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# IslandDER
# Electrical Interface – Rev C.0

## Revision History

| Revision | Description | Date | Approved By |
|---|---|---|---|
| 1.0 | Preliminary Specification | 3/25/2024 | C. Côté |
| 2.0 | Final Specification - Candidate | 5/15/2024 | - |
| A.0 | Initial Release | 6/11/2024 | C. Côté |
| A.1 | • Updated with the cable information and mating connector<br>• Renamed differential signals with _P/_N instead of +/- to match schematic | 7/15/2024 | C. Côté |
| B.0 | • Changed polarity of the MID_Sense_Out signal (H=Closed, L=Open)<br>• Changed the cable connector and mating connector, and added cable lengths in the Cable section.<br>• Added additional details and specifications on the 12V power bus<br>• Added specifications for MID Relay operation<br>• Added specifications for E-Stop circuit.<br>• Added additional fault modes to the MSA_Fault_N signal description.<br>• Added diagrams for Status Bits and other key circuits<br>• Renamed *_RMG_* to *_RGM_* to match the acronym. | 10/8/2024 | C. Côté |
| B.1 | Revert polarity of the MID_Sense_Out signal to previous (L=Closed,H=Open) | 10/22/2024 | C. Côté |
| B.2 | • Added circuit diagrams for current and voltage sense output stages<br>• Added section describing the visual indicators | 11/27/2024 | C. Côté |

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| C.0 | • Added Guidance for Improved System Resiliency/Observability in the Case of Unlikely Faults with the MID_SENSE_12V, Temp_Sense, and 12V_BUS<br>• Added Voltage Sensing Specification at Ambient<br>• Added AC Voltage Specification (min/max) for Grid-side Supply<br>• Added DER Power Requirement Specification for IslandDER V1 Only<br>• Provided Additional CT Specifications<br>• Finalized MSA Current and Supercapacitor Charge Time Specifications<br>• Added Minimum Voltage for E-Stop Loop<br>• Lowered Minimum Current for MSA_Sense<br>• Added Additional Details on the Use of MID_Relay_Ready signal.<br>• Added Additional Guidance to Interpreting MSA Fault<br>• Added Details to Visual Indicators Section<br>• Adjusted the Cable Length Options.<br>• Provided Additional Details in Various Circuit Diagrams | 2/14/2025 | C. Côté |

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## Open Items

Note: open items/values are indicated in yellow in the document and are yet to be finalized.

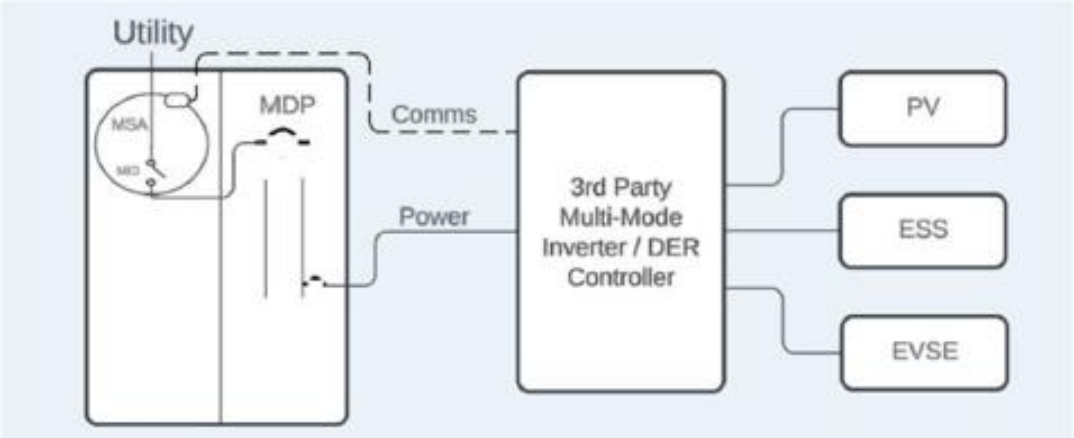
- The maximum temperature measured at the temperature sensor has not been finalized. It is expected to be on the order of 90C. Final temperature will be determined based on measurements on the Beta units.

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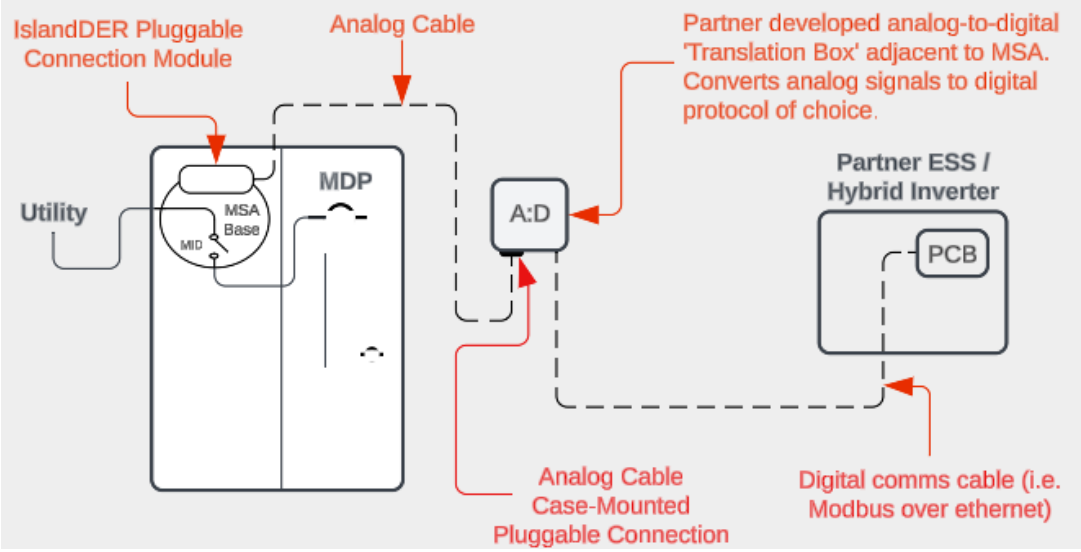
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## Introduction

This specification describes the interface between the IslandDER Meter Socket Adapter (MSA) and 3rd party DER control equipment (i.e. backup gateway, controller, hub, inverter, etc.). This specification is applicable to both the base IslandDER (MSA Only) and the IslandDER Plus (with DER Branch connection) configurations. The figure below represents a typical 3rd party integration with the base IslandDER model and DER control equipment in a 'meter-main combo' configuration:




The figure below represents an example of a suggested integration with IslandDER, whereby the partner develops and utilizes a separate analog to digital 'translation box' to receive the analog signals and convert them to a desired digital protocol:




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# General Specifications

- All signals suitable for up to 25 ft maximum cable length.
- All signal levels are relative to AGND. Note that the MSA doesn't include a connection to PE.
- All signals, including Grid-side AC/DC converter and Voltage Sensing, provide minimum 4kV or better of isolation between the High Voltage (208/240V) and Low Voltage (12V) sections of the circuit.
- Current and Voltage sensing signals are RMS values unless otherwise noted.
- IslandDER MSA includes UL recognized Type 1CA (Component Assembly) Surge Protection Device (SPD) (ANSI/UL 1449 5th) with MCOV: 320V (240V * 33%)
- All inputs must be driven by 3rd party as described in this specification.
- Unless otherwise indicated, outputs are intended for use with high impedance/low current loads.

## Mitigation against unlikely faults

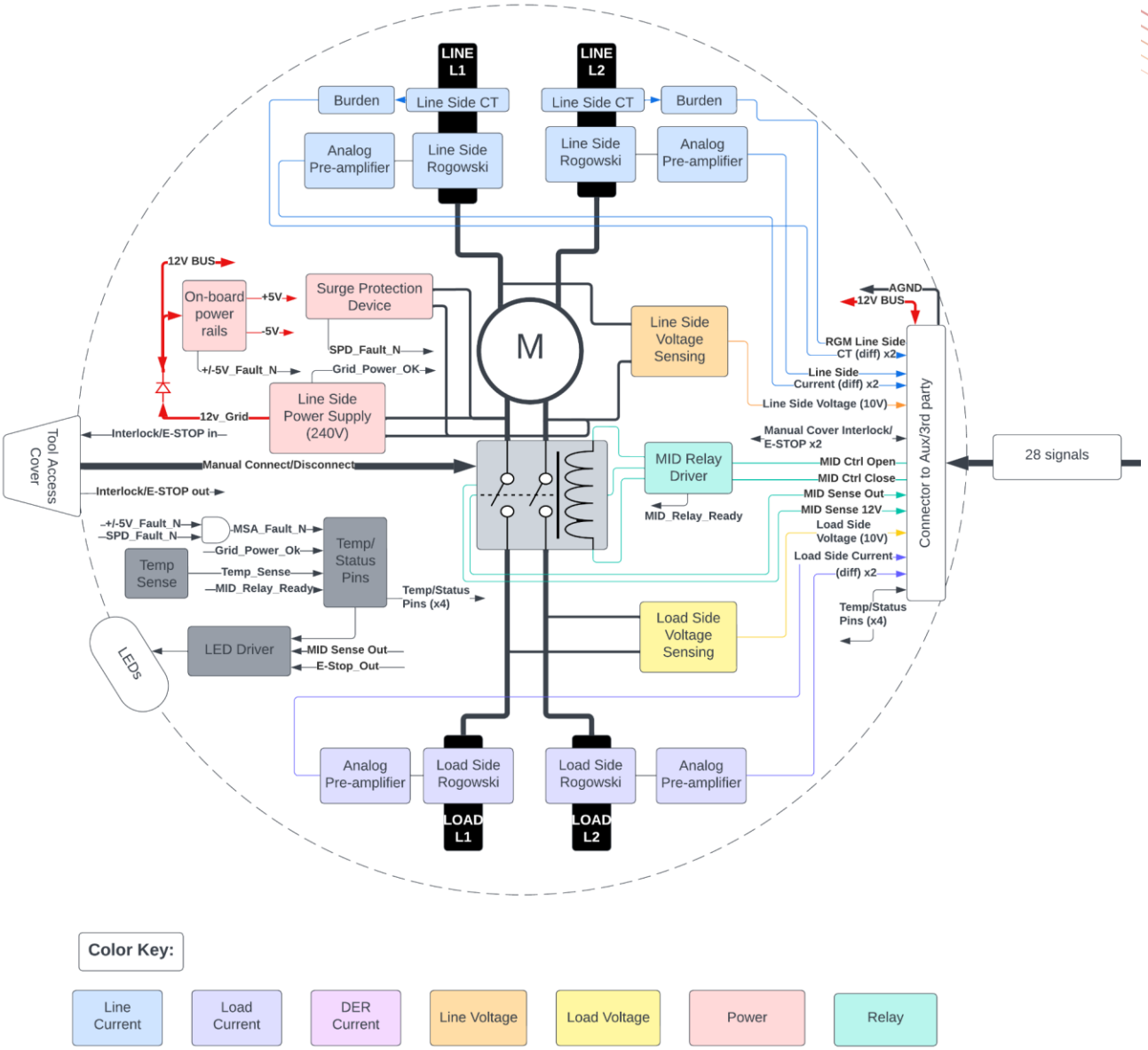
As part of a Failure Mode and Effects Analysis (FMEA) that was conducted on the IslandDER design, faults were identified that introduce a high severity or high risk probability (RPN) impact. In all cases, the faults are rare and unlikely, but to ensure the highest possible level of safety and reliability, mitigations were implemented to reduce/eliminate the occurrence of these faults, or to improve the detectability.

Some faults were identified where the mitigation must be implemented in the 3rd party system. These mitigation recommendations are identified with the following symbol.



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# IslandDER Block Diagram




*Note: Not indicative of physical layout.*

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# Electrical Interface – List of Signals

| # | Signal | Type | Direction | Levels | Other Specs |
|---|---|---|---|---|---|
| 1,2 | 12V_BUS, AGND | Power | Bi-directional | 12V DC | Supplies up to 5W to 3rd party from grid-side. Draws up to 5W when Grid is down. |
| 3,4 | Line_Current_L1_P/ Line_Current_L1_N | Analog, Differential | Output | 0.333V @ 200A | +/-1% accuracy, phase shift < 1% |
| 5,6 | Line_Current_L2_P/ Line_Current_L2_N | Analog, Differential | Output | 0.333V @ 200A | +/-1% accuracy, phase shift < 1% |
| 7,8 | Line_RGM_CT_L1_P/ Line_RGM_CT_L1_N | Analog, Differential | Output | 0.333V @ 200A | Class 0.2 (or better) |
| 9,10 | Line_RGM_CT_L2_P/ Line_RGM_CT_L2_N | Analog, Differential | Output | 0.333V @ 200A | Class 0.2 (or better) |
| 11,12 | Line_Voltage_L1_L2/ AGND | Analog | Output | 0V to 10Vpp @ 288 Vac (5V bias) | Line to line measurement (no neutral). +/-0.4% accuracy at ambient, +/-1% accuracy over Temp, phase shift < 1% |
| 13,14 | Load_Current_L1_P/ Load_Current_L1_N | Analog, Differential | Output | 0.333V @ 200A | +/-1% accuracy, phase shift < 1% |
| 15,16 | Load_Current_L2_P/ Load_Current_L2_N | Analog, Differential | Output | 0.333V @ 200A | +/-1% accuracy, phase shift < 1% |
| 17,18 | Load_Voltage_L1_L2 /AGND | Analog, Differential | Output | 0V to 10Vpp @ 288 Vac (5V bias) | Line to line measurement (no neutral). +/-0.4% accuracy at ambient, +/-1% accuracy over Temp, phase shift < 1% |
| 19 | MID_Ctrl_Open | Digital | Input | Min 3.3V Max 12V | 0.15mA @ 3.3V 0.5mA @ 12V Refer to “Relay Control” section |
| 20 | MID_Ctrl_Close | Digital | Input | Min 3.3V Max 12V | 0.15mA @ 3.3V 0.5mA @ 12V Refer to “Relay Control” section |
| 21 | MID_Sense_12V | Digital Relay Sense | Optional Power | 12V | Independent power for MID Sense. 5mA minimum. Refer to “Relay Control” section for additional details. |

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| 22 | MID_Sense_Out | Digital Relay Sense | Output | 12V | 10kOhm Pulldown<br>L=Closed<br>H=Open<br>No Debouncing |
| 23 | E-Stop_In | Dry Contact for Manual Relay Cover | Input | 5V - 36V DC | Must supply power externally.<br>Refer to “E-Stop Loop” section |
| 24 | E-Stop_Out | Dry Contact for Manual Relay Cover | Output | Up to 36V DC | Must provide external pulldown consistent with supply voltage<br>Refer to “E-Stop Loop” section |
| 25 | Temp_Sense | Analog | Output | 5V | -50C to 150C,<br>+/- 2.5C accuracy |
| 26 | Grid_Power_OK | Digital | Output | 5V | Indicated status of Grid Supply<br>H=Power On<br>L=Power Off (Fault if Grid power is present). Not intended for grid sensing. |
| 27 | MID_Relay_Ready | Digital | Output | 5V | Indicates whether MID Relay Drive circuit is ready to actuate<br>H=Ready<br>L=Not Ready (Fault if in this state for more than 10 minutes) |
| 28 | MSA_Fault_N | Digital | Output | 5V | Indicates the SPD has been triggered or the +5V/-5V rails are not operating, and MSA should be replaced<br>H=No Fault<br>L=Fault |
| 29, 30 | Reserved | Unused | - | - | - |
| - | Shield Drain | Cable shield | Ground | - | Must be tied to Earth Ground (or corresponding) at the partner end |

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## 12V DC Power Bus

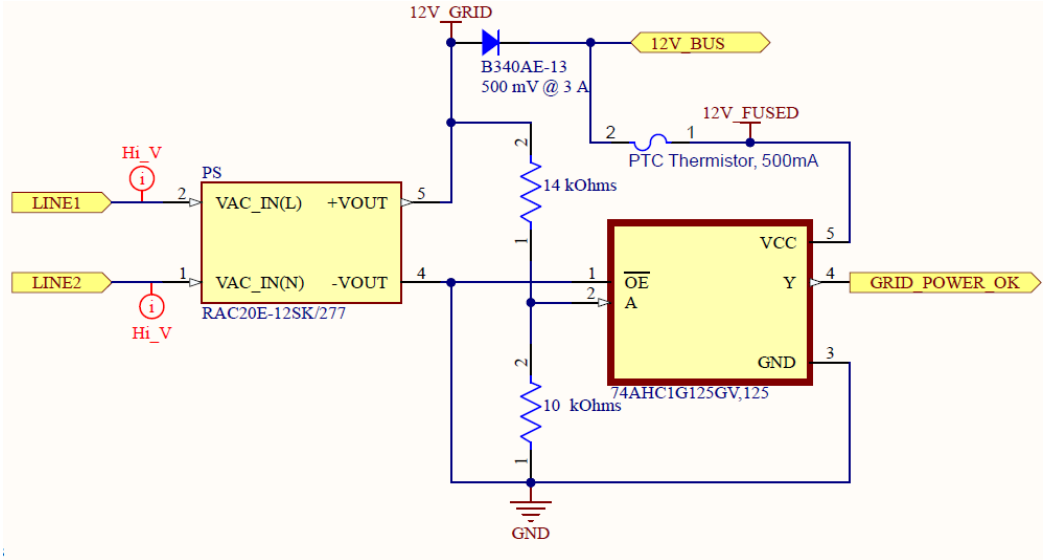
IslandDER MSA supports dual power sources. A 12V AC to DC converter is connected to the Line (Grid) side of the MID relay. This can provide 5W to connected 3rd party circuits for black start conditions, i.e. when the grid comes up but the MID relay is open and the DER system has insufficient reserve power to reconnect to the grid. The grid side supply provides 4kV isolation from input to output and is fed through a blocking diode to prevent back-feeding the supply.

The IslandDER MSA is also expected to be powered by a 12VDC supply from the DER system, which can supply up to 5W to the connected electronics. This ensures that the MSA electronics remain powered when the grid is down. The DER supply should also be connected via a diode inside the 3rd party circuit.

Under normal conditions where both grid and DER power are present, the 12V_Bus should be powered from both sources, so both are available to pick up the load if one should go off.

All 12V loads inside the MSA are protected by a self resettable PTC fuse with a hold current of 500mA and a trip current of 2.5A @ 25C. The Grid side supply includes Short Circuit, Over Voltage, and Over Load protection.

To protect against unlikely faults where the 12V_BUS could short to GND, the 3rd party DER Power Supply should also include some form of Short Circuit protection.







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## Grid Side Power Supply - Key Specifications

| | |
|---|---|
| AC Voltage Range | 85-305VAC |
| Start-up Time | 50ms |
| Rise Time | 40ms |
| Hold-up Time | 30ms |
| Output Ripple and Noise (20MHz BW) | 150mVp-p |
| Voltage Accuracy | +/-2% |
| Blocking Diode forward voltage range (current and temperature dependent) | 0.1V - 0.45V |
| Output Voltage Range | 11.31V to 12.14V; 11.7V typ. |
| Line Regulation (low line to high line) | ±0.5% typ. |
| Load Regulation (10% to 100% load) | 0.5% typ. |
| Transient Response (25% load step change) | 3.0% max.<br>500µs typ. recovery time |
| Overvoltage Category | OVCIII |
| Isolation Voltage | 4kVAC |
| Short Circuit Protection (SCP) | hiccup mode, automatic restart |
| Over Voltage Protection (OVP) | 105-120%, clamping, automatic restart |
| Over Load Protection (OLP) | 150-195%, hiccup mode |

## DER Power Supply - Key Requirements

| | |
|---|---|
| Supply Voltage | 12V |
| Minimum Power Available for IslandDER | 5W<br>3W for IslandDER V1 only |
| Steady State Current<br>(Relay bulk storage fully charged) | ~125mA typ. |
| Current Following Single Relay Actuation<br>(Relay bulk storage charging) | <150 mA typ. |
| Initial charging current (cold start) | ~ 0.6A inrush, then<br>< 250mA typ. |
| Output Voltage Range on 12V_BUS (after blocking diode) | 10.8V to 12.6V |
| Output Ripple and Noise | Comparable to Grid-side supply |
| Transient Response (25% load step change recovery time) | Comparable to Grid-side supply |
| Short Circuit Protection | Electronic circuit protection, fuse, circuit breaker, or other means |

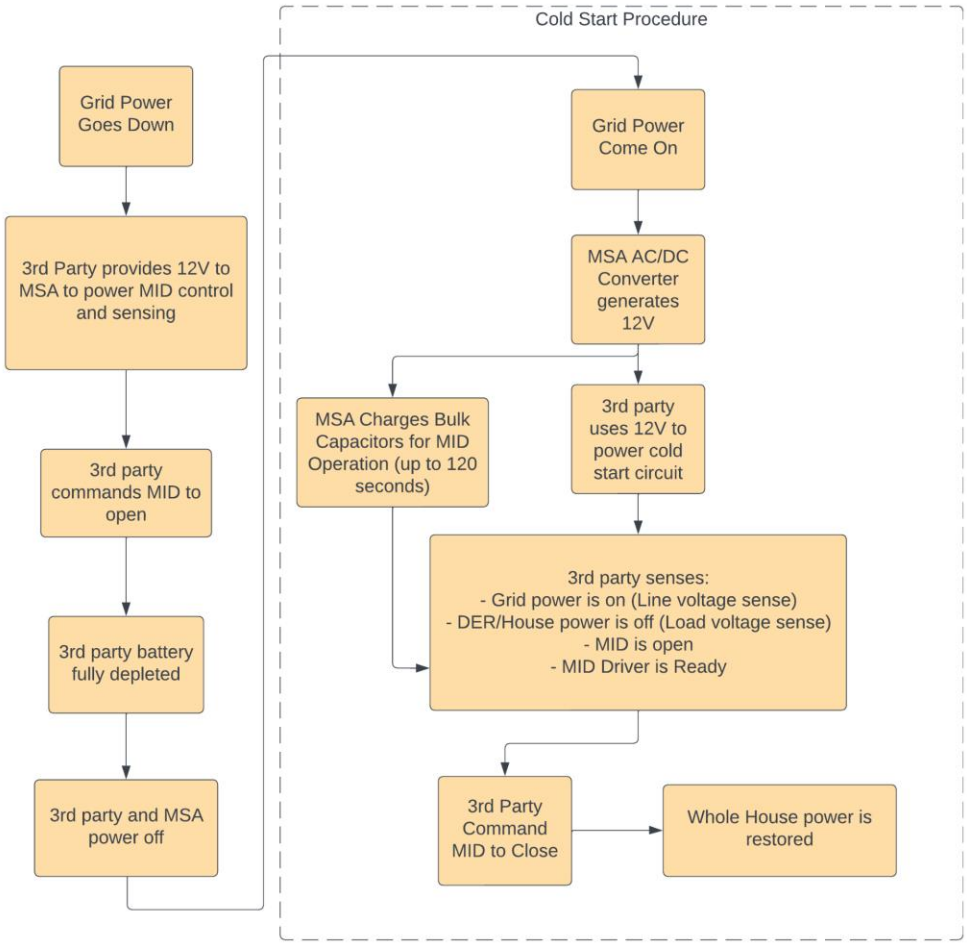
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# Cold/Black Start Procedure

When the grid is down and the DER system is fully depleted and unable to supply 12V power to the MSA, the whole system becomes powered off. When the grid power returns, the MSA is able to power back on due to its built-in grid-side AC/DC converter. The grid-side supply provides up to 5W to the 3rd party DER control equipment to perform the cold start operation. Based on the following conditions, the 3rd party DER control equipment should:

- Sense that the grid is back (via line side voltage sensing)
- Sense that the house side is off (via internal sensing of the DER source or load side voltage sensing)
- Sense that the MID relay is open (via MID sense)
- Sense that the MID driver is ready (Via MID_Relay_Ready signal)
- Command the MID to close.

## Cold Start Flow Chart



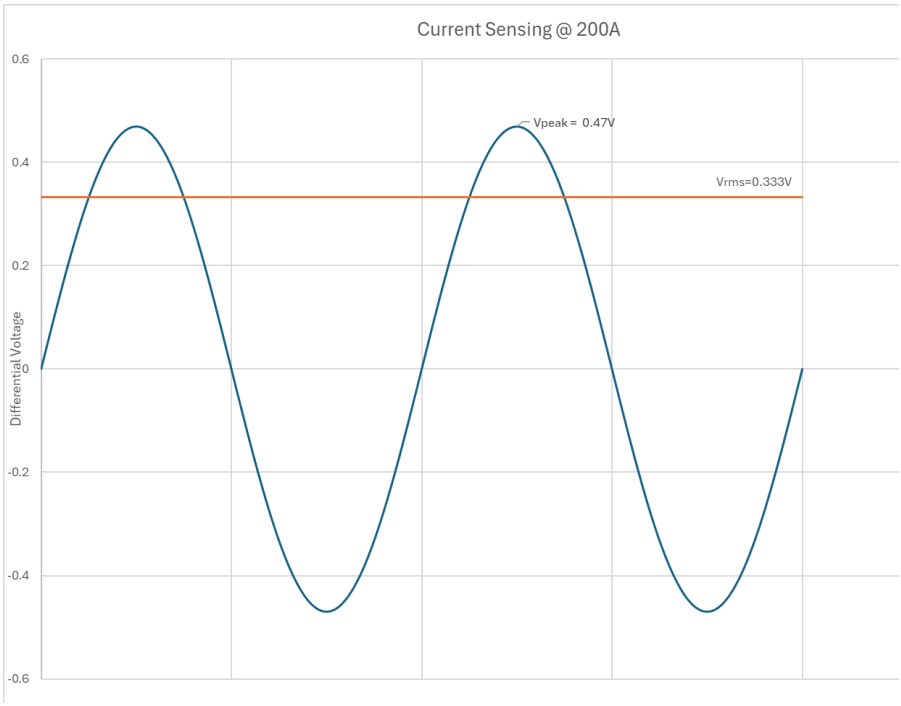

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## Current Sensing

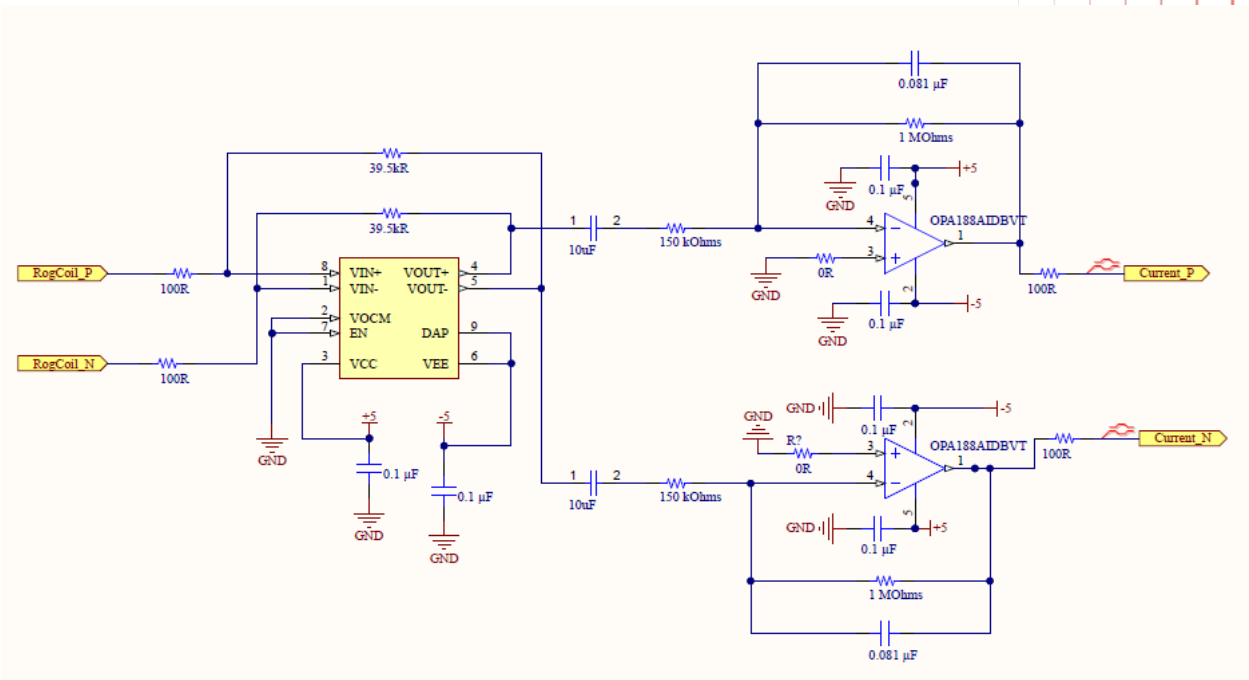
The IslandDER MSA provides current sensing on both line (grid) and load (house) side of the MID relay.

- Current sensing values are scaled to +/-0.333V RMS signals @ 200A, similar to commercially available CTs, with full-scale at 120% of rated current to provide measurements in overcurrent conditions, e.g. up to 240A vs. 200A.




- Any unused signals on the incoming cable can be terminated with a large resistance (>1k Ohm) or left floating, but must NOT be tied to ground.
- All signals are expected to achieve +/- 1% amplitude and phase accuracy.
- The output stage of the Current Sensing circuit is configured as an integrating amplifier circuit to ensure phase alignment with other sense signals.

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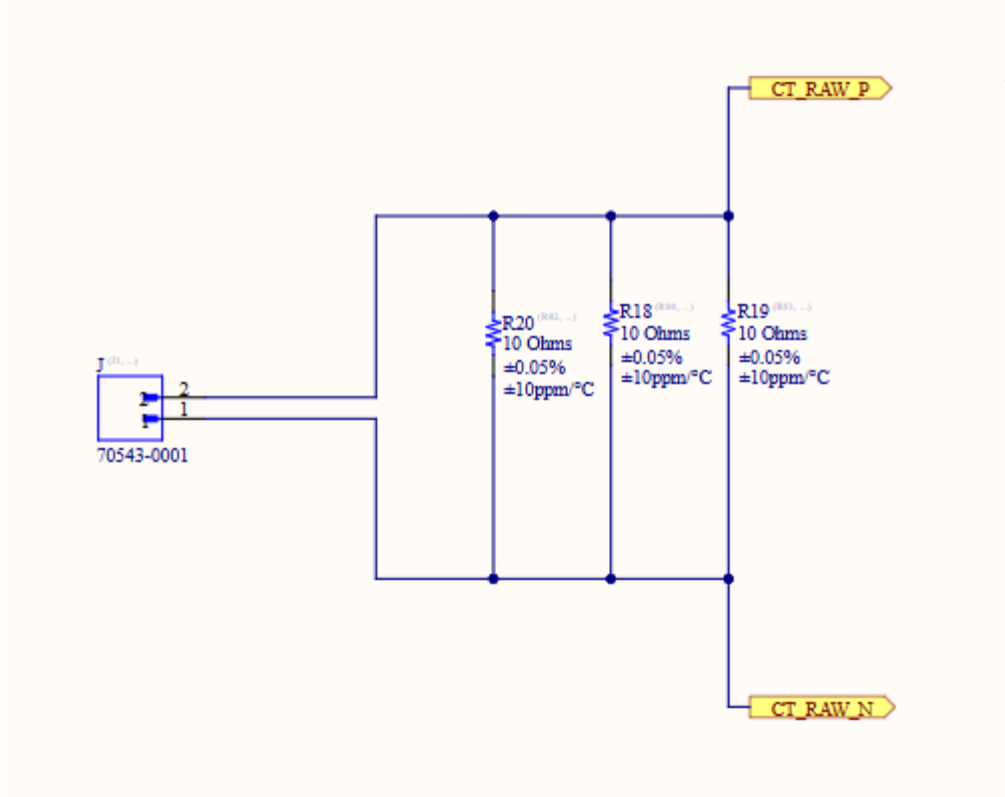

## Revenue Grade Current Sensing

In addition to the base current sensing described above, a revenue-grade capable current transformer (CT) is provided on the line side of the MSA. The CT is an ANSI Class 0.2 (or better) accuracy sensor. The signal from each sensor is provided directly to the 3rd party DER equipment, with only the burden resistor added to the MSA.

## CT Specification

| | |
|---|---|
| Input Current | 2 ~ 200A AC |
| Turn Ratio | 1:2000 |
| Burden | 3.33 Ohms (+/- 0.05%) |
| Max Load | 12.5 Ohms |
| Operating Frequency | 50Hz/60Hz |
| Accuracy | < 0.2% (Including burden) |
| Phase Displacement | 0 ~ 15’ |
| Saturation Current | ~320A typ. |

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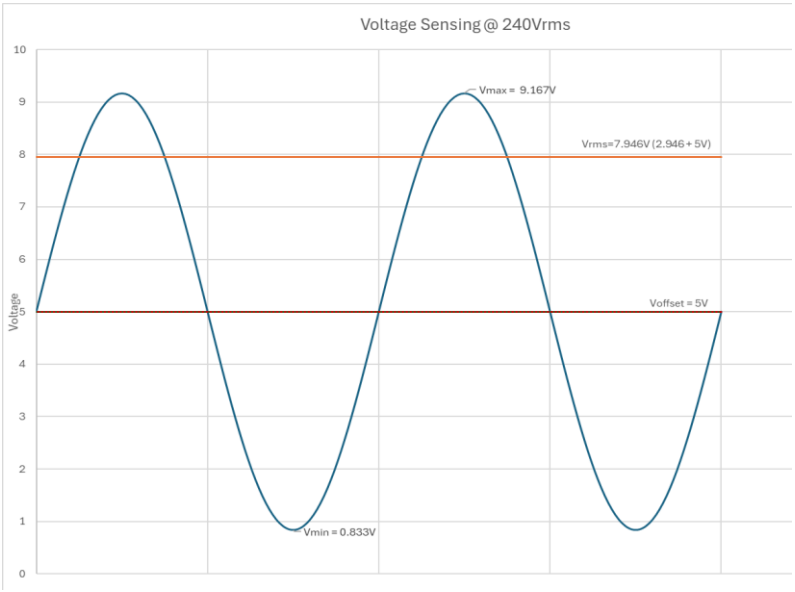



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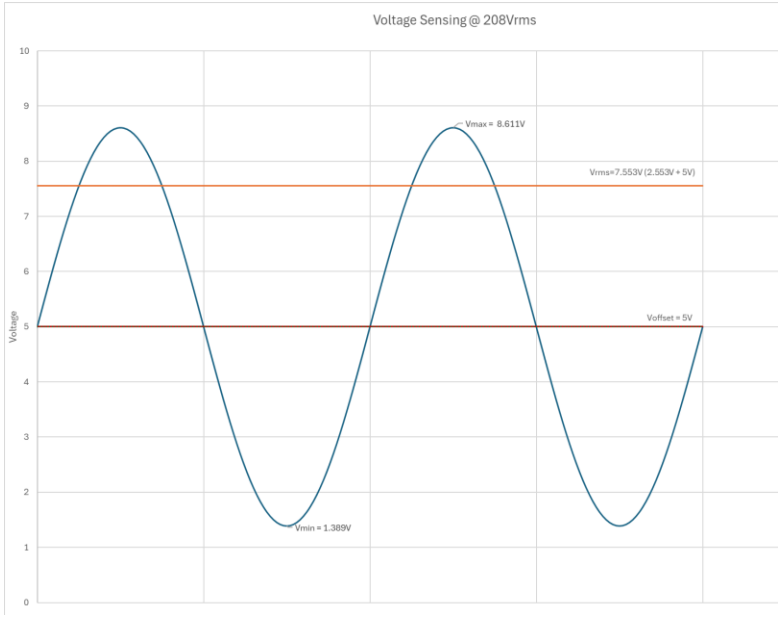
## Voltage Sensing

The IslandDER MSA provides current sensing on both line (grid) and load (house) side of the MID relay.

- Voltage sensing is line-to-line, i.e. 240V/208V, scaled to a 0 to 10V range with a 5V bias. Full-scale is set at 120% of rated voltage (288V) to provide measurements in overvoltage conditions.



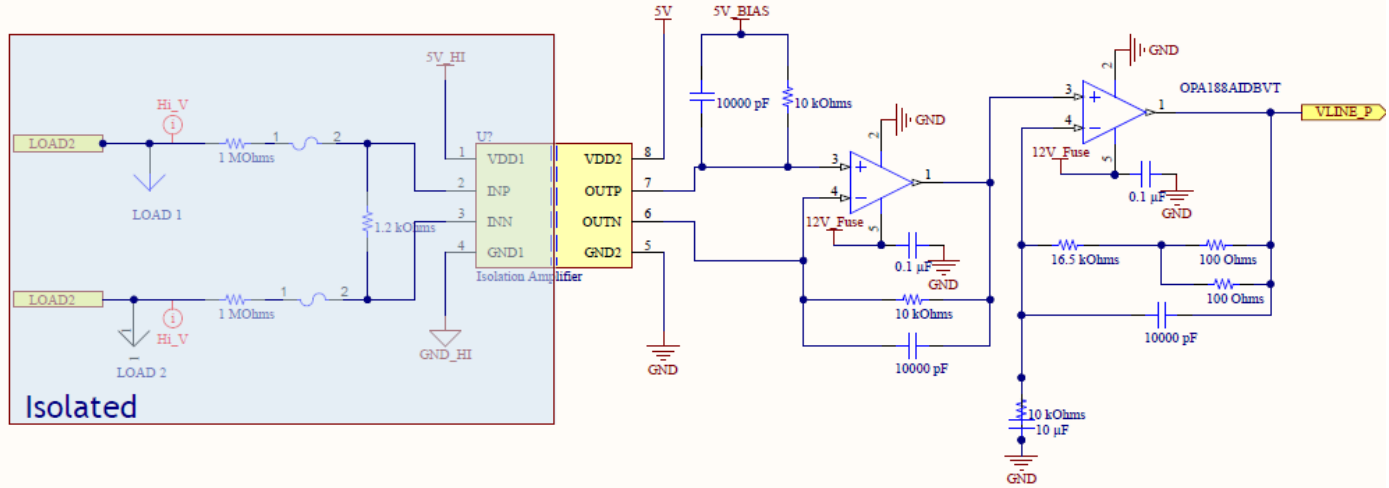

Voltage Sensing at 240Vrms (above) and 208Vrms (below)




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The voltage sense signal is paired with a dedicated ground wire to ensure a tightly coupled ground reference as the signal traverses the outgoing cable. This ground should be terminated nearby where the voltage sense signal is terminated on the PCB, whereupon it should connect to the analog measurement ground of the PCB. Upon termination, no special protocols are required for this ground beyond the normal considerations for separating digital noise and ground loops.

- Any unused signals on the incoming cable can be terminated with a large resistance (>1k Ohm) or left floating, but must NOT be tied to ground.
- Voltage sensing signals are expected to achieve +/- 0.4% accuracy at ambient, and +/- 1% amplitude and phase accuracy over the temperature range.
- The output stage of the Voltage Sense circuit provides filtering for frequencies above ~840 Hz.




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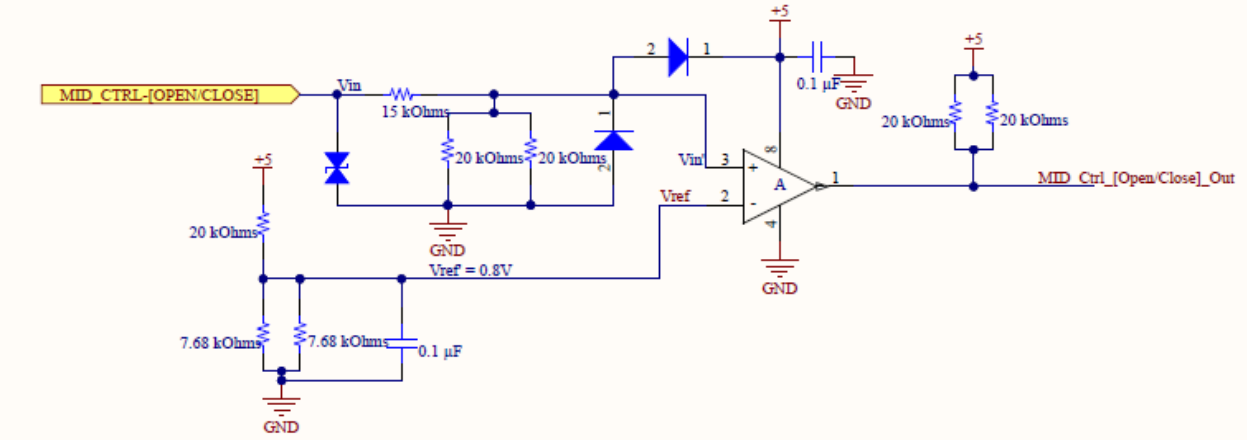
# MID Relay

## Relay Specifications

| | |
|---|---|
| Type | Dual Pole Single Throw Latching Relay |
| Rated Current | 200A @ 240V |
| Max. switching voltage | 276 Vac |
| Max. carrying current | 200 A |
| Max. switching current | 200 A |
| Electrical Endurance @ 200A | 10,000 Cycles |
| Mechanical Endurance (No load) | 100,000 Cycles |
| Switching Time (Open/Close) | < 15ms |
| Minimum time between actuations | 31ms |
| Consecutive Actuations | At least 2 open/close cycles at minimum time.<br><br>*Additional actuations are possible based on temperature and age of the MSA. Refer to MID_Relay_Ready for additional details.* |
| Bulk storage Initial charge time (from cold start) | <120 sec to MID_RELAY_READY high<br><15 minutes to full charge |
| Bulk storage recharge time (after 1 actuation) | ~60ms typ. |
| Bulk storage discharge time (from full charged state) | 25 mins to MID_RELAY_READY low<br>4 hrs to fully discharged. |

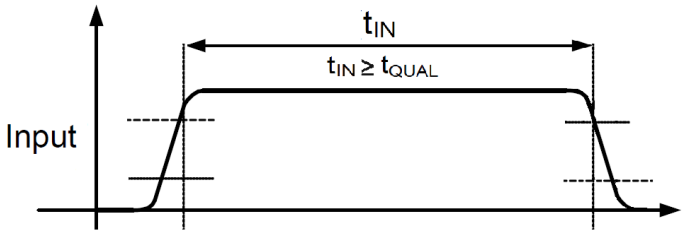
## Relay Control

The MID relay is controlled via MID_Ctrl_Open and MID_Ctrl_Close inputs.




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To operate the relay driver, one must send a pulse signal (LOW to HIGH to LOW) with minimum duration of $t_{IN} \geq 1$ ms either to: MID_Ctrl_Close to close/connect the MID relay, OR to MID_Ctrl_Open, to open/disconnect. For the input to be considered valid, it must be longer or equal to the qualification time ($t_{QUAL}$= 1 ms). Pulse signals with $t_{IN}$ shorter than $t_{QUAL}$, or sending a pulse signal on both MID_Close and MID_Open (simultaneous or staggered), will result in the pulse signal not being qualified. Once a pulse signal is qualified, the corresponding relay operation (Open/Close) is performed for a duration of $t_{out}$ = 30 ms. During this time, any pulse signal to MID_Ctrl_Close or MID_Ctrl_Open is ignored.



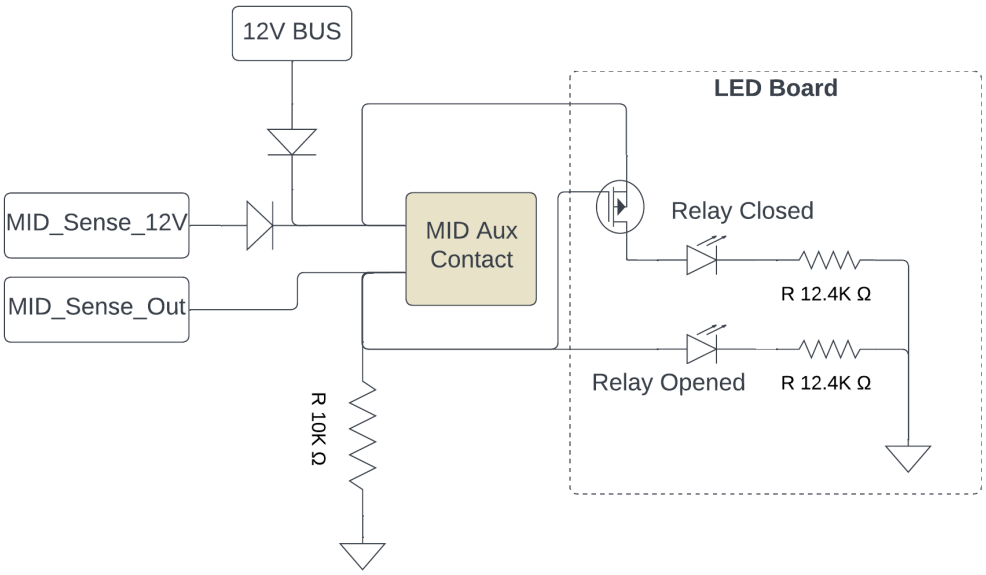

Additional notes:

- The $t_{QUAL}$ delay is implemented to prevent inadvertent pulses, for example from electromagnetic interference, from causing the MID relay to change state.
- The relay actuation time is $t_{QUAL}$ + mechanical actuation time $\leq$ 15ms.
- The $t_{out}$ duration ensures that the relay coil is energized for a predictable period, regardless of the input (long or short).
- Invalid inputs that do not meet the qualification requirements, including unintentional interference/EMI, will result in the input being ignored. For example, if MID_Ctrl_Open is asserted while MID_Ctrl_Close qualification is in progress, both will be ignored.
- Once a signal has been qualified, the relay operation will proceed regardless of any subsequent changes to the input signal. For example, asserting MID_Ctrl_Open immediately after MID_Ctrl_Close has been qualified will still result in the relay performing a “Close” operation.
- Note that the relay operation (open or close) is performed in full regardless of the actual state of the relay (as indicated by “MID_Sense_Out”). For example, if the relay is in the “closed” state, and a MID_Ctrl_Close signal is qualified, the IslandDER MSA will “close” the relay again for $t_{out}$ duration.

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## Relay Sensing

The state of the relay can be sensed via 2 pins described below.




- MID_Sense_Out provides a 12V nominal signal indicating the state of the relay via an internal 10kOhm pulldown. This signal is not debounced and will reflect the state of the auxiliary contact on the relay. Typical bounce times observed are generally under 750us.

| State | Level |
|---|---|
| Opened/Disconnected | 11.3V typ. |
| Closed/Connected | 0V |

Notes:

  - The Auxiliary contacts are the opposite of the main relay contact, i.e. when the relay is open, the auxiliary contacts are closed, and vice-versa.
  - Due to the forward voltage of the blocking diode, the measured voltage in the Opened/Disconnected state is typically 11.3V rather than 12V.
  - The MID_Sense_Out signal is also used for the LED indicators. The 10kOhms pulldown is therefore in parallel with the 12.4kOhms resistor for the LED.

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An unlikely fault exists where the MID_SENSE_OUT could short to MID_SENSE_12V. In this condition, the MID_SENSE_OUT would always show the relay as “Opened,” even if it is closed. This condition can be detected by measuring the voltage of the MID_SENSE_OUT. Under normal conditions, the “high” level should be less than the MID_SENSE_12V level as a result of a diode forward voltage, typically 0.7V, resulting in a typical 11.3V voltage level. When the MID_SENSE_12V is shorted to MID_SENSE_OUT, the diode is bypassed and the MID_SENSE_OUT would be equal to MID_SENSE_12V, which would indicate a fault.

- MID_Sense_12V is an optional signal used to provide power to the relay sense circuit. This allows the relay sensing to be powered and sensed independent of the 12V Bus power. Because this signal will power the visual indicators on the MSA, it must be able to provide a minimum of 15mA.
    - If independent power for the relay sense is not required, this signal can be connected to 12V_BUS (preferred) or left unconnected.



To protect against an unlikely fault where the MID_SENSE_12V could short to the MID_CTRL_CLOSE signal, thereby unintentionally closing the MID, it is recommended to include a series resistor on the MID_SENSE_12V to prevent overdriving the MID Control signal.

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# E-Stop Loop

*Implementation of this feature is strongly recommended to ensure safe operation of the Manual Disconnect/Reconnect Switch.*

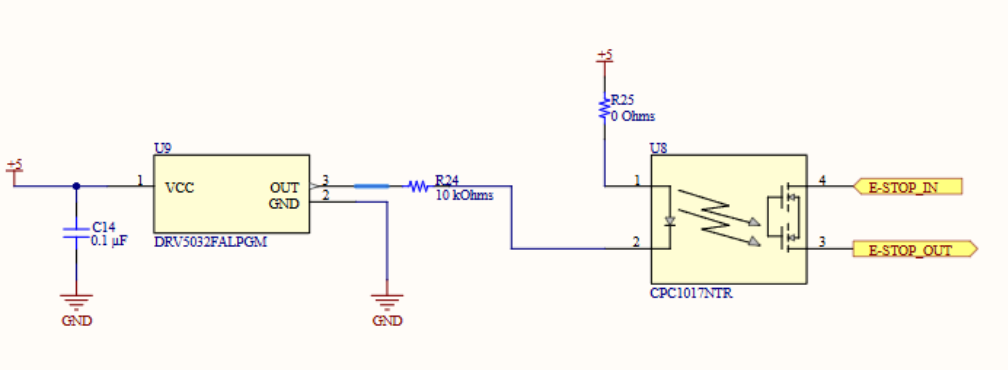
The IslandDER MSA includes a Manual (mechanical) MID Disconnect/Reconnect under a tool-access cover. To prevent manual reconnecting to the grid in a hazardous condition, the tool access cover is interlocked. Opening the cover must cause the alternate energy source (DER) to de-energize. This can be achieved in 2 ways:

- Add IslandDER MSA to existing Emergency Stop (E-Stop)/Rapid Shutdown loop. Note: Not suitable for AC E-Stop Loops
- Provide sense voltage to E-STOP_IN (any suitable voltage, up to 36V) and pulldown on E-STOP_OUT. De-energize Alternate Energy Source (DER) when E-STOP_OUT is low.

The E-Stop Loop is not intended to be used as a means of rapid shutdown, or as the primary disconnect for the alternate energy source. Its purpose is to act as an additional layer of protection for the Manual Disconnect/Reconnect Switch. All alternative energy sources must be de-energized prior to using the Manual Switch.

## Physical Implementation

The E-Stop signal is implemented using an optocoupled Solid State Relay (SSR), controlled by an omnipolar Hall Effect sensor. A magnet in the cover activates the Hall Effect sensor. When the cover is removed, the SSR is opened.







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SSR Specification

| | |
|---|---|
| Blocking Voltage | 60V |
| Max Load Current | 100mA Continuous<br>350mA Peak (10ms) |
| On-resistance | 16 Ohms |
| Off state leakage current @ 60V | 1uA |
| Output Capacitance | 5pF |
| Switching Speed | 10ms |

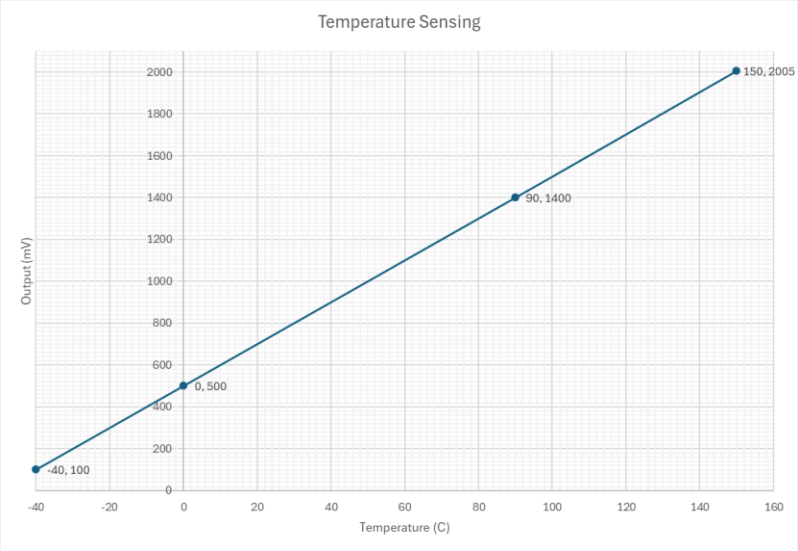
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# Temperature

*Implementation of this behavior is strongly recommended as this is an area of concern for utilities.*

Internal MSA temperature is provided as an analog signal representing a temperature between -50C and 150C.

- Vout = Temperature * 10mV + 500mV
- Accuracy +/- 2.5C over the range,
- Reading of values below 100mV and above 2V are invalid and should be treated as a fault




The temperature sensor must be monitored by the 3rd party DER control equipment to ensure the MSA temperature does not exceed a temperature of 90C. When the measured temperature exceeds the threshold, the MID relay should be opened to prevent further heat rise. This condition would not be expected to occur under normal operating conditions at the rated current of 200A.

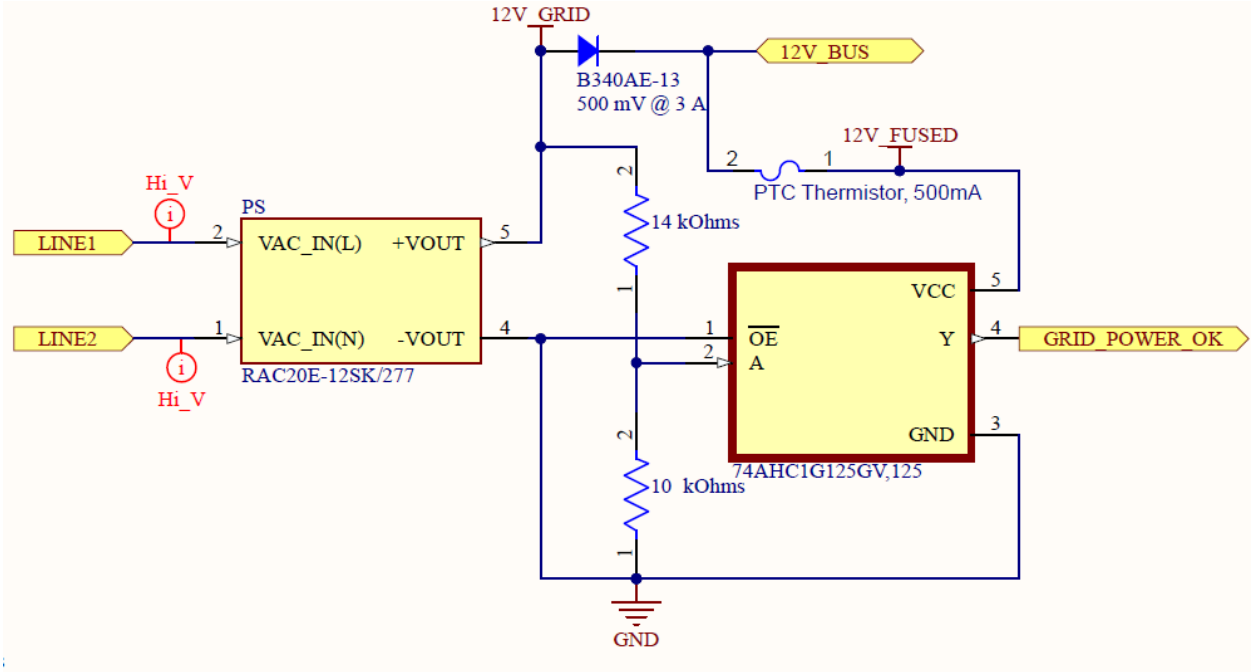
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## Status Signals

The IslandDER MSA provides 3 status signals to the 3rd party DER control equipment to assist in diagnostics and proper operation of the MSA. Each status bit is represented by a 5V digital signal, where the Low state indicates a fault/not ready condition.

- Grid_Power_OK: This signal indicates that the grid-side power supply is on and generating power. This signal is expected to be low if the grid is down. If the grid is up (e.g. voltage is present on the line voltage sense) but this signal is LOW, this would be an indication that the MSA needs to be replaced, as the grid-side power supply is faulty.

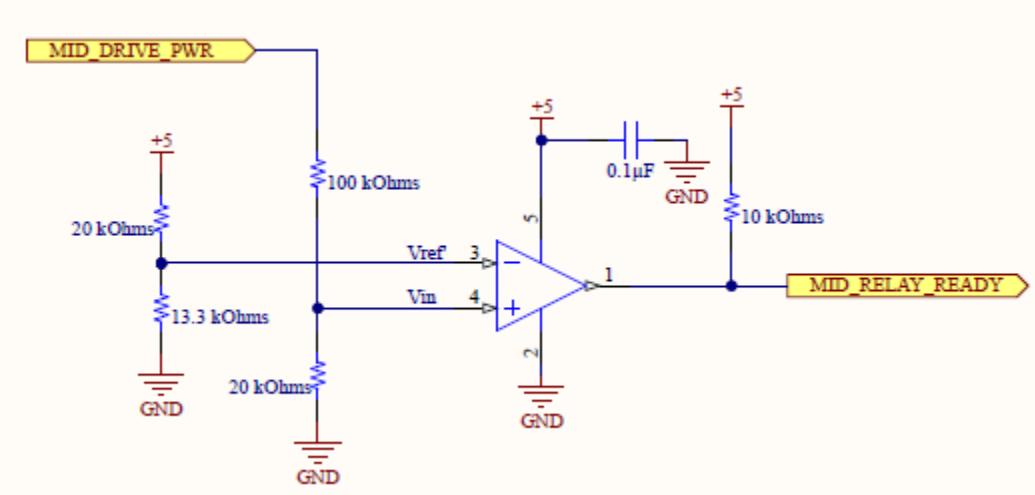
  *Note: This signal is not recommended to detect grid down conditions by the control* system. *Power supply hold up time will delay this signal after grid events. Use the analog voltage signals to detect grid conditions*




- MID_Relay_Ready: This signal indicates that the MID relay driver circuit is ready to operate the MID. In practical terms, the bulk storage for the MID is sufficiently charged to perform an Open or Close operation. This signal is expected to be low at initial startup, such as when the MSA is first powered, or after an extended outage of both Grid and DER power. The signal may also be low for a short duration after several actuations of the MID in close succession, but under normal operation should remain high after a single actuation. Monitoring of this signal immediately following the relay

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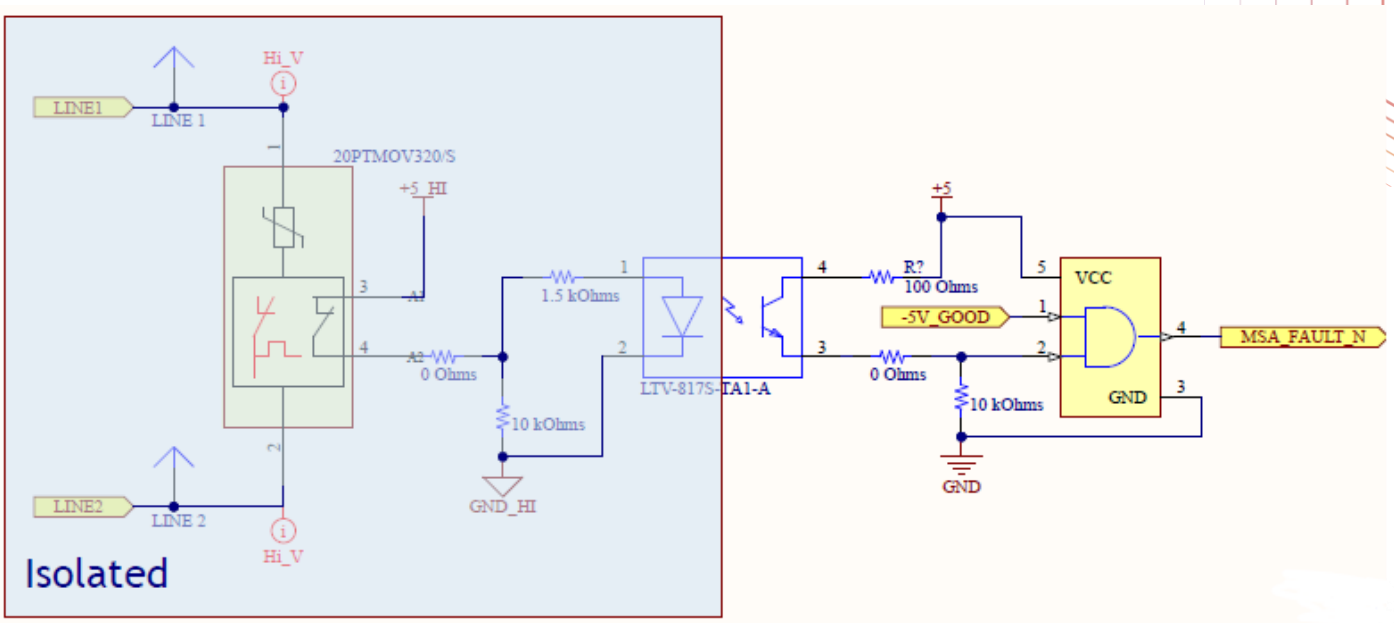
actuation can indicate the bulk storage has degraded to the point where it can affect performance. This signal becomes permanently low in case of failure of the MID Drive voltage supply.




- MSA_Fault_N: This signal indicates that one of the following conditions has occurred and the MSA should be replaced:
    - The Surge Protection Device (SPD) has been tripped. The MSA should be replaced once it has been exposed to a surge as the protection is no longer available. If MSA_Fault_N is low and all other signals (voltage, current, temperature sense, etc.) all appear functional, then the fault is likely an SPD fault.
    - The 5V rail is no longer providing power. Loss of the 5V rail would result in E-Stop going open, Mid_Relay_Ready going Low, and voltage sensing going to 5V (i.e. bias stays on), and current sensing not matching CT current.
    - The isolated 5V rail is no longer providing power. Loss of the isolated 5V would affect the voltage sensing only, and result in voltage sensing going to 5V (i.e. bias stays on) on both Line and Load side. Current, temperature and other sensing would remain present.
    - The -5V rail is no longer providing power. Loss of the -5V rail would affect the Current sensing only. The current sensing would no longer match the CT current.

Note that MSA_Fault_N would be LOW if the 12V_BUS is not powered. Loss of 12V rail would be reflected as all signals at 0V.

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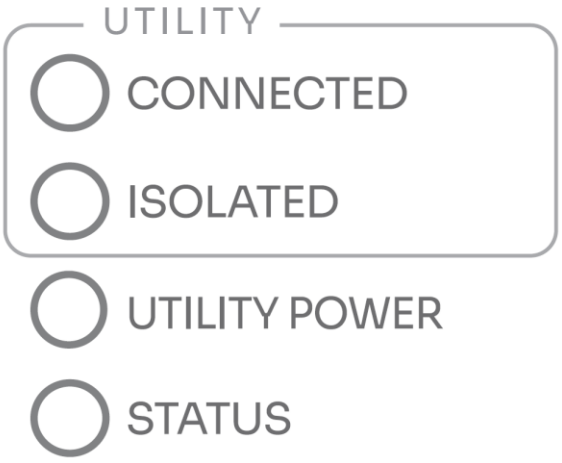


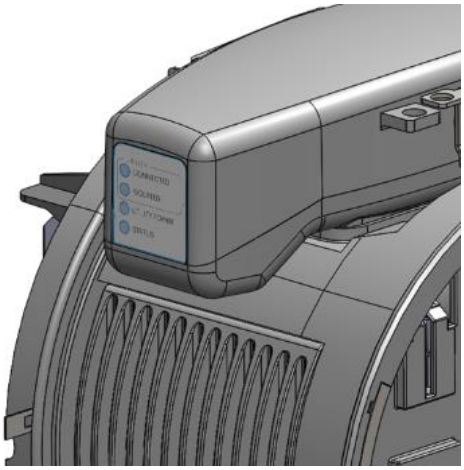
| | | |
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## Visual Indicators (LEDs)

The IslandDER MSA includes 4 visual indicators that are positioned vertically on one end of the Connection Module. The 4 indicators are:

- Utility Connected: Indicates that the Relay is Closed (Solid White)
- Utility Isolated: Indicates that the Relay is Open (Solid Blue)
- Utility Power: Indicates that Grid Power is Present (Solid White)
- Status (In order of precedence):
    - Indicates that there is a fault in the MSA, such as SPD, 5V or -5V rail (Solid Red)
    - Indicates that E-Stop loop is open, including if the tool-access cover is removed (Blinking Red)
    - Indicates that MID_Relay_Ready is Low, i.e. the MID Relay is not ready to operate (Blinking Green)
    - Indicates that there are no faults on the MSA (Solid Green)



### Physical Implementation

The LED board is connected in parallel with the signal cable. The LEDs are derived from the following signals described in this specification. The signals are connected as indicated below.

- MID_Sense_12V: Used to power the Isolated LEDs only. Current draw of 1 mA for the LED is included in the specification for this signal.
- MID_Sense_Out: Directly connected to Closed LED. Current draw of 1mA.

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- E-Stop_Out: Connected to n-channel and p-channel MOSFET Gate for level translation. Gate current of less than 1uA.
- Grid_Power_OK: Directly connected to Utility Power LED. 1mA current draw.
- MID_Relay_Ready: Connected to n-channel MOSFET Gate for level translation. Gate current of less than 1uA.
- MSA_Fault_N: Connected to n-channel MOSFET Gate for level translation. Gate current of less than 1uA.
- 12V_BUS: Connected to 12V_Bus via isolation diode and PTC fuse. Overall less than 10mA total current.
- AGND: Common Ground.

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ConnectDER

## Cable Specification

The IslandDER cable is a multi-conductor, outdoor-rated cable that will come pre-terminated to a circular, 32 position plug.

| Key Specifications | Value |
|---|---|
| Construction | 15 twisted pairs, 24 AWG tinned copper, 300V insulation |
| Twists | Pair: 9.6 twists/ft(min)<br>Cable: 2.4 Twist/ft (min) |
| Shield | Alum/Mylar tape |
| Shield Drain | 24 AWG tinned copper |
| End Connector | Amphenol-Sine Ecomate® Aquarius, Circular Plug, 32 positions.<br>Plug MPN: RTS6BS18N32S03<br>Contacts MPN: SS24W2F |
| Outer Diameter | 0.405” (0.428” Max.) |
| Bend Radius | 10x Diameter |
| Lengths | Options: 3’, 4’, 5’, 6ft (subject to market feedback)<br>Special order options: 10’, 25’ (cost adder) |
| Temperature | -30C to 105C |
| Environmental Ratings | Sun (UV) Resistant |

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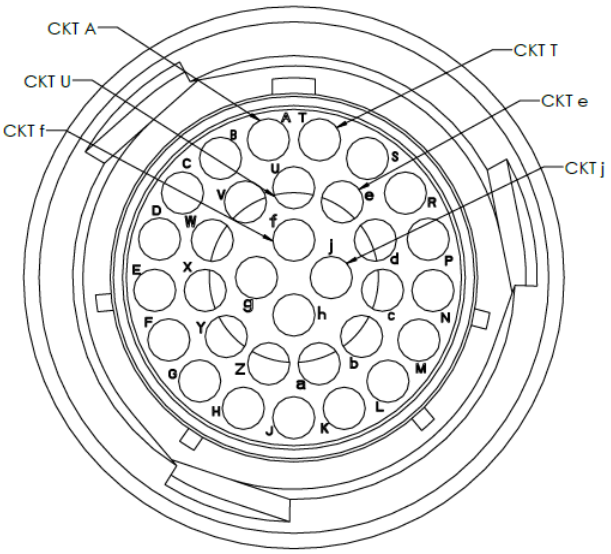
## Pin/Signal Mapping

The signals are assigned to pins as follows (Cable end):

*Note: Reference # refers to the List of Signals in the previous section of this document*

| Reference # | Signal Name | End Connector Position |
|---|---|---|
| 1 | 12V_BUS | g |
| 2 | AGND | h |
| 3 | Line_Current_L1_P | A |
| 4 | Line_Current_L1_N | B |
| 5 | Line_Current_L2_P | C |
| 6 | Line_Current_L2_N | D |
| 7 | Line_RGM_CT_L1_P | E |
| 8 | Line_RGM_CT_L1_N | F |
| 9 | Line_RGM_CT_L2_P | G |
| 10 | Line_RGM_CT_L2_N | H |
| 11 | Line_Voltage_L1_L2 | J |
| 12 | AGND | K |
| 13 | Load_Current_L1_P | L |
| 14 | Load_Current_L1_N | M |
| 15 | Load_Current_L2_P | N |
| 16 | Load_Current_L2_N | P |
| 17 | Load_Voltage_L1_L2 | R |
| 18 | AGND | S |
| 19 | MID_Ctrl_Open | U |
| 20 | MID_Ctrl_Close | V |
| 21 | MID_Sense_12V | W |
| 22 | MID_Sense_Out | X |
| 23 | E-Stop_In | Y |
| 24 | E-Stop_Out | Z |
| 25 | Temp_Sense | c |
| 26 | Grid_Power_OK | d |
| 27 | MID_Relay_Ready | e |
| 28 | MSA_Fault_N | f |
| 29, 30 | Reserved | a,b |
| 31 | Shield Drain | T |

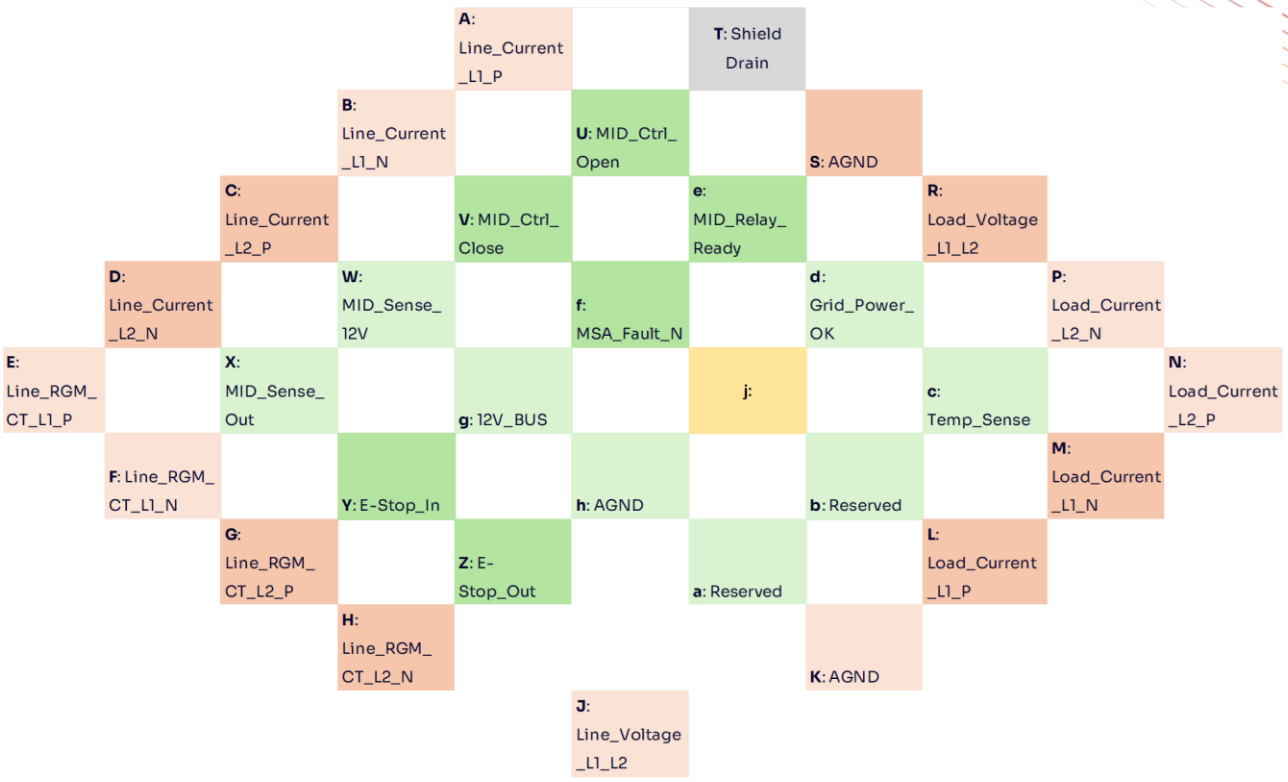



*Note: Shield Drain must be tied to Earth Ground (or corresponding) at the partner end.*

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The picture below provides a visual representation of the location of each pair within the connector (colors are for differentiation only)




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## Mating Connector

The IslandDER cable mates with the following connector available in 2 variants:

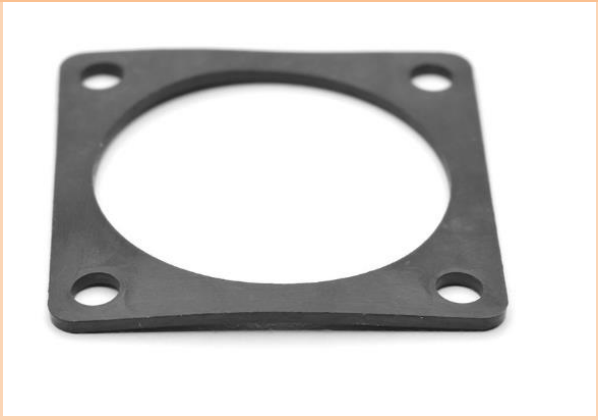
| Amphenol-Sine Ecomate® Aquarius, Circular Receptacle, Square Flange, 32 Positions | Amphenol-Sine Ecomate® Aquarius, Circular Receptacle, Jam Nut, 32 Positions |
|---|---|
|  |  |
| MPN : RTS018N32P03 | MPN : RTS718N32P03 |

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Either option must be used with the following mating contacts for the IslandDER cable.

| Amphenol-Sine Ecomate® Aquarius, Circular Pin Contact, Stamped, Size 20, Gold 5µ", 26-24 AWG |
| --- |
|  |
| MPN : SP24W2F |

The following accessories are recommended:

| Amphenol-Sine Ecomate® Aquarius, Square Flange Receptacle Gasket | Amphenol-Sine Ecomate® Aquarius, Circular Receptacle Dust Cap |
| --- | --- |
|  |  |
| MPN : RTFD18B | MPN : RTS018DCG |

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Product Specs, Drawing, and Models:

- Square Flange Receptacle: https://www.amphenol-sine.com/RTS018N32P03-Receptacle-square-flange-32-positions-size-18-pin-contact-silicone-rubber-seal-Comparable-to-PN-UTS01832P_p_8178.html
- Jam Nut Receptacle: https://www.amphenol-sine.com/RTS718N32P03-Receptacle-jam-nut-32-positions-size-18-pin-contact-silicone-rubber-seal-Comparable-to-PN-UTS71832P_p_8176.html
- Pin Contact: https://www.amphenol-sine.com/SP24W2F-Pin-Contact-Stamped-Size-20-Gold-5181-Wire-Range-14-25mm178-26-24-AWG-with-3-Tangs_p_8554.html
- Dust Cap: https://www.amphenol-sine.com/RTS018DCG-Dust-cap-for-Receptacle-Size-18-Comparable-to-PN-UTS18DCG_p_8256.html
- Flange Gasket: https://www.amphenol-sine.com/RTFD18B-Shell-Size-18-Square-Flange-Receptacle-Gaskets-Thickness-08mm-%C2%B102-Compatible-to-part-UTFD16B_p_1384.html

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