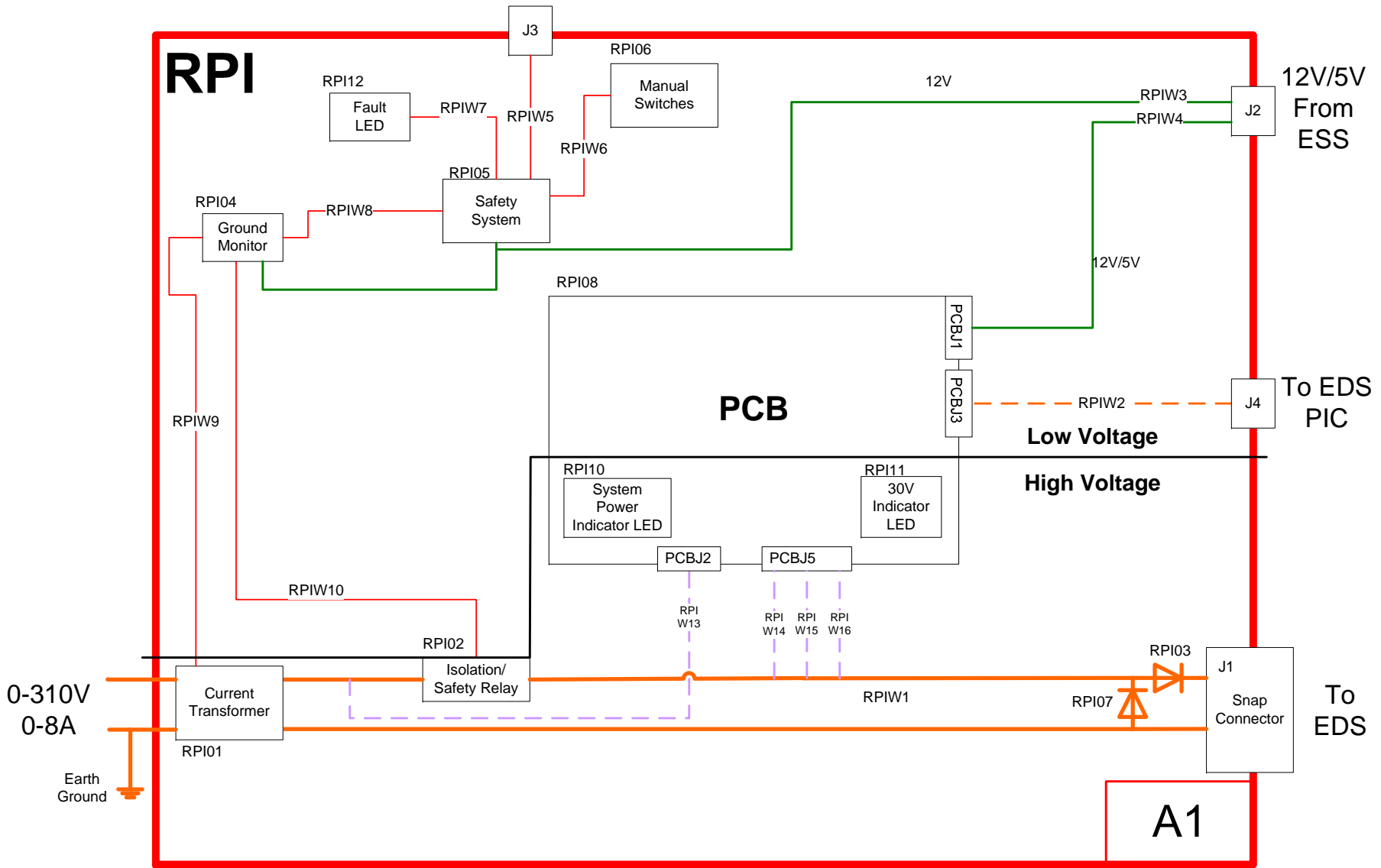


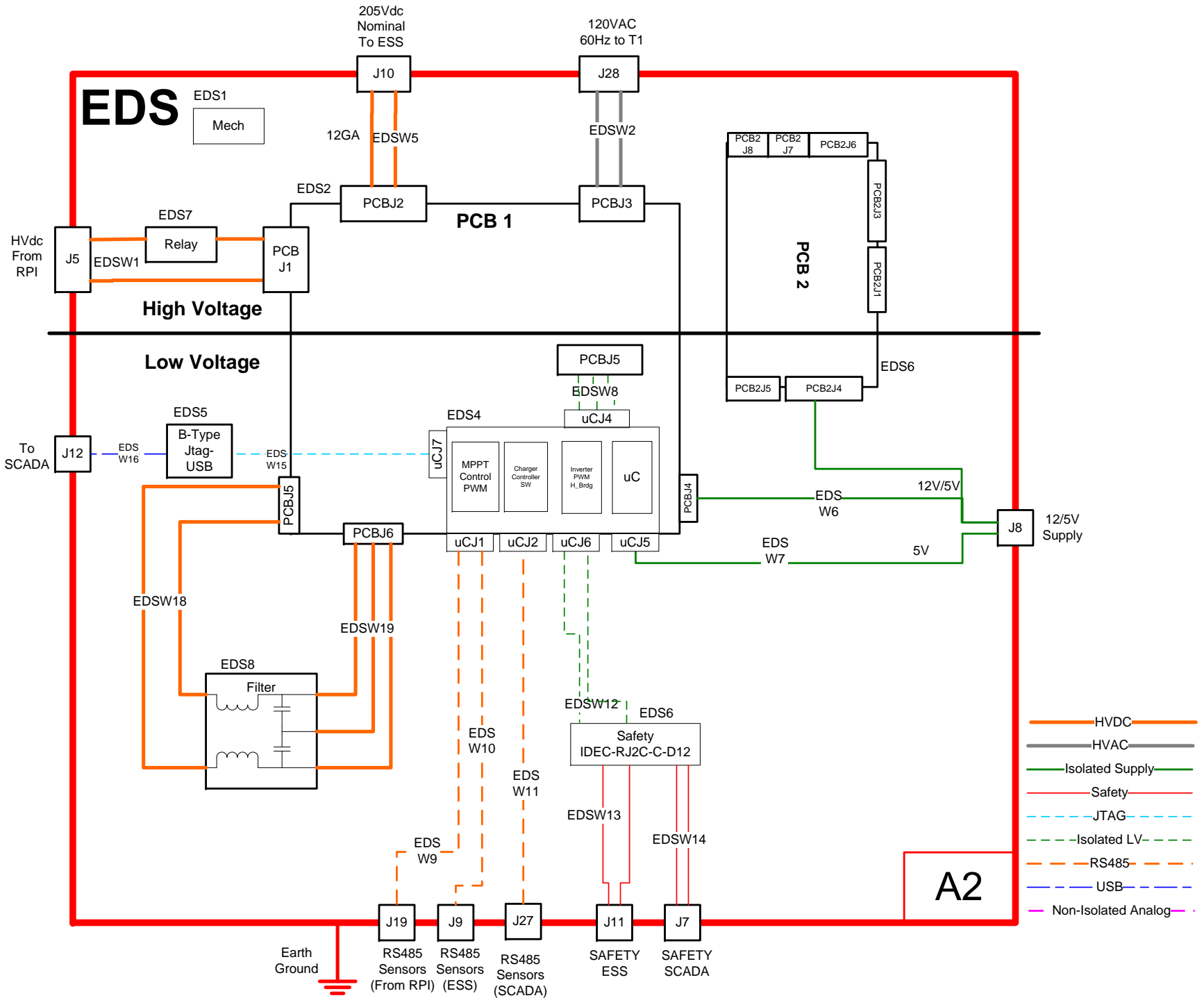
Safety from ESS



- HVDC
- Isolated Supply
- Non-Isolated Supply
- Safety
- - - Isolated LV
- - - Non-Isolated LV
- - - Non-Isolated Analog
- - - RS485



Earth Ground



EDS1
Mech

HVdc
From
RPI

205Vdc
Nominal
To ESS

120VAC
60Hz to T1

High Voltage

Low Voltage

PCB 1

PCB 2

A2

To
SCADA

EDS5
B-Type
Jtag-
USB

EDS4
MPPT
Control
PWM
Charger
Controller
SW
Inverter
PWM
H_Brdg
uC

EDS8
Filter

Safety
IDEC-RJ2C-C-D12

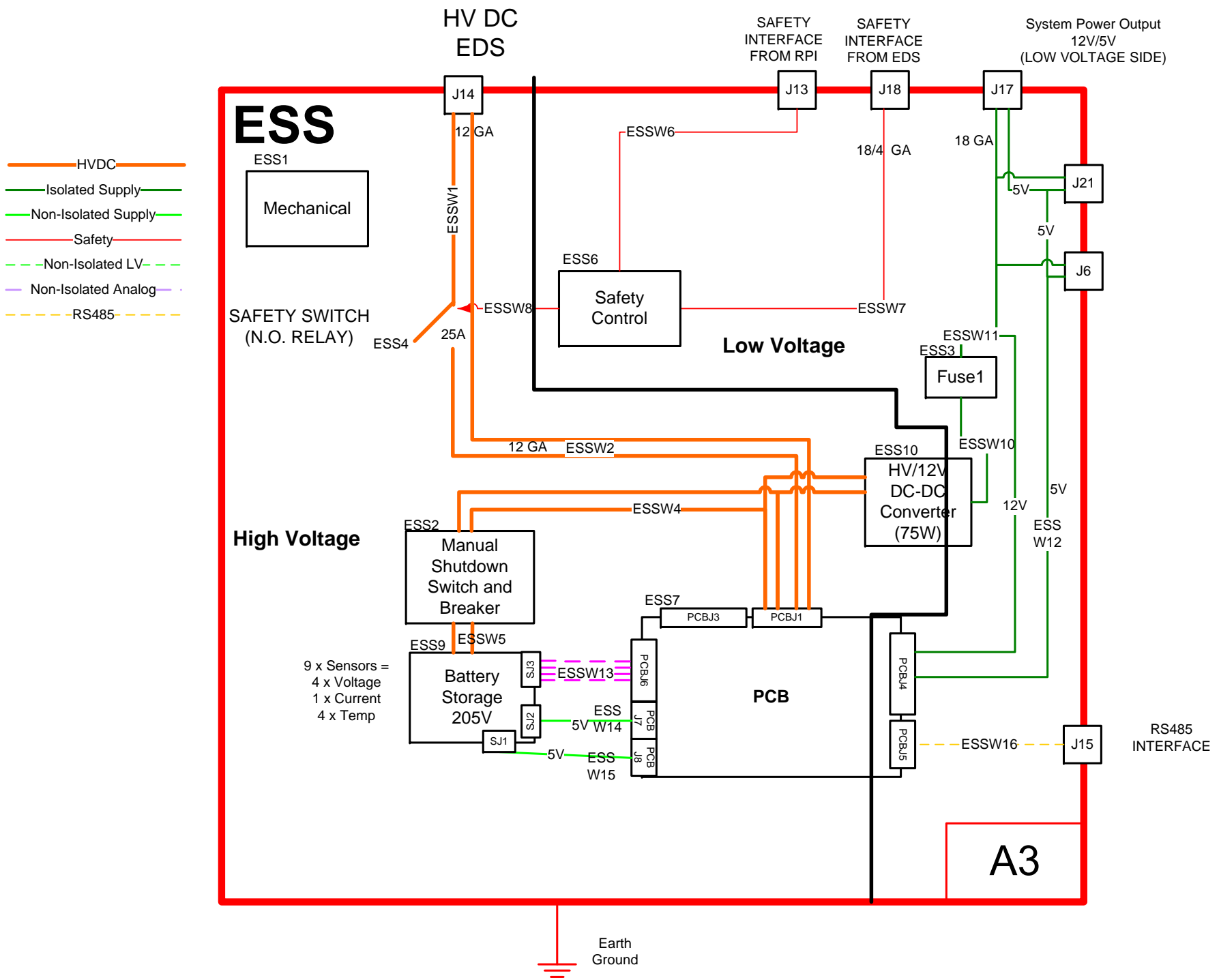
Earth
Ground

J19 RS485
Sensors
(From RPI)
J9 RS485
Sensors
(ESS)
J27 RS485
Sensors
(SCADA)

J11 SAFETY
ESS
J7 SAFETY
SCADA

J8 12/5V
Supply

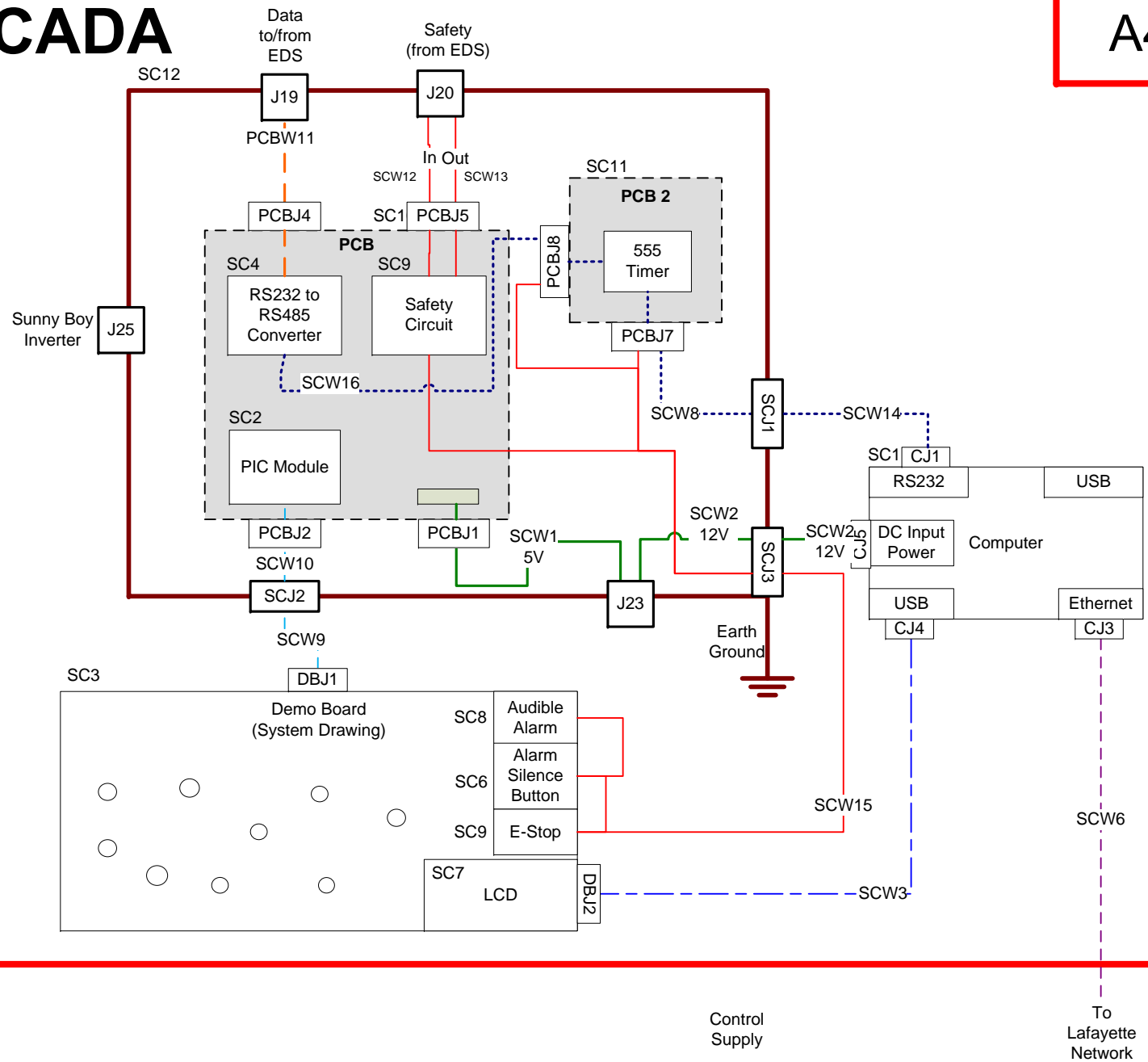
EDS



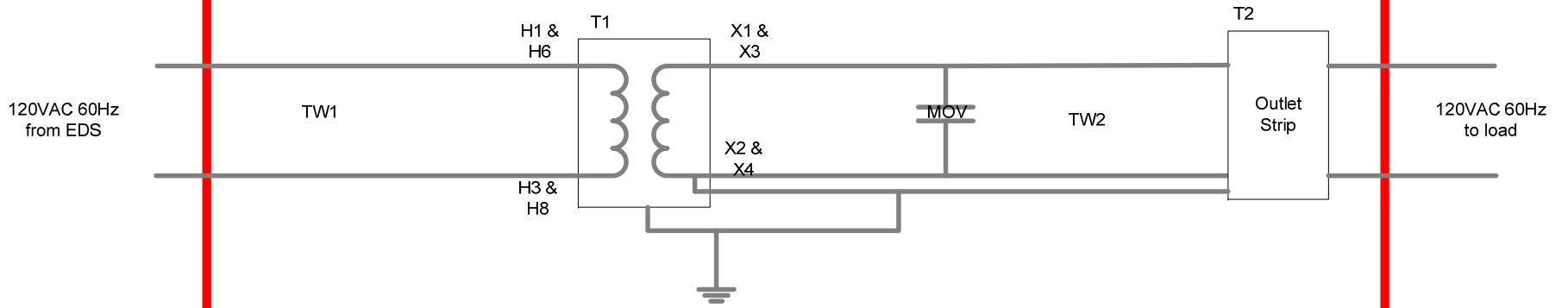
SCADA

A4

- Isolated Supply
- Safety
- Isolated LV
- Ethernet
- RS485
- Ribbon Cable
- USB
- RS232

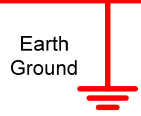


T1



HVAC

A5



T2.2: Interface Control Document
Steve Lockett and Alyssa Batula
May 13, 2009

The Interface Control Document and drawing A0 (ICD) illustrate the connections between the PV Transfer Switch, the 120 VAC output and each subgroup of the LPRDS-ETS-2009. This document controls the connections, cabling and their associated parts for the whole system. The overall system has been divided into four major groups: The Raw Power Input group (RPI drawing A1), the Energy Delivery System group (EDS drawing A2), the Energy Storage System (ESS drawing A3) and the Supervisory Control And Data Acquisition group (SCADA drawing A4). The one minor group is the Transformer group (T1 drawing A5) which was created due to weight constraints (the transformer weighs approximately 65 lbs.). Cables that connect all five groups together (ICD Cables) have been placed into one group along with the Bills of Material (BOMs). The drawings can be found on the project website under the Documents/Development Documents/Overall System Design link (<http://ww2.lafayette.edu/~ece492-2009/Documents/DevelopmentDocs/FullSystemDiagram5-1.pdf>).

RPI Connections (A1)

In the RPI (Raw Power Input) enclosure, there are five different external voltage and signal cables connected. The PV (Photo Voltaic array) high voltage DC (direct current) is hard wired through conduit (single wires through a piece of conduit mounted to the RPI enclosure). The wiring of the PV high voltage DC to the inside (top section of the enclosure panel) of the RPI is as follows:

10 AWG Red wire - connects to - HV+ terminal
10 AWG Black wire - connects to - HV- terminal
8 AWG Green wire - connects to - Ground terminal

The J1 connector, for High Voltage DC distribution, is a four pin Anderson Power “Power Pak®” connector, located on the bottom of the enclosure, configured for three contacts and wired with a 14 AWG wires:

Pin 1 a 14 AWG Red wire - connects to – HV4 terminal
Pin 2 a 14 AWG Black wire - connects to - HV- terminal
Pin 3 a 14 AWG Green wire - connects to - GND terminal

The J2 connector, for system low voltage DC supply from ESS, is a six pin Amp/Tyco “Mate-N-Lok” connector, located on the bottom of the enclosure and wired with a 18/6 cable (18 AWG wire, 6 conductor cable):

Pin 1 an 18 AWG Red wire - connects to - +12V terminal
Pin 2 an 18 AWG Black wire - connects to – 12VCOM terminal
Pin 3 an 18 AWG White wire - connects to – 5VCOM terminal
Pin 4 an 18 AWG Green wire - connects to - +5V terminal

Pin 5 an 18 AWG Orange wire - spare
Pin 6 an 18 AWG Blue wire - spare

The J3 connector, for the Safety system interface leaving RPI, is a four pin Amp/Tyco “Mate-N-Lok” connector, located on the bottom of the enclosure and wired with a 18/4 cable (18 AWG wire, 4 conductor cable):

Pin 1 an 18 AWG White wire - connects to – 1D terminal
Pin 2 an 18 AWG Green wire - connects to – 1E terminal
Pin 3 an 18 AWG Red wire - connects to – 1H terminal
Pin 4 an 18 AWG Black wire – not connected

The J4 connector, for the system RS485 communication, is an L-COM Cat 5E RJ45 coupler connector, located on the bottom of the enclosure. An inexpensive Cat 5E cable (4 twisted pair cable – 8 24 AWG conductors) connects to the inside of the coupler. The other end of the Cat 5E cable will be cut to length and stripped (no more than 1/2” on the end) to connect the following wires:

Pin 7 a 24 AWG White/Brown wire - connects to - PIC connection (on PCB board -B)
Pin 8 a 24 AWG Brown wire - connects to - PIC connection (on PCB board -A)

EDS Connections (A2)

In the EDS (Energy Delivery System) enclosure, there are ten different voltage and signal cables connected. The PV high voltage DC enters the EDS section (through connector J5) where the voltage is inverted through the H Bridge, passed through a transformer and sent to the 120 VAC (120 Volts AC- alternating current) or the PV voltage is sent through another connection (J10) to the ESS (Energy Storage System) where it charges batteries to be used during times when the PV voltage is not available. At times when the PV is not available, the battery voltage from the ESS section will flow through the J10 connector to the Inverter section in EDS. The wiring of the EDS connectors follows:

The J5 connector (connected to cable W1 from RPI), for High Voltage DC distribution, is a four pin Anderson Power “Power Pak®” connector, configured for three contacts and wired with 14 AWG wire:

Pin 1 a 14 AWG Red wire - connects to - High Voltage DC HV+ terminal
Pin 2 a 14 AWG Black wire - connects to - High Voltage DC Ground HV- terminal
Pin 3 a 14 AWG Green wire - connects to - GND terminal

The J10 connector (connected to cable W11 to ESS), for delivery of High Voltage DC to and from the ESS section, is a four pin Anderson Power “Power Pak®” connector, configured for three contacts and wired with 12 AWG wire:

Pin 1 a 12 AWG Red wire - connects to - High Voltage DC HV+ terminal
Pin 3 a 12 AWG Black wire - connects to - High Voltage DC Ground HVGND terminal
Pin 2 a 12 AWG Green wire - connects to - GND terminal

The J8 connector (connected to cable W6 from ESS), for system low voltage DC supply from ESS, is a six pin Amp/Tyco “Mate-N-Lok” connector, located on the bottom of the enclosure and wired with an 18/6 cable:

Pin 1 an 18 AWG Red wire - connects to - +12V terminal
Pin 2 an 18 AWG Black wire - connects to - 12VCOM terminal
Pin 3 an 18 AWG White wire - connects to - 5VCOM terminal
Pin 4 an 18 AWG Green wire - connects to - +5V terminal
Pin 5 an 18 AWG Orange wire - spare
Pin 6 an 18 AWG Blue wire - spare

The J11 connector (connected to cable W12 from ESS), for the Safety system interface from ESS, is a four pin Amp/Tyco “Mate-N-Lok” connector, located in the enclosure and wired with an 18/4 cable:

Pin 1 an 18 AWG White wire - connects to - 1F to Thermal Switch
Pin 2 an 18 AWG Green wire - connects to - J7 Pin 2 (18 AWG Green wire)
Pin 3 an 18 AWG Red wire - connects to - J7 Pin 3 (18 AWG Red wire)
Pin 4 an 18 AWG Black wire - connects to - J7 Pin 4 (18 AWG Black wire)

The J7 connector (connected to cable W5 to SCADA), for the Safety system interface to SCADA, is a four pin Amp/Tyco “Mate-N-Lok” connector, located in the enclosure and wired with an 18/4 cable:

Pin 1 an 18 AWG White wire - connects to - 1G to Thermal Switch
Pin 2 an 18 AWG Green wire - connects to - J11 Pin 2 (18 AWG Green wire)
Pin 3 an 18 AWG Red wire - connects to - J11 Pin 3 (18 AWG Red wire)
Pin 4 an 18 AWG Black wire - connects to - J11 Pin 4 (18 AWG Black wire)

The J19 (connected to cable W4 from RPI), J9 (connected to cable W10 to ESS) and J27 (connected to cable W16 to SCADA) connectors, for the system RS485 communication, are L-COM Cat 5E RJ45 coupler connectors mounted in the enclosure. An inexpensive Cat 5E cable connects to the inside of the coupler and the other end of the cable will be cut to length and stripped (no more than 1/2” on the end) to connect the following wires:

Pin 7 a 24 AWG White/Brown wire - connects to - EDS6 PCB (to RS485 -B)
Pin 8 a 24 AWG Brown wire - connects to - EDS6 PCB (to RS485 -A)

The J12 connector (connected to cable W9 from SCADA), for the USB to Jtag communication from SCADA, used for software downloads, is an L-COM USB (a) to USB (b) jack. A short USB cable connects the “Jtag to USB converter” to the J12 jack. The “Jtag to USB converter connects to the EDS PCB board.

The J28 connector (connected to cable W15 from T1), for delivery of 120 VAC to the Isolation Transformer, is a three connection mini AC receptacle and wired with 12/3 AWG wire (3 conductor cable consisting of 12 AWG wire):

Gold Screw – 12 AWG Black wire - connects to – Filter PCB 120V terminal
Silver Screw – 12 AWG White wire - connects to – Filter PCB Neutral terminal
Green Screw – 12 AWG Green wire - connects to - GND terminal

ESS Connections (A3)

In the ESS (Energy Storage System) enclosure, there are seven different voltage and signal cable connections. High voltage DC enters the ESS section (through connector J14) where the voltage charges the storage batteries and provides system low voltage (+12V and +5V) through DC to DC converters. The stored battery energy will also leave the ESS section through connector J14 to provide EDS power for the Inverter during heavy load and low PV power availability. Wiring of the ESS connections follows:

The J14 connector (connected to cable W11 from EDS), for High Voltage DC distribution between batteries and EDS, is a four pin Anderson Power “Power Pak®” connector, configured for three contacts and wired with a 14 AWG wire:

Pin 1 a 14 AWG Red wire - connects to - High Voltage DC HV terminal
Pin 3 a 14 AWG Black wire - connects to - High Voltage DC Ground HVGND terminal
Pin 2 a 14 AWG Green wire - connects to - GND terminal

The J6 (connected to cable W2 to RPI), J17 (connected to cable W8 to SCADA) and J21 (connected to cable W6 to EDS) connectors, for system low voltage DC supply distribution, are six pin Amp/Tyco “Mate-N-Lok” connectors, located in the enclosure and wired with an 18/6 cable:

Pin 1 an 18 AWG Red wire - connects to - +12V terminal
Pin 2 an 18 AWG Black wire - connects to - COM terminal
Pin 3 an 18 AWG White wire - connects to – 5VCOM terminal
Pin 4 an 18 AWG Green wire - connects to - +5V terminal
Pin 5 an 18 AWG Orange wire - spare
Pin 6 an 18 AWG Blue wire - spare

The J13 connector (connected to cable W12 to EDS), for the Safety system interface to EDS, is a four pin Amp/Tyco “Mate-N-Lok” connector, located in the enclosure and wired with an 18/4 cable:

Pin 1 an 18 AWG White wire - connects to - 1E
Pin 2 an 18 AWG Green wire - connects to – blank terminal
Pin 3 an 18 AWG Red wire - connects to - 1H terminal

Pin 4 an 18 AWG Black wire - connects to – C2 terminal

The J18 connector (connected to cable W3 from RPI), for the Safety system interface from RPI, is a four pin Amp/Tyco “Mate-N-Lok” connector, located in the enclosure and wired with an 18/4 cable:

Pin 1 an 18 AWG White wire - connects to – 1F terminal
Pin 2 an 18 AWG Green wire - connects to – blank terminal
Pin 3 an 18 AWG Red wire - connects to – 1H terminal
Pin 4 an 18 AWG Black wire - connects to – C2 terminal

The J15 connector (connected to cable W10 from EDS), for the system RS485 communication to EDS, is an L-COM Cat 5E RJ45 coupler connector mounted in the enclosure. An inexpensive Cat 5E cable connects to the inside of the coupler and the other end of the cable will be cut to length and stripped (no more than 1/2” on the end) to connect the following wires:

Pin 7 a 24 AWG White/Brown wire - connects to – ESS PCB RS485 B terminal
Pin 8 a 24 AWG Brown wire - connects to – ESS PCB RS485 A terminal

SCADA Connections (A4)

In the SCADA (Supervisory Control And Data Acquisition) area, there are six different voltage and signal cable connection points. The SCADA area contains 4 basic parts: the FIT PC computer, the PIC/ Safety PCB, the RS232 Converter PCB and the Display board. The connections to these parts follow:

The J23 connector (connected to cable W8 from ESS), for system low voltage DC supply distribution, is the end of the 18/6 cable:

Pin 1 an 18 AWG Red wire - connects to - +12V terminal
Pin 2 an 18 AWG Black wire - connects to - COM terminal
Pin 3 an 18 AWG White wire - connects to – 5VCOM terminal
Pin 4 an 18 AWG Green wire - connects to - +5V terminal
Pin 5 an 18 AWG Orange wire - spare
Pin 6 an 18 AWG Blue wire - spare

The J20 connector (connected to cable W5 from EDS), for the Safety system interface from EDS, is a four pin Amp/Tyco “Mate-N-Lok” connector, mounted in the SCADA area and wired with an 18/4 cable:

Pin 1 an 18 AWG White wire - connects to - 1G terminal
Pin 2 an 18 AWG Green wire - connects to – 1K terminal
Pin 3 an 18 AWG Red wire - connects to - 1H terminal
Pin 4 an 18 AWG Black wire - connects to - C2 terminal

(The SCADA safety relay contact is a normally open contact, contact is closed when power is applied to the relay coil)

The J19 connection is wired to the W16 cable from EDS, for the system RS485 communication to EDS. It is an inexpensive Cat 5E cable that will be cut to length and stripped (no more than 1/2" on the end) to connect the following wires to the PIC PCB and the other end will connect to the EDS enclosure:

Pin 7 a 24 AWG White/Brown wire - connects to – SCADA PCB RS485 B terminal
Pin 8 a 24 AWG Brown wire - connects to – SCADA PCB RS485 A terminal

The J24 connection (cable W9 from EDS), for the USB communication used for software downloads, is a USB port in the back of the SCADA (FIT PC) computer.

The J25 connection (cable W14 to Sunny Boy), for the communication used to monitor Sunny Boy is undetermined at this time. Information will be provided, in the future, for this connection.

The J26 connection (cable W13 to the Lafayette network), for the Ethernet communication is an inexpensive Cat 5E cable that plugs from the SCADA (FIT PC) computer to the Network connection in the wall in room 401.

T1 Connections (A5)

In the T1 (Transformer) area, there is an AC cable that comes from the EDS group (W15) that supplies the 120 Volts AC to the transformer. The Transformer is wired as follows:

From W15 cable:

12 AWG Black wire - connects to H1 and H6 in the Transformer
12 AWG White wire - connects to H3 and H8 in the Transformer
12 AWG Green wire - connects to chassis ground in the Transformer

To Load Outlet Strip:

Black wire to outlets - connects to X1 and X3 in the Transformer
White wire to outlets - connects to X2 and X4 in the Transformer
Green wire to outlets - connects to X2 and X4 and chassis ground in the Transformer

ICD Cables – See attached ICD Cable BOM

Cable **W1** High Voltage DC wiring - 14/3 Cable (15 Ft. Length):

Pin 1 = 14 AWG Black wire - High Voltage DC Positive
Pin 2 = 14 AWG White wire - High Voltage DC Common
Pin 3 = 14 AWG Green wire - Ground

Cable **W2** Low Voltage DC wiring - 18/6 Cable (15 Ft. Length):

- Pin 1 = 18 AWG Red wire - +12V
- Pin 2 = 18 AWG Black wire - COM
- Pin 3 = 18 AWG White wire – 5VCOM
- Pin 4 = 18 AWG Green wire - +5V
- Pin 5 = 18 AWG Orange wire - spare
- Pin 6 = 18 AWG Blue wire - spare

Cable **W3** Safety wiring - 18/4 Cable (15 Ft. Length):

- Pin 1 = 18 AWG White wire - Safety Signal out
- Pin 2 = 18 AWG Green wire - Safety Signal in
- Pin 3 = 18 AWG Red wire - Safety Voltage
- Pin 4 = 18 AWG Black wire - Safety COM

Cable **W4** RS485 communication wiring – Cat5E Cable (15 Ft. Length):

- Pin 7 a 24 AWG White/Brown wire - Send
- Pin 8 a 24 AWG Brown wire - Receive

Cable **W5** Safety wiring - 18/4 Cable (3 Ft. Length):

- Pin 1 = 18 AWG White wire - Safety Signal out
- Pin 2 = 18 AWG Green wire - Safety Signal in
- Pin 3 = 18 AWG Red wire - Safety Voltage
- Pin 4 = 18 AWG Black wire - Safety COM

Cable **W6** Low Voltage DC wiring -18/6 Cable (3 Ft. Length):

- Pin 1 = 18 AWG Red wire - +12V
- Pin 2 = 18 AWG Black wire - COM
- Pin 3 = 18 AWG White wire – 5VCOM
- Pin 4 = 18 AWG Green wire - +5V
- Pin 5 = 18 AWG Orange wire - spare
- Pin 6 = 18 AWG Blue wire - spare

Cable **W8** Low Voltage DC wiring -18/6 Cable (3 Ft. Length):

- Pin 1 = 18 AWG Red wire - +12V
- Pin 2 = 18 AWG Black wire - COM
- Pin 3 = 18 AWG White wire – 5VCOM
- Pin 4 = 18 AWG Green wire - +5V
- Pin 5 = 18 AWG Orange wire - spare
- Pin 6 = 18 AWG Blue wire - spare

Cable **W9** RS485 communication wiring – Cat5E Cable (3 Ft. Length):

- Pin 7 a 24 AWG White/Brown wire - Send
- Pin 8 a 24 AWG Brown wire - Receive

Cable **W10** RS485 communication wiring – Cat5E Cable (3 Ft. Length):

- Pin 7 a 24 AWG White/Brown wire - Send
- Pin 8 a 24 AWG Brown wire - Receive

Cable **W11** High Voltage DC wiring -14/3 Cable (3 Ft. Length):

- Pin 1 = 14 AWG Black wire - High Voltage DC Positive
- Pin 3 = 14 AWG White wire - High Voltage DC Common
- Pin 2 = 14 AWG Green wire - Ground

Cable **W12** Safety wiring - 18/4 Cable (3 Ft. Length):

- Pin 1 = 18 AWG White wire - Safety Signal out
- Pin 2 = 18 AWG Green wire - Safety Signal in
- Pin 3 = 18 AWG Red wire - Safety Voltage
- Pin 4 = 18 AWG Black wire - Safety COM

Cable **W13** Ethernet (Purchased)

Cable **W14** undetermined

Cable **W15** High Voltage AC – 12/3 Cable (Wired to T1 – see T1 above)

- Gold Screw – 12 AWG Black wire - 120V Hot
- Silver Screw – 12 AWG White wire - 120V Neutral
- Green Screw – 12 AWG Green wire - GND

Cable **W16** RS485 communication wiring– Cat5E Cable (6 Ft. Length, connector only on one end):

Pin 7 a 24 AWG White/Brown wire - Send
Pin 8 a 24 AWG Brown wire - Receive

RPI Test Cable High Voltage DC wiring -14/3 Cable (connector on one end, alligators on the other):

Pin 1 = 14 AWG Black wire - High Voltage DC Positive (HV+)
Pin 2 = 14 AWG White wire - High Voltage DC Common (HV-)
Pin 3 = 14 AWG Green wire – Ground

EDS Test Cable High Voltage DC wiring -14/3 Cable (connector on one end, alligators on the other):

Pin 1 = 14 AWG Black wire - High Voltage DC Positive (HV+)
Pin 3 = 14 AWG White wire - High Voltage DC Common (HV-)
Pin 2 = 14 AWG Green wire – Ground

ESS E-Stop Cheater Cable Low Voltage DC wiring – 18/2 Cable (8” length)- (6 Pin connector on one end, 4 Pin connector on the other):

Pin 1 = 18 AWG Red wire - +12V	to	Pin 3
Pin 2 = 18 AWG Black wire - COM	to	Pin 4
Pin 3 = NC		Pin 1
Pin 4 = NC		Pin 2
Pin 5 = NC		
Pin 6 = NC		

RPI E-Stop Cheater Connector Low Voltage DC wiring – Yellow 14 AWG wire (2” length, 4 Pin connector)

Pin 1 = 14 AWG Yellow wire	to	Pin 2
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RPI Connector BOM (also included in the RPI mechanical BOM)

RPI Budget										
J1 - High Voltage Receptacle	Total	# of Items	Manufacturer	Supplier 1	Part # Supplier 1	Cost 1	Supplier 2	Part # Supplier 2	Cost 2	Other Details
Connector Housing	\$0.00	0	Anderson Power	Allied Electronics	1470G1	\$1.50				4-Pin Housing
Connection Pin	\$0.30	1	"	Allied Electronics	110G9	\$0.30				
Red Pin Housing	\$0.95	1	"	Allied Electronics	1327FP	\$0.95				
Black Pin Housing	\$0.96	1	"	Allied Electronics	1327G5FP	\$0.96				
Green Pin Housing	\$1.04	1	"	Allied Electronics	1845G1	\$1.04				
Contact	\$1.99	2	"	Allied Electronics	269G1-LPBK	\$0.99				
Ground Contact	\$0.55	1	"	Allied Electronics	1630G1-LPBK	\$0.55				
J2 - 12V Supply Receptacle										
Connector Receptacle	\$1.93	1	Tyco/AMP	Allied Electronics	1604210-1	\$1.93				6-Pin
Plugs	\$0.78	6	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
J3 - Safety Receptacle										
Connector Receptacle	\$0.59	1	Tyco/AMP	Allied Electronics	350780-1	\$0.59				4-Pin
Plugs	\$0.52	4	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
J4 - RS485 Receptacle										
Connector Receptacle	\$10.61	1	LCOM	Allied Electronics	ECF504-SC5E	\$10.61				RS485
Cat 5E Cable	\$1.54	1	Emerson	Allied Electronics	73-7775-3	\$1.54				yellow - 3 ft.
TOTAL	\$21.95									

EDS Connector BOM (also included in the EDS mechanical BOM)

EDS Budget										
	Total	# of Items	Manufacturer	Supplier 1	Part # Supplier 1	Cost 1	Supplier 2	Part # Supplier 2	Coet 2	Other Details
J5 - High Voltage Receptacle										
Connector Housing	\$1.50	1	Anderson Power	Allied Electronics	1470G1	\$1.50				4-Pin Housing
Connection Pin	\$0.30	1	"	Allied Electronics	110G9	\$0.30				
Red Pin Housing	\$0.95	1	"	Allied Electronics	1327FP	\$0.95				
Black Pin Housing	\$0.96	1	"	Allied Electronics	1327G6FP	\$0.96				
Green Pin Housing	\$1.04	1	"	Allied Electronics	1845G1	\$1.04				
Contact	\$1.98	2	"	Allied Electronics	269G1-LPBK	\$0.99				
Ground Contact	\$0.55	1	"	Allied Electronics	1830G1-LPBK	\$0.55				
J10 - High Voltage Receptacle										
Connector Housing	\$1.50	1	Anderson Power	Allied Electronics	1470G1	\$1.50				4-Pin Housing
Connection Pin	\$0.30	1	"	Allied Electronics	110G9	\$0.30				
Red Pin Housing	\$0.95	1	"	Allied Electronics	1327FP	\$0.95				
Black Pin Housing	\$0.96	1	"	Allied Electronics	1327G6FP	\$0.96				
Green Pin Housing	\$1.04	1	"	Allied Electronics	1845G1	\$1.04				
Contact	\$1.98	2	"	Allied Electronics	269G1-LPBK	\$0.99				
Ground Contact	\$0.55	1	"	Allied Electronics	1830G1-LPBK	\$0.55				
J8 - 12V Supply Receptacle										
Connector Receptacle	\$1.93	1	Tyco/AMP	Allied Electronics	1604210-1	\$1.93				6-Pin
Pins	\$0.78	6	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
J7 - Safety Receptacle										
Connector Receptacle	\$0.59	1	Tyco/AMP	Allied Electronics	350780-1	\$0.59				4-Pin
Pins	\$0.52	4	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
J11 - Safety Receptacle										
Connector Receptacle	\$0.59	1	Tyco/AMP	Allied Electronics	350780-1	\$0.59				4-Pin
Pins	\$0.52	4	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
J9 - RS485 Receptacle										
Connector Receptacle	\$10.81	1	LCOM	Allied Electronics	ECF504-SCSE	\$10.81				RJ45
Cat 5E Cable	\$1.54	1	Emerson	Allied Electronics	73-7775-3	\$1.54				yellow - 3 ft.
J19 - RS485 Receptacle										
Connector Receptacle	\$10.81	1	LCOM	Allied Electronics	ECF504-SCSE	\$10.81				RJ45
Cat 5E Cable	\$1.54	1	Emerson	Allied Electronics	73-7775-3	\$1.54				yellow - 3 ft.
J27 - RS485 Receptacle										
Connector Receptacle	\$10.81	1	LCOM	Allied Electronics	ECF504-SCSE	\$10.81				RJ45
Cat 5E Cable	\$1.54	1	Emerson	Allied Electronics	73-7775-3	\$1.54				yellow - 3 ft.
J12 - USB Receptacle										
Connector Receptacle	\$6.95	1	LCOM	Allied Electronics	ECF504-BAS	\$6.95				USB b to a jack
USB to Jtag Converter	\$54.00	1	Olimex	MicroController Pros	AVR-USB-JTAG	\$54.00				http://microcontrollershop.com/product_info.php?products_id=938
USB Cable	\$2.05	1	Emerson	Allied Electronics	30-3007-3	\$2.05				
J28-XFMR Connection										
125 VAC Midqet Receptacle	\$14.99	1	McMaster-Carr	McMaster-Carr	6755K281	\$14.99				EDS Receptacle to Xfmr
125 VAC Midqet Plug	\$10.03	1	McMaster-Carr	McMaster-Carr	6755K15	\$10.03				Plug from Xfmr to EDS
TOTAL	\$144.56									

ESS Connector BOM (also included in the ESS mechanical BOM)

ESS Budget										
J14 - High Voltage Receptacle	Total	# of Items	Manufacturer	Supplier 1	Part # Supplier 1	Cost 1	Supplier 2	Part # Supplier 2	Cost 2	Other Details
Connector Housing	\$1.50	1	Anderson Power	Allied Electronics	1470G1	\$1.50				4-Pin Housing
Connection Pin	\$0.30	1	"	Allied Electronics	110G9	\$0.30				
Red Pin Housing	\$0.95	1	"	Allied Electronics	1327FP	\$0.95				
Black Pin Housing	\$0.95	1	"	Allied Electronics	1327G6FP	\$0.95				
Green Pin Housing	\$1.04	1	"	Allied Electronics	1845G1	\$1.04				
Contact	\$1.98	2	"	Allied Electronics	269G1-LPBK	\$0.99				
Ground Contact	\$0.55	1	"	Allied Electronics	1830G1-LPBK	\$0.55				
J6 - 12V Supply Receptacle										
Connector Receptacle	\$1.93	1	Tyco/AMP	Allied Electronics	1604210-1	\$1.93				6-Pin
Pins	\$0.78	6	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
J17 - 12V Supply Receptacle										
Connector Receptacle	\$1.93	1	Tyco/AMP	Allied Electronics	1604210-1	\$1.93				6-Pin
Pins	\$0.78	6	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
J21 - 12V Supply Receptacle										
Connector Receptacle	\$1.93	1	Tyco/AMP	Allied Electronics	1604210-1	\$1.93				6-Pin
Pins	\$0.78	6	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
J13 - Safety Receptacle										
Connector Receptacle	\$0.59	1	Tyco/AMP	Allied Electronics	350780-1	\$0.59				4-Pin
Pins	\$0.52	4	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
J21 - Safety Receptacle										
Connector Receptacle	\$0.59	1	Tyco/AMP	Allied Electronics	350780-1	\$0.59				4-Pin
Pins	\$0.52	4	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
J15 - RS485 Receptacle										
Connector Receptacle	\$10.81	1	LCOM	Allied Electronics	ECF504-SC5E	\$10.81				RJ45
Cat 5E Cable	\$1.54	1	Emerson	Allied Electronics	73-7775-3	\$1.54				yellow - 3 ft.
TOTAL	\$29.98									

SCADA Connector BOM (also included in the SCADA mechanical BOM)

SCADA Budget										
J20 - Safety Receptacle										
Connector Receptacle	\$0.59	1	Tyco/AMP	Allied Electronics	350780-1	\$0.59				4-Pin
Pins	\$0.52	4	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
J23 - 12V Supply Receptacle										
Connector Receptacle	\$1.93	1	Tyco/AMP	Allied Electronics	1604210-1	\$1.93				6-Pin
Pins	\$0.78	6	Tyco/AMP	Allied Electronics	350552-1	\$0.13				
SCW15 - E-Stop/Alarm/Reset										
Connector Receptacle	\$0.00	1	Tyco/AMP	donated	206705-2	\$0.00				9-Pin Free Hanging Receptacle
Pins	\$0.00	8	Tyco/AMP	donated	68009-3	\$0.00				
Connector Plug	\$0.00	1	Tyco/AMP	donated	206708-1	\$0.00				9-Pin Free Hanging Plug
Sockets	\$0.00	8	Tyco/AMP	donated	68101-3	\$0.00				
Shell/Clamp	\$0.00	2	Tyco/AMP	donated	206966-1	\$0.00				
TOTAL	\$1.11									

ICD Cable BOM

	Total	# of Items	Manufacturer	Supplier 1	Part # Supplier 1	Cost 1	Supplier 2	Part # Supplier 2	Cost 2	Other Details
Cable W1										
Connector Housing	\$2.82	2	Anderson Power	Allied Electronics	1460G1	\$1.41				4-Pin Housing
Clamp Kit	\$1.50	2	"	Allied Electronics	115G1	\$0.75				
Red Pin Housing	\$1.90	2	"	Allied Electronics	1327FP	\$0.95				
Black Pin Housing	\$1.92	2	"	Allied Electronics	1327G5FP	\$0.96				
Green Pin Housing	\$2.08	2	"	Allied Electronics	1845G1	\$1.04				
Contact	\$3.96	4	"	Allied Electronics	269G1-LPBK	\$0.99				
Ground Contact	\$1.10	2	"	Allied Electronics	1830G1-LPBK	\$0.55				
Cable W2										
Connector Plugs	\$1.04	2	TycooAMP	Allied Electronics	350715-1	\$0.52				5-Pin
Sockets	\$1.92	12	TycooAMP	Allied Electronics	350551-1	\$0.16				
Cable W3										
Connector Plugs	\$0.76	2	TycooAMP	Allied Electronics	350779-1	\$0.38				4-Pin
Sockets	\$1.28	8	TycooAMP	Allied Electronics	350551-1	\$0.16				
Cable W4										
Cat 5E Cable	\$4.74	1	Quest	Allied Electronics	NFC-0915	\$4.74				blue - 25 ft
Cable W5										
Connector Plugs	\$0.76	2	TycooAMP	Allied Electronics	350779-1	\$0.38				4-Pin
Sockets	\$1.28	8	TycooAMP	Allied Electronics	350551-1	\$0.16				
Cable W6										
Connector Plugs	\$1.04	2	TycooAMP	Allied Electronics	350715-1	\$0.52				6-Pin
Sockets	\$1.92	12	TycooAMP	Allied Electronics	350551-1	\$0.16				
Cable W7										
Connector Plugs	\$1.04	2	TycooAMP	Allied Electronics	350715-1	\$0.52				6-Pin
Sockets	\$1.92	12	TycooAMP	Allied Electronics	350551-1	\$0.16				
Cable W8										
USB Cable	\$2.05	1	Emerson	Allied Electronics	30-3007-3	\$2.05				usb b to a 3 ft
Cable W10										
Cat 5E Cable	\$1.54	1	Emerson	Allied Electronics	73-7775-3	\$1.54				yellow - 3 ft
Cable W11										
Connector Housing	\$2.82	2	Anderson Power	Allied Electronics	1460G1	\$1.41				4-Pin Housing
Clamp Kit	\$1.50	2	"	Allied Electronics	115G1	\$0.75				
Red Pin Housing	\$1.90	2	"	Allied Electronics	1327FP	\$0.95				
Black Pin Housing	\$1.92	2	"	Allied Electronics	1327G5FP	\$0.96				
Green Pin Housing	\$2.08	2	"	Allied Electronics	1845G1	\$1.04				
Contact	\$3.96	4	"	Allied Electronics	269G1-LPBK	\$0.99				
Ground Contact	\$1.10	2	"	Allied Electronics	1830G1-LPBK	\$0.55				
Cable W12										
Connector Plugs	\$0.76	2	TycooAMP	Allied Electronics	350779-1	\$0.38				4-Pin
Sockets	\$1.28	8	TycooAMP	Allied Electronics	350551-1	\$0.16				
Cable W13										
Cat 5E Cable	\$1.54	1	Emerson	Allied Electronics	73-7775-3	\$1.54				yellow - 3 ft
Cable W14										
Cat 5E Cable	\$1.54	1	Emerson	Allied Electronics	73-7775-3	\$1.54				yellow - 3 ft
RPI Test Cable										
Connector Housing	\$1.41	1	Anderson Power	Allied Electronics	1460G1	\$1.41				4-Pin Housing
Clamp Kit	\$0.75	1	"	Allied Electronics	115G1	\$0.75				
Red Pin Housing	\$0.95	1	"	Allied Electronics	1327FP	\$0.95				
Black Pin Housing	\$0.96	1	"	Allied Electronics	1327G5FP	\$0.96				
Green Pin Housing	\$1.04	1	"	Allied Electronics	1845G1	\$1.04				
Contact	\$1.98	2	"	Allied Electronics	269G1-LPBK	\$0.99				
Ground Contact	\$0.55	1	"	Allied Electronics	1830G1-LPBK	\$0.55				
EDS Test Cable										
Connector Housing	\$1.41	1	Anderson Power	Allied Electronics	1460G1	\$1.41				4-Pin Housing
Clamp Kit	\$0.75	1	"	Allied Electronics	115G1	\$0.75				
Red Pin Housing	\$0.95	1	"	Allied Electronics	1327FP	\$0.95				
Black Pin Housing	\$0.96	1	"	Allied Electronics	1327G5FP	\$0.96				
Green Pin Housing	\$1.04	1	"	Allied Electronics	1845G1	\$1.04				
Contact	\$1.98	2	"	Allied Electronics	269G1-LPBK	\$0.99				
Ground Contact	\$0.55	1	"	Allied Electronics	1830G1-LPBK	\$0.55				
ESS E-Stop Chassis Cable										
Connector Plugs	\$0.67	1	TycooAMP	Digikey	350715-1	\$0.67	A14284-ND			5-Pin
Connector Plugs	\$0.38	1	TycooAMP	Digikey	350779-1	\$0.38	A14282-ND			4-Pin
Sockets	\$0.84	4	TycooAMP	Digikey	350551-1	\$0.16	A14302-ND			
RPI E-Stop Jumper										
Connector Plugs	\$0.38	1	TycooAMP	Digikey	350779-1	\$0.38	A14282-ND			4-Pin
Sockets	\$0.32	2	TycooAMP	Digikey	350551-1	\$0.16	A14302-ND			
TOTAL	\$73.94									