OMPONENT: part in most basic configuration MECHANISM: assembly of COMPONENTS with specific function OTS: standard (non custom order) item available to all teams, unmodified, bisolete OK MENOR: Tax ID; not a FIRST team; ship COTS ≤5 days; maintains stock; products variable to all teams; ABRICATED ITEM: COMPONENT or MECHANISM altered* 102 General Robot Design RAI FRAME PERIMITER: in bumper zone; fixed non-articulated structural; excl minor prot. ≤ ½" R2 STARTING CONFIGURATION ≤ FRAME PERIMETER (excludes bumpers & minor protrusions) R3 FP ≤ 120 inches, Starting height ≤ 48" R4 Max extension: 30" beyond FP R5 Robot weight ≤ 125 lb (excl bumpers, battery w/<12" cable) Safety & Damage Prevention R6 not designed to shoot H PANEL > 3' past FP (G6) 7" "71 rule": limits damaging traction devices * No hoxards from protrusions or exposed surfaces General hazmat, safety & interference rule * No power to remove game pieces or robot Lubricants: internal only 104 Budget Constraints and Fabrication Schedule R12 BOM ≤ \$5500, excludes ≤\$5/part & 2019 KOP Individual part ≤ \$500 R14 BOM uses Fair Market Value: COTS: VENDOR price, else mat'ls & nonteam labor. Cap kickoff/FC items at \$500. R15 No physical elements before kickoff. Exceptions: operator console; bumpers; battery assemblies; single COTS electrical + wires modified, connectors, shaft, gear, pulley, filter capacitor R16 software/designs before kickoff must be public R17 Bag ROBOT by Feb 19 2259 CST, excl. withholding, except'ns to R15, COTS R18 up to 3 bags, separate tags & entries, one form R19 Re-seal if attending another event R20 Hands-off times and exceptions & limitations * R21 Robot access times for 2 day events * R22 Unbag at competition only after lock-up form approval and pits open R28 R0BOT by Feb 19 2259 CST, excl. withholding, except'ns to R15, COTS Bumper Rules R24 Cover corners to 6 in; curves are corners R25 In BUMPERS TONE (0-7.5") except per G23 (HAB)* R26 BUMPERS Non-articulated rel to FP R27 Quick/easy installation &		2019 Robot and Inspection Rules Summary as of 15 Feb (TU12)			
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R4 Max extension: 30" beyond FP R5 Robot weight ≤ 125 lb (excl bumpers, battery w/ <12" cable) 10.3 Safety & Damage Prevention R6 not designed to shoot H PANEL > 3' past FP (G6) R7 "71 rule": limits damaging traction devices * R8 No hazards from protrusions or exposed surfaces R9 General hazmat, safety & interference rule * R10 No power to remove game pieces or robot R11 Lubricants: internal only R12 BOM ≤ \$5500, excludes ≤\$5/part & 2019 KoP R13 Individual part ≤ \$500 R14 BOM uses Fair Market Value: COTS: VENDOR price, else mat'ls & nonteam labor. Cap kickoff/FC items at \$500. R15 No physical elements before kickoff. Exceptions: operator console; bumpers; battery assemblies; single COTS electrical + wires modified, connectors, shaft, gear, pulley, filter capacitor R16 software/designs before kickoff must be public R17 Bag ROBOT by Feb 19 2259 CST, excl. withholding, except'ns to R15, COTS R18 up to 3 bags, separate tags & entries, one form R19 Re-seal if attending another event R20 Hands-off times and exceptions & limitations * R21 Robot access times for 2 day events * Unbag at competition only after lock-up form approval and pits open R23 WITHHOLDING ALLOWANCE ≤ 30 lb * R24 Cover corners to 6 in; curves are corners R25 In BUMPERS non-articulated rel to FP R27 Quick/easy installation & removal for inspection R28 Red/Blue; no markings except: R29, hook & loop or snaps on hard parts, white FIRST logo R29 numbers: visible all sides; Arabic num 4+" tall; ½"+stroke; white or w. outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows: ¾" nom x 4.5-5.5" plywood or robust wood ho hard parts >1" beyond FP pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section		•			
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R6 not designed to shoot H PANEL > 3' past FP (G6) R7 "71 rule": limits damaging traction devices * R8 No hazards from protrusions or exposed surfaces R9 General hazmat, safety & interference rule * R10 No power to remove game pieces or robot R11 Lubricants: internal only 10.4 Budget Constraints and Fabrication Schedule R12 BOM ≤ \$5500, excludes ≤\$5/part & 2019 KoP R13 Individual part ≤ \$500 R14 BOM uses Fair Market Value: COTS: VENDOR price, else mat'ls & nonteam labor. Cap kickoff/FC items at \$500. R15 No physical elements before kickoff. Exceptions: operator console; bumpers; battery assemblies; single COTS electrical + wires modified, connectors, shaft, gear, pulley, filter capacitor R16 software/designs before kickoff must be public R17 Bag ROBOT by Feb 19 2259 CST, excl. withholding, except'ns to R15, COTS R18 up to 3 bags, separate tags & entries, one form R19 Re-seal if attending another event R20 Hands-off times and exceptions & limitations * R21 Robot access times for 2 day events * R22 Unbag at competition only after lock-up form approval and pits open R23 WITHHOLDING ALLOWANCE ≤ 30 lb * Bumper Rules R24 Cover corners to 6 in; curves are corners R25 In BUMPERS non-articulated rel to FP R27 Quick/easy installation & removal for inspection R28 Red/Blue; no markings except: R29, hook & loop or snaps on hard parts, white FIRST logo R29 numbers: visible all sides; Arabic num 4+" tall; ½"+stroke; white or w. outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows: ¾" nom x 4.5-5.5" plywood or robust wood no hard parts > 1" beyond FP c pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section d Rugged smooth solid color cloth on ext. surfaces*	R5	Robot weight ≤ 125 lb (excl bumpers, battery w/ <12" cable)			
R7 "71 rule": limits damaging traction devices * R8 No hazards from protrusions or exposed surfaces General hazmat, safety & interference rule * R10 No power to remove game pieces or robot R11 Lubricants: internal only 10.4 Budget Constraints and Fabrication Schedule R12 BOM ≤ \$5500, excludes ≤ \$5/part & 2019 KOP R13 Individual part ≤ \$500 R14 BOM uses Fair Market Value: COTS: VENDOR price, else mat'ls & nonteam labor. Cap kickoff/FC items at \$500. R15 No physical elements before kickoff. Exceptions: operator console; bumpers; battery assemblies; single COTS electrical + wires modified, connectors, shaft, gear, pulley, filter capacitor R16 software/designs before kickoff must be public R17 Bag ROBOT by Feb 19 2259 CST, excl. withholding, except'ns to R15, COTS R18 up to 3 bags, separate tags & entries, one form R19 Re-seal if attending another event R20 Hands-off times and exceptions & limitations * R21 Robot access times for 2 day events * R22 Unbag at competition only after lock-up form approval and pits open R23 WITHHOLDING ALLOWANCE ≤ 30 lb * Bumper Rules R24 Cover corners to 6 in; curves are corners R25 In BUMPER ZONE (0-7.5") except per G23 (HAB)* R26 BUMPERS non-articulated rel to FP R27 Quick/easy installation & removal for inspection R28 Red/Blue; no markings except: R29, hook & loop or snaps on hard parts, white FIRST logo R29 numbers: visible all sides; Arabic num 4+" tall; ½"+stroke; white or w. outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows: ¾" nom x 4.5-5.5" plywood or robust wood ho hard parts >1" beyond FP c pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section Rugged smooth solid color cloth on ext. surfaces*	10.3	Safety & Damage Prevention			
R8 No hazards from protrusions or exposed surfaces R9 General hazmat, safety & interference rule * R10 No power to remove game pieces or robot R11 Lubricants: internal only 10.4 Budget Constraints and Fabrication Schedule R12 BOM ≤ \$5500, excludes ≤ \$5/part & 2019 KoP R13 Individual part ≤ \$500 R14 BOM uses Fair Market Value: COTS: VENDOR price, else mat'ls & nonteam labor. Cap kickoff/FC items at \$500. R15 No physical elements before kickoff. Exceptions: operator console; bumpers; battery assemblies; single COTS electrical + wires modified, connectors, shaft, gear, pulley, filter capacitor R16 software/designs before kickoff must be public R17 Bag ROBOT by Feb 19 2259 CST, excl. withholding, except'ns to R15, COTS R18 up to 3 bags, separate tags & entries, one form R19 Re-seal if attending another event R20 Hands-off times and exceptions & limitations * R21 Robot access times for 2 day events * R22 Unbag at competition only after lock-up form approval and pits open R23 WITHHOLDING ALLOWANCE ≤ 30 lb * R24 Cover corners to 6 in; curves are corners R25 In BUMPER ZONE (0-7.5") except per G23 (HAB)* R26 BUMPERS non-articulated rel to FP R27 Quick/easy installation & removal for inspection R28 Red/Blue; no markings except: R29, hook & loop or snaps on hard parts, white FIRST logo R29 numbers: visible all sides; Arabic num 4+" tall; ½"+stroke; white or w. outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows: A** nom x 4.5-5.5" plywood or robust wood no hard parts >1" beyond FP c pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section Rugged smooth solid color cloth on ext. surfaces*	R6	not designed to shoot H PANEL > 3' past FP (G6)			
R9 General hazmat, safety & interference rule * R10 No power to remove game pieces or robot R11 Lubricants: internal only 10.4 Budget Constraints and Fabrication Schedule R12 BOM ≤ \$5500, excludes ≤ \$5/part & 2019 KoP R13 Individual part ≤ \$500 R14 BOM uses Fair Market Value: COTS: VENDOR price, else mat'ls & nonteam labor. Cap kickoff/FC items at \$500. R15 No physical elements before kickoff. Exceptions: operator console; bumpers; battery assemblies; single COTS electrical + wires modified, connectors, shaft, gear, pulley, filter capacitor R16 software/designs before kickoff must be public R17 Bag ROBOT by Feb 19 2259 CST, excl. withholding, except'ns to R15, COTS R18 up to 3 bags, separate tags & entries, one form R19 Re-seal if attending another event R20 Hands-off times and exceptions & limitations * R21 Robot access times for 2 day events * R22 Unbag at competition only after lock-up form approval and pits open R23 WITHHOLDING ALLOWANCE ≤ 30 lb * R24 Cover corners to 6 in; curves are corners R25 In BUMPER ZONE (0-7.5") except per G23 (HAB)* R26 BUMPERS non-articulated rel to FP R27 Quick/easy installation & removal for inspection R28 Red/Blue; no markings except: R29, hook & loop or snaps on hard parts, white FIRST logo R29 numbers: visible all sides; Arabic num 4+" tall; ½"+stroke; white or w. outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows: %" nom x 4.5-5.5" plywood or robust wood no hard parts >1" beyond FP c pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section d Rugged smooth solid color cloth on ext. surfaces*		"71 rule": limits damaging traction devices *			
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10.5 Bumper Rules R24 Cover corners to 6 in; curves are corners R25 In BUMPER ZONE (0-7.5") except per G23 (HAB)* R26 BUMPERS non-articulated rel to FP R27 Quick/easy installation & removal for inspection R28 Red/Blue; no markings except: R29, hook & loop or snaps on hard parts, white FIRST logo R29 numbers: visible all sides; Arabic num 4+" tall; ½"+stroke; white or w. outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows: ¾" nom x 4.5-5.5" plywood or robust wood no hard parts >1" beyond FP pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section Rugged smooth solid color cloth on ext. surfaces*		Unbag at competition only after lock-up form approval and pits open			
R24 Cover corners to 6 in; curves are corners R25 In BUMPER ZONE (0-7.5") except per G23 (HAB)* R26 BUMPERS non-articulated rel to FP R27 Quick/easy installation & removal for inspection R28 Red/Blue; no markings except: R29, hook & loop or snaps on hard parts, white FIRST logo R29 numbers: visible all sides; Arabic num 4+" tall; ½"+stroke; white or w. outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows: ¾" nom x 4.5-5.5" plywood or robust wood no hard parts >1" beyond FP pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section d Rugged smooth solid color cloth on ext. surfaces*	-	WITHHOLDING ALLOWANCE ≤ 30 lb *			
R25 In BUMPER ZONE (0-7.5") except per G23 (HAB)* R26 BUMPERS non-articulated rel to FP R27 Quick/easy installation & removal for inspection R28 Red/Blue; no markings except: R29, hook & loop or snaps on hard parts, white FIRST logo R29 numbers: visible all sides; Arabic num 4+" tall; ½"+stroke; white or w. outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows:		Bumper Rules			
R26 BUMPERS non-articulated rel to FP R27 Quick/easy installation & removal for inspection R28 Red/Blue; no markings except: R29, hook & loop or snaps on hard parts, white FIRST logo R29 numbers: visible all sides; Arabic num 4+" tall; %"+stroke; white or w. outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows:					
R27 Quick/easy installation & removal for inspection R28 Red/Blue; no markings except: R29, hook & loop or snaps on hard parts, white FIRST logo R29 numbers: visible all sides; Arabic num 4+" tall; ½"+stroke; white or w. outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows:		`			
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white FIRST logo R29 numbers: visible all sides; Arabic num 4+" tall; ½"+stroke; white or w. outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows: ¾" nom x 4.5-5.5" plywood or robust wood no hard parts >1" beyond FP c pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section d Rugged smooth solid color cloth on ext. surfaces*					
outline; not around sharp corners; no subst. logos or icons for numerals R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows: ¼" nom x 4.5-5.5" plywood or robust wood no hard parts >1" beyond FP c pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section d Rugged smooth solid color cloth on ext. surfaces*	.,_0	white FIRST logo			
R30 Bumper set, incl fasteners & structures ≤ 15 lb R31 Bumpers must be constructed as follows: a ¾" nom x 4.5-5.5" plywood or robust wood no hard parts >1" beyond FP c pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section d Rugged smooth solid color cloth on ext. surfaces*	R29				
Bumpers must be constructed as follows: a ¾" nom x 4.5-5.5" plywood or robust wood b no hard parts >1" beyond FP c pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section d Rugged smooth solid color cloth on ext. surfaces*	R30				
a %" nom x 4.5-5.5" plywood or robust wood b no hard parts >1" beyond FP c pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section d Rugged smooth solid color cloth on ext. surfaces*		•			
 b no hard parts >1" beyond FP c pair of 2.5" (nominal) round, petal, hex pool noodles, solid or cored. No mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section d Rugged smooth solid color cloth on ext. surfaces* 		·			
mods or deforms except end cuts; All same in a bumper set; soft fasteners inside OK, but mind cross-section d Rugged smooth solid color cloth on ext. surfaces*	b	no hard parts >1" beyond FP			
fasteners inside OK, but mind cross-section d Rugged smooth solid color cloth on ext. surfaces*	С	, , , , , , , , , , , , , , , , , , , ,			
d Rugged smooth solid color cloth on ext. surfaces*		·			
e.t metal angle/bracket may secure cloth & segments		Rugged smooth solid color cloth on ext. surfaces*			
	e,f	metal angle/bracket may secure cloth & segments			
g attach rigidly to FP * R32 Fill the corperioints with pool poodle					
R32 Fill the cornerjoints with pool noodle R33 FP backing: ½" @ ends; gaps ≤ ½" deep, ≤8" wide					
1.33 1. Bucking. 72 @ Citus, gaps 2.74 uccp, 20 Wide	1133	11. 555kmg. 12 @ cmus, 8445 2 14 ucch, 20 wide			

10.6	Motors & Actuators
R34	Only motors permitted (any quantity)
	List of Motors * (overview in R37 rows 1 to 3)
	solenoid, ≤1" stroke, ≤10W cont at 12V.
	hard drive motors or fans in kickoff/FIRST Choice; or part of controller or COTS computing
	vibration & focus motors in COTS computing
	PWM COTS servos with a retail cost < \$75
	Motors integral to COTS sensor One R86 compliant compressor to compress air
R35	No motor mods except
	Mounting brackets & output shaft
	Leads trimmed, connected, or spliced
	remove Denso motor window locking pins conn. housings on KOP auto for connections
	Servos as specified by the manufacturer
	Dynamo wiring harness as doc'd by FIRST*
R36	Minimal labeling: purpose, connectivity, performance Except servos, fans & integral motors, each actuator controlled by one of:
	MC (Motor Controllers): DMC 60[c]; Jaguar (PWM); Dynamo integrated;
	SD540; Spark; Spark MAX; Talon; Talon SRX; Victor 884, 888, SP, or SPX.*
	RM (Relay Modules): Spike; Automation Direct* PC (Pneumatics controllers): PCM
R37	Power regulator to load map. UNO, 1 load/reg
	1/MC: CIM; AM 9015 RS775 Pro; BAG; mini-CIM; Banebots; RedLine; NEO
	2/MC or 1/RM: KOP Auto; AM PG; Snow Blower; NeverRest
	Integrated controller only: Nidec Dynamo RM or PC: Compressor
	multi/RM or 1/PC: pneumatic solenoid valves
	multi/MC or RM, or 1/PC: solenoids or CC
	CC (CUSTOM CIRCUIT): electrical COMPONENT except motor, elec. or pneum. solenoid, roboRIO, PDP, PCM, VRM, RSL, 120A breaker, MC, RM,
	radio, battery
R38	Servos connect to ONE of: RIO PWM, Spartan Sensor PWM, or REV Servo
	module
10.7	Power Distribution
D20	Apply for event, not just FIELD/MATCHES
R39	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals
R40	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging
R40 R41	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB
R40 R41 R42	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging
R40 R41 R42 R43	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period
R40 R41 R42 R43 R44	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions
R40 R41 R42 R43 R44 R45	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times
R40 R41 R42 R43 R44	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions
R40 R41 R42 R43 R44 R45	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected
R40 R41 R42 R43 R44 R45 R46	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9
R40 R41 R42 R43 R44 R45 R46 R47	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55)
R40 R41 R42 R43 R44 R45 R46 R47	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ)
R40 R41 R42 R43 R44 R45 R46 R47	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible
R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible PDP, wiring, breakers: easily visible (inspection)
R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible PDP, wiring, breakers: easily visible (inspection) CC may not produce voltages > 24V
R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible PDP, wiring, breakers: easily visible (inspection) CC may not produce voltages > 24V RIO power ONLY from designated PDP terminals
R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible PDP, wiring, breakers: easily visible (inspection) CC may not produce voltages > 24V RIO power ONLY from designated PDP terminals Radio power ONLY from 12V 2A VRM output Radio's VRM powered by designated PDP terminals. 1 PCM is only other
R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible PDP, wiring, breakers: easily visible (inspection) CC may not produce voltages > 24V RIO power ONLY from designated PDP terminals Radio power ONLY from 12V 2A VRM output
R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible PDP, wiring, breakers: easily visible (inspection) CC may not produce voltages > 24V RIO power ONLY from designated PDP terminals Radio power ONLY from 12V 2A VRM output Radio's VRM powered by designated PDP terminals. 1 PCM is only other load there PDP: One WAGO, one wire. Only PDP breakers are Snap Action: VB3-A series F57 terminals; MX5-A or
R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57	Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible PDP, wiring, breakers: easily visible (inspection) CC may not produce voltages > 24V RIO power ONLY from designated PDP terminals Radio power ONLY from 12V 2A VRM output Radio's VRM powered by designated PDP terminals. 1 PCM is only other load there PDP: One WAGO, one wire. Only PDP breakers are Snap Action: VB3-A series F57 terminals; MX5-A or MX5-L series, ≤40A
R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible PDP, wiring, breakers: easily visible (inspection) CC may not produce voltages > 24V RIO power ONLY from designated PDP terminals Radio power ONLY from 12V 2A VRM output Radio's VRM powered by designated PDP terminals. 1 PCM is only other load there PDP: One WAGO, one wire. Only PDP breakers are Snap Action: VB3-A series F57 terminals; MX5-A or MX5-L series, ≤40A Fuses in PDP: mini-automotive rated as marked.
R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57	Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible PDP, wiring, breakers: easily visible (inspection) CC may not produce voltages > 24V RIO power ONLY from designated PDP terminals Radio power ONLY from 12V 2A VRM output Radio's VRM powered by designated PDP terminals. 1 PCM is only other load there PDP: One WAGO, one wire. Only PDP breakers are Snap Action: VB3-A series F57 terminals; MX5-A or MX5-L series, ≤40A Fuses in PDP: mini-automotive rated as marked. One breaker one circuit. Breaker values:
R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible PDP, wiring, breakers: easily visible (inspection) CC may not produce voltages > 24V RIO power ONLY from designated PDP terminals Radio power ONLY from 12V 2A VRM output Radio's VRM powered by designated PDP terminals. 1 PCM is only other load there PDP: One WAGO, one wire. Only PDP breakers are Snap Action: VB3-A series F57 terminals; MX5-A or MX5-L series, ≤40A Fuses in PDP: mini-automotive rated as marked.
R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57	Apply for event, not just FIELD/MATCHES Battery is robot's only electrical energy source: Non-spill SLA, 12V, 17- 18.2Ah, rectangular 7.1"x3"x6.6"; 11-14.5#; nut/bolt terminals COTS computing & I/O may be powered by integral or 100Wh USB batteries 2.5A max/port. Musts: secured, COTS cables, mfg recc charging Battery chargers need installed SB connector Battery chargers only used at ≤ 6A charging R39 & R40 only batteries on robot, period Secure the battery, including rolls & inversions All mains connections fully insulated at all times Only non-elec energy: compressed air per R86 & R87; change robot CoG; deformation (springs); closed-loop gas shocks; air filled wheels Mains circuit: 1 battery, 1pr SB conn., 1 120A breaker*, 1 PDP, connected with 6+ AWG copper wire only, no add'l devices or mods, per fig 10-9 Circuits powered from ONE PDP WAGO pair (except R53 & R55) Isolate electricals from ROBOT frame (>3kΩ) ONE main breaker, quickly & safely accessible PDP, wiring, breakers: easily visible (inspection) CC may not produce voltages > 24V RIO power ONLY from designated PDP terminals Radio power ONLY from designated PDP terminals. 1 PCM is only other load there PDP: One WAGO, one wire. Only PDP breakers are Snap Action: VB3-A series F57 terminals; MX5-A or MX5-L series, ≤40A Fuses in PDP: mini-automotive rated as marked. One breaker one circuit. Breaker values: ≤40A: (MC CC 40A AD relay), 1ea ≤20A: Fans, no limit; (Spike 25A AD relay), 1 ea

R60	All circuits: insulated copper wire sized at least:	R84 The only pneumatic items permitted:
	12 AWG: 31-40A protected circuit	a KoP-equi vent plug valves
	14 AWG: 21-30A protected circuit	b KoP-equiv pressure relief valves; c Solenoid valves ¾" (3mm) NPT, BSPP,BSPT diameter, or ¾" OD tubing
	18 AWG: 6-20A; PDP->(VRM, PCM->compressor)	c Solenoid valves ¼" (3mm) NPT, BSPP,BSPT diameter, or ¼" OD tubing connectors
	22 AWG: ≤5A; PDP->RIO	d pneumatic tubing, 1/4" max OD
	24 AWG: VRM 2A circuits	e transducers, gauges, flow control valves, manifolds, and connection
	26 AWG: RIO PWM port putputs	fittings
	28 AWG: SIGNAL LEVEL (≤1A draw and source) [Examples*] May be non-	f check & quick exhaust valves meeting R93a
	copper.	g Releiving shutoff valves (3-way exhausting)
	Exempt: wires recommended/attached by mfg	h regulators adjusted to 60 psi or less i cylinders, linear and rotary actuators
R61	Connectors, slip rings, etc.: protected as rated	j storage tanks, except white clippard tanks
R62	Non-signal level, constant polarity wiring shall be color coded the entire	k One compressor, R86 compliant
	length as follows:	l Debris or coalescing (water) filters,
	Pos: red, yellow, white, brown, black w/stripe Neg: black, blue	m Venturi valves (high pressure is subject to pneumaticrules, vacuum side
	Exempt: orig attached to devices, POE ethernet	is exempt)
R63	Custom circuits may not directly alter power*	R85 If pneumatic used, following are required: One (1) FRC-legal compressor (per R86)
10.8	Control, Command, & Signals System	Relief valve (R84-b) via rigid fittings to compressor
R64	· · · · · · · · · · · · · · · · · · ·	Nason pressure switch SM-2B-115/R443
R65	One RoboRIO, image version ≤ FRC_2019_v14	at least on pressure vent plug
	One OM5P-AN or OM5P-AC radio, cfg for event	Stored pressure gauge, upstream of primary reg
R66	RIO ethernet => "18-24vPOE" port on radio. Network switch allowed but	Working pressure gauge, downstream of regulator
DC=	discouraged.	Working pressure regulator
R67	Robot-> console comms is limited to 4Mb/s and to specific network ports*	Compressor Pressure Pressure "Stored"
R68	•	Relief Valve Vent Plug Pressure
R69	Configure RIO, DS, & radio as directed*	Air Storage Tank Gauge
	All signals must be Console -> Arena -> ROBOT	AND THE PROPERTY OF THE PROPER
R70	No wireless to/from robot except per R65 & R69	Clippard
R71	Mount radio so diagnositc lights are visible	Air to "working" Pressure Switch
R72	1 or 2 RSLs, visible 3' away, RIO RSL+ terminal to both La and Lb, RIO RSL-	components Pressure
R73	terminal to RSL center No mods to DS SW, RIO, PDP, PCM, VRM, RSL, breaker, MCs, RMs, radio,	(cylinders, etc.) Regulator
N/3	or batteries except:	(Symmetry Tregulator
	User programmable code on RIO	
	Calibration of motor controllers per manuals	"Working" Pressure Gauge
	Fans on motor controllers from their power	R86 ONE onboard compressor, 1.1 cfm.
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker	
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi.
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p.
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved.	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK Wires on MCs cut, stripped, connectorized	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output R92 Nason p. switch SM-2B-115/R443; high side, wired to PCM or to RIO
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output R92 Nason p. switch SM-2B-115/R443; high side, wired to PCM or to RIO programmed for shutoff
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK Wires on MCs cut, stripped, connectorized Devices repaired (not improved) Talon SRX data port cover removed Tape may be applied to Al plate inside radio	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output R92 Nason p. switch SM-2B-115/R443; high side, wired to PCM or to RIO programmed for shutoff R93 Vent plug: vent all air pressure & be accessible
R74	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK Wires on MCs cut, stripped, connectorized Devices repaired (not improved) Talon SRX data port cover removed Tape may be applied to Al plate inside radio Except designated 12V input, no 12V power, RM, or MC outputs shall be	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output R92 Nason p. switch SM-2B-115/R443; high side, wired to PCM or to RIO programmed for shutoff R93 Vent plug: vent all air pressure & be accessible R94 Don't plumb solenoid valve outputs together 10.10 Operator Console R95 NI Driver Station rev 19.0 or newer
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK Wires on MCs cut, stripped, connectorized Devices repaired (not improved) Talon SRX data port cover removed Tape may be applied to Al plate inside radio Except designated 12V input, no 12V power, RM, or MC outputs shall be connected to the RIO	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output R92 Nason p. switch SM-2B-115/R443; high side, wired to PCM or to RIO programmed for shutoff R93 Vent plug: vent all air pressure & be accessible R94 Don't plumb solenoid valve outputs together 10.10 Operator Console R95 NI Driver Station rev 19.0 or newer R96 must include diagnostic graphic display visible for inspection and match
R75	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK Wires on MCs cut, stripped, connectorized Devices repaired (not improved) Talon SRX data port cover removed Tape may be applied to Al plate inside radio Except designated 12V input, no 12V power, RM, or MC outputs shall be connected to the RIO Every power controller connected properly*	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output R92 Nason p. switch SM-2B-115/R443; high side, wired to PCM or to RIO programmed for shutoff R93 Vent plug: vent all air pressure & be accessible R94 Don't plumb solenoid valve outputs together 10.10 Operator Console R95 NI Driver Station rev 19.0 or newer R96 must include diagnostic graphic display visible for inspection and match R97 Driver station: direct connect to FMS (no switch) using proded cable.
	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK Wires on MCs cut, stripped, connectorized Devices repaired (not improved) Talon SRX data port cover removed Tape may be applied to Al plate inside radio Except designated 12V input, no 12V power, RM, or MC outputs shall be connected to the RIO Every power controller connected properly* Motors controlled via MXP must be controlled via PWM pins, passive	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output R92 Nason p. switch SM-2B-115/R443; high side, wired to PCM or to RIO programmed for shutoff R93 Vent plug: vent all air pressure & be accessible R94 Don't plumb solenoid valve outputs together 10.10 Operator Console R95 NI Driver Station rev 19.0 or newer R96 must include diagnostic graphic display visible for inspection and match R97 Driver station: direct connect to FMS (no switch) using proded cable. Ethernet port accessible.
R75	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK Wires on MCs cut, stripped, connectorized Devices repaired (not improved) Talon SRX data port cover removed Tape may be applied to Al plate inside radio Except designated 12V input, no 12V power, RM, or MC outputs shall be connected to the RIO Every power controller connected properly* Motors controlled via MXP must be controlled via PWM pins, passive conductors to extend same, or an approved ACTIVE DEVICE: : Kauai Labs	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output R92 Nason p. switch SM-2B-115/R443; high side, wired to PCM or to RIO programmed for shutoff R93 Vent plug: vent all air pressure & be accessible R94 Don't plumb solenoid valve outputs together 10.10 Operator Console R95 NI Driver Station rev 19.0 or newer R96 must include diagnostic graphic display visible for inspection and match R97 Driver station: direct connect to FMS (no switch) using proded cable. Ethernet port accessible. R98 ≤ 60" long, ≤14" deep or worn/held, ≤78" from floor, no attachment
R75	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK Wires on MCs cut, stripped, connectorized Devices repaired (not improved) Talon SRX data port cover removed Tape may be applied to Al plate inside radio Except designated 12V input, no 12V power, RM, or MC outputs shall be connected to the RIO Every power controller connected properly* Motors controlled via MXP must be controlled via PWM pins, passive conductors to extend same, or an approved ACTIVE DEVICE: : Kauai Labs navX MXP; RCAL MXP daughterboard; REV RIOduiono; REV Digit Board;	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output R92 Nason p. switch SM-2B-115/R443; high side, wired to PCM or to RIO programmed for shutoff R93 Vent plug: vent all air pressure & be accessible R94 Don't plumb solenoid valve outputs together 10.10 Operator Console R95 NI Driver Station rev 19.0 or newer R96 must include diagnostic graphic display visible for inspection and match R97 Driver station: direct connect to FMS (no switch) using proded cable. Ethernet port accessible. R98 ≤ 60" long, ≤14" deep or worn/held, ≤78" from floor, no attachment except loop tape & ethernet
R75	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK Wires on MCs cut, stripped, connectorized Devices repaired (not improved) Talon SRX data port cover removed Tape may be applied to Al plate inside radio Except designated 12V input, no 12V power, RM, or MC outputs shall be connected to the RIO Every power controller connected properly* Motors controlled via MXP must be controlled via PWM pins, passive conductors to extend same, or an approved ACTIVE DEVICE: : Kauai Labs navX MXP; RCAL MXP daughterboard; REV RIOduiono; REV Digit Board; WCP Spartan Sensor Board; Huskie 2.0 board.	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output R92 Nason p. switch SM-2B-115/R443; high side, wired to PCM or to RIO programmed for shutoff R93 Vent plug: vent all air pressure & be accessible R94 Don't plumb solenoid valve outputs together 10.10 Operator Console R95 NI Driver Station rev 19.0 or newer R96 must include diagnostic graphic display visible for inspection and match R97 Driver station: direct connect to FMS (no switch) using proded cable. Ethernet port accessible. R98 ≤ 60" long, ≤14" deep or worn/held, ≤78" from floor, no attachment
R75 R76	Fans on motor controllers from their power Spike relay ==> compressor may have breaker Wires, cables, signal connected as provided Fasteners, including adhesives OK Thermal interface material/paste ok Labels ok Jumpers may be moved. Jaguars: custom limit switch circuit OK Mfg supplied firmware updates OK Wires on MCs cut, stripped, connectorized Devices repaired (not improved) Talon SRX data port cover removed Tape may be applied to Al plate inside radio Except designated 12V input, no 12V power, RM, or MC outputs shall be connected to the RIO Every power controller connected properly* Motors controlled via MXP must be controlled via PWM pins, passive conductors to extend same, or an approved ACTIVE DEVICE: : Kauai Labs navX MXP; RCAL MXP daughterboard; REV RIOduiono; REV Digit Board; WCP Spartan Sensor Board; Huskie 2.0 board. Each CAN MC must be controlled from the RIO, passed via PWM (per	R86 ONE onboard compressor, 1.1 cfm. R87 Stored air ≤ 120 psi. None stored offboard. R88 One primary adj. releiving regulator ≤ 60 psi. R89 Only compressor, relief, p. switch, vent plug, gauge, tanks, tubing, p. transducer, filters, fittings on high pressure side R90 Gauges easily visible on high and low sides R91 Relief valve: hard fittings to compressor output R92 Nason p. switch SM-2B-115/R443; high side, wired to PCM or to RIO programmed for shutoff R93 Vent plug: vent all air pressure & be accessible R94 Don't plumb solenoid valve outputs together 10.10 Operator Console R95 NI Driver Station rev 19.0 or newer R96 must include diagnostic graphic display visible for inspection and match R97 Driver station: direct connect to FMS (no switch) using proded cable. Ethernet port accessible. R98 ≤ 60" long, ≤14" deep or worn/held, ≤78" from floor, no attachment except loop tape & ethernet R99 No wireless comms except FMS R100 No hazmat, unsafe conditions, or interference
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