CR) and 0x0A (LF) should be supported by the terminal program.

Serial Monitor

The serial monitor allows RS-232 communications to a PC or similar device wired to the GEN COM TX, GEN COM RX, and GEN COMMON lines. Communications are 115200 bps, Eight Bit, No Parity, No Flow Control.

The monitor functions as a terminal host, and can be accessed using conventional terminal programs such as HyperTerminal. The command set is version-dependent, but all versions contain a "?" and/or "Help" command, which will cause all commands to be listed for the user.

Two special commands are documented here.

Send RV-C Message

SEND <pgn> <data> . . . <data>

This command causes an RV-C message to be transmitted on the data bus. All data values must be in hexadecimal. The command will be sent with priority 7 and source address 250. There may be no more than eight data bytes – the command does not support long messages. Note that the TM-102 itself will not see or parse the message sent.

Example: SEND 1FFFE 05 0C 19 05 0C 00 00 FF

This example will send the SET_DATE_TIME_COMMAND and thus set any clocks on the network to 12/25/2005, 12:00 Noon. However, it will *not* set the clock on the TM-102, since the TM-102 will not "hear" this message.

For details of the RV-C PGN definitions, see the RV-C Application Document, published by the RVIA.

Parse RV-C Message

PARSE <pgn> <data> . . . <data>

This command is identical to SEND, except instead of transmitting a message on the RV-C

bus it simulates receiving the message on the bus. The syntax is identical to SEND.

Example: PARSE 1FFFE 05 0C 19 05 0C 00 00 FF

This example will cause the TM-102 to "receive" the SET_DATE_TIME_COMMAND and thus set the TM-102's clock to 12/25/2005, 12:00 Noon.

Example: PARSE 1FEFF 55 FF FF FF FF FF FF FF

This example will start the generator by issuing a GENERATOR_DEMAND_COMMAND, with the Demand, Quiet Time Override, External Activity Reset, and Manual Override flags all set. To stop the generator manually, change the 55 to 40 (No Demand, Manual Override).

Extended Serial Monitor

If this feature is enabled, an additional set of commands and data reports are added to the serial protocol. These additional features are listed in an Addendum document available from SilverLeaf. The Extended Serial Monitor can only operate on the serial ports (GEN COM or SERIAL).

Digital I/O Manager

TM-102 digital inputs and outputs may be monitored and modified. Although the PGN's are used mainly for testing purposes, they may be used by external applications that requires the I/O (i.e. unused ones) for specific functions.

NOTE: The user must use the outputs with EXTREME CAUTION as the functioniality of the TM-102 devices may be compromised, causing ERRATIC AND POSSIBLY DANGEROUS BEHAVIOR of RV appliances and other components.

All statuses are reported by request only. Note that the I/O pin numbers are the same specified in PROP_REPORT_OUTPUT_PIN and PROP_REPORT_INPUT_PIN

Note that access to a specific subset of the available digital I/O can be configured using the PROP_CONFIGURE_IOMANAGER PGN. It is generally wise to take advantage of this feature.

PGNs Supported

DC Load Command

Name:	DC_LOAD_COMMAND	
PGN:	0x1FFBC	
Byte 1:	Instance	See Notes.
Byte 3:	Desired Level	0%="off", non-zero values are "on"

The Instance is determined by the configuration of the IO Manager (see PROP_CONFIG_IOMANAGER). The Base RV-C Instance (default: 250) indicates the starting point of the numbering - the instances count down from that maximum. The Base Internal

Instance determines which pin is mapped to the Base RV-C Instance. The Number of Outputs determines the number of pins accessible through this PGN. Internal instances are mapped sequentially to the RV-C instances. They are related by the formula:

Internal Instance = Base Internal Instance + (Base RV-C Instance - RV-C Instance)

as long as (Base RV-C Instance - RV-C Instance) < Number of Outputs

Pin Instances that are out of range are not acknowledged at all. This is intended to prevent confusion if other DC Load Management products are installed..

PGNs Reported

DC Load Status

Name:	DC_LOAD_STATUS	
PGN:	0x1FFBD	
Byte 1:	Instance	250 minus digital output pin number
Byte 3:	Operating Status	0%=”off”, non-zero values are “on”

Digital Input Status

Name:	DIGITAL_INPUT_STATUS	
PGN:	0x1FFB8	
Byte 1:	Instance	250 minus digital input pin number
Byte 2:	Position	0=”off”, non-zero values are “on”

Suspect Parameters

There are no diagnostic SPNs and no DM1 will be reported.

Interpreting Data Logs

Record IDs

EXECUTIVE	0	OVERRIDESW	55	DCSTATUS	77
CLOCK	1	ACAUTOBACKUP	56	WATERPRESSURE	78
BRIDGE	2	AUTOTEMP	57	WATERPRESSURESW	79
WATERPUMP	3	EXTGENSWITCH	58	DISCONNECT	80
BATTERY	4	AMBIENTAGS	59	LOADSHED	81
CHARGER	5	CYCLETIME	60	ELITEPOWER	82
THERMOMETER	6	ACVOLTAGEAGS	61	BLACKTANKMANGER	83
TERMINAL	7	TOPOFF	62	TRIMARKLOCK	84
INPUTSWITCH	8	TANKMANAGER	63		
OUTPUTMANAGER	9	LPGTANKMANAGER	64		
XANBUS	10	FLOORHEAT	65		
INVERTER	11	AUTOFILL	66		
OUTBACK	12	IMMOBILIZER	67		
GENERATOR	30	EXTGENDEMAND	68		
SURGEGUARD	35	AWNING	69		
ATS	36	SLIDE	70		
SURGEGUARD 34520	37	CLIMATE	71		
GENSTART	50	WATERHEATER	72	EXTSERIAL	240
VOLTAGEAGS1	51	BATTERY_SOC	73	CANPORT0	250
VOLTAGEAGS2	52	AGS_SOC	74	CANPORT1	251
EXERCISER	53	TOPOFF_SOC	75	SERIALPORT0	252
THERMOSTATSW	54	CHARGEBRIDGE	76	SERIALPORT1	253

Events

Source	*Event*	*Notes*
genstart	User Start	
genstart	User Stop	
genstart	Auto Start	
genstart	Auto Stop	
genstart	Quiet Time Stop	
genstart	External Flag Set	

genstart	External Flag Reset	
genstart	Generator Locked	
genstart	Generator Unlocked	
genstart	Enter Quiet Time	
genstart	Exit Quiet Time	
genstart	Auto Start Retry	
genstart	Initialize Flags	
genstart	External Start	Manual start from gen switch outside our system
genstart	External Stop	Manual stop from gen switch outside our system
genstart criteria	Demand ON	
genstart criteria	Demand OFF	
genstart criteria	ARMED	
genstart criteria	DISARMED	
ags switch	Ext switch toggle	
battery	Status	
charger	Disable	
charger	Not Charging	
charger	Bulk	
charger	Absorption	
charger	Overcharge	
charger	Equalize	
charger	Float	
charger	Constant Voltage	
inverter	Disable	
inverter	Invert	
inverter	AC Passthru	
inverter	APS Only	
inverter	Load Sense	
comm	Open	
comm	Write	
comm	Read	
immobilizer	Shift Inhibit OFF	
immobilizer	Shift Inhibit ON	
chargebridge	Charge Bridge OFF	
chargebridge	Bridging Charger	

chargebridge	Bridging Alterntr
dc disconnect	DC Disconnect
dc disconnect	DC Connect
executive	Boot
executive	NVRAM Error
executive	NVRAM Change
executive	NVRAM Reset
executive	Insufficient Memory
executive	Testing flash
executive	Watchdog
executive	Setting Brwnout VRes
generator	Start Command
generator	Stop Command
generator	Generator Start
generator	Generator Stop
generator	Generator Fault
generator	Comm Fault
generator	Precrank Cmd
outback	Outback Command ON
outback	Outback Command OFF
waterpump	Command Pump OFF
waterpump	Command Pump ON
waterpump	Switch Pump OFF
waterpump	Switch Pump ON
waterpump	Secondary Pump OFF
waterpump	Secondary Pump ON
autofill	Command Fill OFF
autofill	Command Fill ON
autofill	Switch Fill OFF
autofill	Switch Fill ON
autofill	Manual Valve ON
autofill	Manual Valve OFF
autofill	Aborted
water heater	OFF
water heater	ON

water heater	FAULT	
water heater	RETRY	
water heater	AC ON	
water heater	AC OFF	
surgeguard	Power Up	
surgeguard	Power Down	
surgeguard	Voltage Status	
surgeguard	ATS Status	
surgeguard	Power Status	
thermostat	Thermostat	
climate	Thermostat	
xanbus	Fault	
xanbus	Warning	
xanbus	Event	
elitepower	Battery Pack1 Status	Records battery % and temperature
elitepower	Battery Pack2 Status	Records battery % and temperature
elitepower	Battery Pack3 Status	Records battery % and temperature
elitepower	Pack1 Comm Status	Started/Failure
elitepower	Pack2 Comm Status	Started/Failure
elitepower	Pack3 Comm Status	Started/Failure

Genstart Flags

Most AGS events display the status of the following flags:

D – Demand
N – Network Demand
E – External Activity
M – Manual Override
L – Genset Lock
Q – Quiet Time
O – Quiet Time Override
V – Disable-On-Movement setting
1 – Pin 6 Lock
2 – Pin 12 Lock

Index

Document Revision History

Date	By	Effective	Revision
06/10/15	CCR	V3.17	Added Outback Auto Battery Topoff Feature Added Charge Bridge Sense Input Edits to Charge Bridge logic description Added DC Voltage and Topoff AGS new requirement of checking for shorepower before starting gen. Added to DC Source Monitor that charging state can now be determined from house battery voltage on the network.
07/10/15	CCR	V3.18	Outback Auto Battery Topoff Feature now includes Float Time requirement Charge Bridge Sense Input changed to pin 11 Engine Run input now only available in “E” version
07/22/15	CCR	V3.22	Added instanced DM1 for Charge bridge solenoid fault (1-3-0)
10/14/15	CCR	V3.23	Added Xantrex Freedom SW AC Input Association setting
10/30/15	CCR	-	Fixed external dimensions
01/27/16	CCR	V3.26	Added new Xantrex SW warnings Added Trimark Entry Door Output Feature
02/19/16	CCR	V3.28	Added support for multiple Elite power battery packs
07/12/16	CCR	V3.33	Added Outback Mate3 support, Max Charging Current Added SOC stop threshold setting Added AGS Max Run Time Max Limit Updated Data Log Record ID table so it's current