UNIVERSITY OF HAWAIʻI AT MĀNOA · MECHANICAL ENGINEERING SENIOR DESIGN

JIK

YESHUA BIKES

Four ME seniors are converting a 1991 Suzuki RM250 to electric. On it we're building the Boost Tank, a gauge that shows the rider how many seconds of full power are left before the motor or controller gets too hot.



Our donor bike, a 1991 Suzuki RM250, before the gas engine comes out.

EXECUTIVE SUMMARY

THE PROJECT IN ONE PAGE

$2,268 spent so far	**$956** of parts still to buy	**Nov 30** rideable, instrumented bike	**70%+** of surveyed riders have hit thermal limits

WHO	Team JIK: four mechanical engineering seniors in ME 482 at UH Mānoa, advised by Dr. John Allen. Riley Lau · Boyd Hagihara · Adrian Ravelo · Cameron Austin
THE PROBLEM	An electric motor can make far more power in a short burst than its cooling can carry away. The hottest parts heat up in seconds while the sensors lag, so controllers either cut power early or drop the rider into limp mode with no warning.
OUR SOLUTION	The Boost Tank. An ESP32 reads motor current and temperatures, predicts how many seconds of full power are left, shows it like a fuel gauge, and only allows boost while the tank has room. It talks to the controller over its standard CAN port, so no custom controller firmware.
THE BIKE	A 1991 Suzuki RM250 with a liquid cooled QS138 motor, a VESC controller, one coolant loop and a donated 72 V battery we're upcycling with a new BMS.
WHERE WE ARE	Motor, controller, cooling loop, telemetry hub and a new BMS and charger bought. A local powersports shop donated a 72 V battery. Won a $500 PACE Kalo Grant. Bench tests start Nov 16.
WHAT WE NEED	$956.04 in parts to finish (full list on the BOM tab), plus testing and a spring 2027 phase. Department and college funds cover part of it. Sponsors fill the rest.
ALSO LOOKING FOR	Time on a local dyno to test the bike. See the Donate tab.
HOW TO HELP	Give through The 1112 Initiative Foundation (our preferred, tax deductible route), buy a part outright, or give through UH. See the Donate tab.
LONG TERM	Rider trials at Kahuku over the winter, then the UH Venture Competition in spring 2027 with real ride data.	

WHERE WE ARE

TIMELINE

DONE	Donor bike, coolant loop, motor and telemetry hub in hand. A local powersports shop donated a 72 V battery. Won a $500 PACE Kalo Grant. Switched to a VESC controller (on its way) and bought a new BMS and charger for the battery.	DONE
NOV 16 TO 30	Motor and controller bench tests on a loaned programmable DC supply, then battery tests.	UP NEXT
NOV 30	Rideable bike with the telemetry hub on board.	GOAL
DEC TO JAN	Rider trials at Kahuku Motocross Park. Stock fixed-timer boost against our Boost Tank: cutouts, peak temperatures and boost delivered.	PLANNED
SPRING 2027	UH Venture Competition with real ride data.	PLANNED

Already helping us

- Our department and college fund the core build parts.
- A local powersports shop donated a 72 V battery pack that wouldn't charge. We're bringing it back with a new BMS.
- A local engineering firm is loaning us a programmable DC supply.
- UH Electrical and Computer Engineering is lending an oscilloscope.
- A licensed power electronics engineer is mentoring our test setup.

SUPPORTERS

WHO'S BACKING THE BUILD

GRANT · $500

PACE Kalo Grant

UH Mānoa's Pacific Asian Center for Entrepreneurship backed the build with a Kalo Grant. Mahalo, PACE.

OPEN SPOT

Your company here

Sponsors get their logo on the bike, our poster and our final report, plus updates on how the money was used.

THE BUILD

WHAT'S ON THE BIKE

DONOR	1991 Suzuki RM250 Two stroke motocross bike, engine coming out	MOTOR	QS138 90H, liquid cooled 4 kW rated, built-in reduction, chain drive
CONTROLLER	VESC Labs Classic+ 100V Open source, current set live by the ESP32 over CAN	BATTERY	72 V pack, upcycled from a failed battery On loan, testing in November
COOLING	Motor and controller on one coolant loop Pump, radiator and fans from Golden Motor	BRAIN	ESP32 telemetry hub Logs temperatures, coolant flow, current and power to SD
DISPLAY	3.5 in handlebar screen Shows the Boost Tank and part temperatures	THROTTLE	Kickdown boost Twist past a click to ask for boost

HOW THE BOOST TANK WORKS

THREE STEPS, MANY TIMES A SECOND

1

Measure

Motor current, motor and controller temperatures, and coolant temperature and flow go into the ESP32.

2

Predict

A small heat model of the windings and the case turns current into the seconds of full power left before any part reaches its limit.

3

Gate boost

When the rider clicks for boost, the ESP32 raises the controller's current limit over CAN only while the tank has room, and shows the number on the dash.

SAFETY

HOW WE TEST SAFELY

The pack runs up to 84 V and well over 100 A, so every test follows the same rules.

Before any high voltage test

- A written risk assessment, reviewed by our department
- An approved test location
- Nobody works alone, ever
- A licensed power electronics engineer reviews our setup

In the power path

- 200 A Class T main fuse
- Anti-spark connectors and a precharge step
- A contactor on a key switch
- A lanyard kill switch that cuts power when pulled

Battery and bench

- Charged to 82 V max for testing, supervised
- ABC extinguisher and fire blanket on hand
- Regen off on the bench supply, motor clamped, chain guarded
- 1000 V insulated tools and an IR camera to watch temperatures

BILL OF MATERIALS · UPDATED NOV 9, 2026

EVERY PART, WHAT IT COST, WHAT'S LEFT

SPENT SO FAR	STILL TO BUY	ONLY IF A CHECK CALLS FOR IT	NEXT PHASE, SPRING 2027
$2,267.80	**$956.04**	**$449**	**~$250**

Prices are list prices before Hawai‘i tax and shipping. Department and college funds cover part of the list. "If needed" parts are only bought if a test or fit check calls for them. TBD means not priced yet.

Spent so far — $2,267.80

ITEM	COST	STATUS
1991 Suzuki RM250 donor bike With stock radiator	$350.00	BOUGHT
QS138 90H liquid cooled motor 4 kW rated, built-in reduction, incl. shipping and tax	$731.70	BOUGHT
VESC Labs Classic+ 100V controller Open source, 300 A, talks to the ESP32 over CAN. Replaces the FarDriver (returned, refunded). Incl. FedEx from Sweden	$375.28	BOUGHT
Telemetry hub parts ESP32 x2, SD logging, clock, coolant probes, ADCs, flow meter, current sensing, energy meter, 3.5 in display, switches, encoder, harness connectors	$289.09	BOUGHT
Golden Motor liquid cooling system Pump, radiator, fans and converter, incl. shipping	$168.82	BOUGHT
Bench loop fittings and heater Tees, barbs, clamps, PTFE tape, 300 W immersion heater, reference thermometer	$76.61	BOUGHT
JK smart BMS (JK-BD6A20S20P) New BMS for the upcycled 72 V pack, 200 A, active balancing, Bluetooth. Incl. tax	$109.94	BOUGHT
84 V 5 A battery charger YZPOWER, for the upcycled pack. Incl. tax	$72.24	BOUGHT
Pack charge plug M23 2+1+5 waterproof plug set for the pack's charge port	$11.40	BOUGHT
CAN boards SN65HVD230 transceivers, 2 pk (ESP32 to VESC, battery CAN). Incl. tax	$17.79	BOUGHT
Raspberry Pi Pico boards 2 pk, CAN logger for diagnosing the battery. Incl. tax	$14.51	BOUGHT
Torx security bit set To open the battery pack case. Incl. tax	$10.46	BOUGHT
FarDriver USB programming cable Not needed after the switch to VESC, being returned	$39.96	RETURNING
Total	**$2,267.80**	

Loaned, borrowed and on hand

Traction battery — DONATED

72 V, 35 Ah pack that wouldn't charge. Donated by a local powersports shop; we're upcycling it with a new BMS and charger

Programmable DC supply — LOANED BY A LOCAL ENGINEERING FIRM

Bench power for motor and controller bring-up, Nov 16 to 30

Oscilloscope — LOANED BY UH ECE

Throttle, hall and noise checks

IR camera — ON HAND

Thermal images during tests

Machine shop and 3D printer UH SHOP

Motor plates, throttle collar, sensor and dash housings

Drivetrain and high voltage

$167.60 needed

ITEM	QTY	COST	STATUS
Red port mating plug (Gridpower) Connects the pack's red discharge port to the bike's 6 AWG run. Backup charge plug for step 7.	1	$25.00	IF NEEDED
Class T main fuse, about 110 to 125 A Main fuse on pack +. Protects the 6 AWG run.	1	TBD	IF NEEDED
VOZINMOST Class T holder Holder for the main fuse.	1	$22.99	IF NEEDED
QS8-S anti-spark plugs, 5 pairs On pack + and pack −. Unplugged means the bike is off. Swap point between the pack and the bench supply.	1	$29.99	NEEDED
BNTECHGO 6 AWG red + black, 3 ft each Pack + to fuse, fuse to QS8, QS8 to contactor, and the negative run.	1	$21.98	NEEDED
TKDMR 6 AWG 5/16 in lugs, 10 Ends for the 6 AWG runs, VESC leads and the M8 0 V bolt.	1	$7.98	NEEDED
TKDMR 4 AWG 5/16 in lugs, 10 QS138 phase lead ends.	1	$7.99	NEEDED
TEMCo hammer lug crimper Crimps the 6 and 4 AWG lugs.	1	$13.50	NEEDED
Hongfa HFE82V-300C contactor, 300 A, 12 V coil Main switch on pack +. The coil runs through the key and the lanyard.	1	$58.80	NEEDED
Qjaiune 100 ohm 25 W resistor, 2 pk Precharge. Fills the VESC capacitors so the contactor and the BMS never see inrush.	1	$5.49	NEEDED
Ulincos 16 mm momentary button Precharge button, in series with the resistor.	1	$7.88	NEEDED
Witproton 10 A PV fuse holder Fuses the DC-001 input off the contactor input stud.	1	$13.99	NEEDED
72 to 12 V 10 A buck Fallback 12 V source.	1	$16.99	IF NEEDED

12 V system

$151.91 needed

ITEM	QTY	COST	STATUS
Blue Sea 5025 fuse block Six 12 V circuits off the DC-001. Rated 32 V, so 12 V side only.	1	$31.16	NEEDED
ATO blade fuse kit, 60 pcs 5 A coil, 3 A pump, fans and hub.	1	$6.59	NEEDED
Ignition key switch, 2 wire Key in the contactor coil line.	1	$8.99	NEEDED
Dual circuit kill lanyard Circuit 1 opens the contactor coil. Circuit 2 tells the ESP32.	1	$22.19	NEEDED
1N5819 diodes, 100 Flyback diode across the contactor coil, unless it has built-in suppression.	1	$7.99	NEEDED
DROK 12 to 5 V buck, 6 A 5 V for the hub, TFT, SD and flow meter.	1	$17.99	NEEDED
14 AWG red + black primary wire DC-001 yellow to the fuse block, and the 0 V bus to the junction.	1	$12.00	NEEDED
18 AWG red + black primary wire 12 V circuits and the precharge loop.	1	$10.00	NEEDED
Insulated ring terminal kit + ratchet crimper 5/16 in rings for 18 to 14 AWG and #8 rings for the fuse block.	1	$25.00	NEEDED
1 in 3:1 adhesive heat shrink Covers the bolted phase splices and the 0 V junction.	1	$10.00	NEEDED

Signals and telemetry

$172.11 needed

ITEM	QTY	COST	STATUS
Axiniu dual hall throttle Twist throttle into VESC AD1. 5 V hall, about 0.8 V closed to 3.8 V open.	1	$42.99	NEEDED
Weasch IP67 roller switch, 2 pk Kickdown click at full throttle (boost request to the ESP32).	1	$12.99	NEEDED
HARFINGTON M6 ball plunger, 5 pk Kickdown detent.	1	$6.19	NEEDED

ITEM	QTY	COST	STATUS
Hydraulic brake switches x2 Brake signal into VESC AD2 and the ESP32.	1	$15.34	IF NEEDED
DOT 4 brake fluid Bleed after fitting the brake switches.	1	$10.00	IF NEEDED
Ceramic capacitor kit (100 nF) Kickdown debounce, ADC and CAN decoupling.	1	$14.99	NEEDED
22 AWG 4C shielded cable, 25 ft CAN pair and probe runs.	1	$16.99	NEEDED
Ceedmon clip-on ferrites, 20 On the throttle, hall and CAN leads near the VESC.	1	$8.99	NEEDED
Deutsch DT kit, 2 to 12 pin, with crimper Break points so the hub, dash and motor come off without cutting.	1	$38.99	NEEDED
ADuM3160 USB isolator Laptop to VESC Tool or the hub while 72 V is live.	1	$16.99	NEEDED
Arctic MX-4 paste Surface probes on the motor case and pack. Tape them on, no glue.	1	$4.99	NEEDED
ESP32 lead for the JK data port (4 pin, 1.25 mm) JK BMS data into the ESP32 at 115200 baud.	1	$8.00	NEEDED
UGREEN SD card reader Read the SD logs on a laptop.	1	$8.49	IF NEEDED
CR2032 coin cell RTC backup.	1	$2.00	IF NEEDED

Battery: BMS swap and charging

$51.97 needed

ITEM	QTY	COST	STATUS
Kuject solder seal connectors, 120 Splice the JK balance harness one wire at a time.	1	$9.99	NEEDED
Pangda fish paper, adhesive Insulation under the BMS and over exposed busbars.	1	$11.99	NEEDED
MYJOR Kapton tape Tape exposed metal inside the pack.	1	$9.99	NEEDED
2 cam straps + rubber pad Hold the pack in the cradle and keep it removable.	1	$20.00	NEEDED
M6 ring lugs for the JK BMS terminals Pack's internal B− and P− cable onto the JK's M6 studs.	1	$8.00	IF NEEDED
Second NTC 10k probe Second JK temp probe on the middle cells.	1	$7.00	IF NEEDED
15 A PV fuse + inline holder Fuse on the charge lead.	1	$14.00	IF NEEDED
Neutral cure RTV Reseal the case.	1	$10.00	IF NEEDED

Cooling loop

$41.27 needed

ITEM	QTY	COST	STATUS
PATIKIL 40 x 120 mm cold plates, 2 pk Side by side under the VESC (107 x 72 mm), in series.	1	$14.29	NEEDED
Aairhut thermal pad 13 W/mK, 120 x 120 x 1 mm VESC base to the cold plates.	1	$11.98	NEEDED
3/8 in ID silicone hose, 10 ft More hose for the loop.	1	$19.99	IF NEEDED
Coolant, distilled + aluminum safe Loop fill.	1	$15.00	NEEDED

Mechanical

$92.79 needed

ITEM	QTY	COST	STATUS
M8 x 30 grade 8.8 bolt kit Phase splices, 0 V junction, brackets.	1	$10.99	NEEDED
M10 x 40 grade 8.8 bolt kit Motor plates to the stock engine bosses (match sheet C1 to C3).	1	$13.69	NEEDED
M8 rubber isolators, 4 Battery cradle mounts.	1	$9.99	NEEDED
6061 plate, 1/4 in, 12 x 12 in Motor side plates.	1	$45.39	NEEDED
6061 angle, 1.5 x 1.5 x 1/8 in Battery cradle.	1	$12.73	NEEDED
520 13T sprocket for the QS138 Front sprocket.	1	$49.99	IF NEEDED
520 chain Drive chain.	1	$76.81	IF NEEDED

Tools and safety

$89.39 needed

ITEM	QTY	COST	STATUS
Gunpla 1000 V insulated tools Insulated screwdrivers and pliers. The SOP requires them.	1	$29.99	NEEDED
UNI-T UT210e clamp meter DC current checks: load steps, precharge, charger, VESC current.	1	$65.99	IF NEEDED
Wagner HT1000 heat gun Lug heat shrink and solder seals.	1	$33.49	NEEDED
Kester 44 solder Hub and harness solder joints.	1	$15.93	NEEDED
Pinecil V2 soldering iron Soldering iron.	1	$42.00	IF NEEDED
iCrimp SN-28B crimper Dupont and JST crimper for small connectors.	1	$22.29	IF NEEDED
Wire stripper + flush cutters Prep for every run.	1	$31.96	IF NEEDED
Fire blanket On hand for every live battery step.	1	$9.98	NEEDED
ABC extinguisher On hand for every live step.	1	TBD	NEEDED

Testing and later

$189.00 needed

ITEM	QTY	COST	STATUS
Rider trials at Kahuku Track day fees and thank yous for test riders.	1	$189.00	NEEDED
PCM boost buffer Wax block in the coolant loop. Spring 2027.	1	$250.00	SPRING 2027

Hand tools the team already owns (sockets, wrenches, drill, calipers) aren't listed.

DONATE

THREE WAYS TO HELP

Every gift goes to parts, testing and the next phase of the bike. Mention "Yeshua Bikes" with your gift.

PREFERRED

Give through The 1112 Initiative Foundation

The 1112 Initiative Foundation is a 501(c)(3) nonprofit, so gifts are tax deductible. Anything we don't spend this semester stays with the foundation for the next phase of the bike and future student builds.

- **Online:** email us and we'll send the giving link.
- **By check:** payable to The 1112 Initiative Foundation, memo "Yeshua Bikes." Email us for the mailing address.
- **Receipt:** we'll send our EIN and a receipt for your records.

FASTEST

Buy a part outright

Pick any item marked Needed on the BOM tab. Email us first so we don't double up, and we'll send the shipping address.

A part counts toward a sponsor level at its price.

THROUGH UH

Give through the University of Hawai‘i Foundation

Prefer to give through the university? We're setting up a UH Foundation option for our project. Email us and we'll send the details once it's confirmed.

About The 1112 Initiative Foundation

The 1112 Initiative Foundation is a 501(c)(3) nonprofit and our preferred home for project gifts. Gifts marked "Yeshua Bikes" go to this build, and anything left over funds the next phase and future student engineering builds. We'll send our EIN with your receipt.

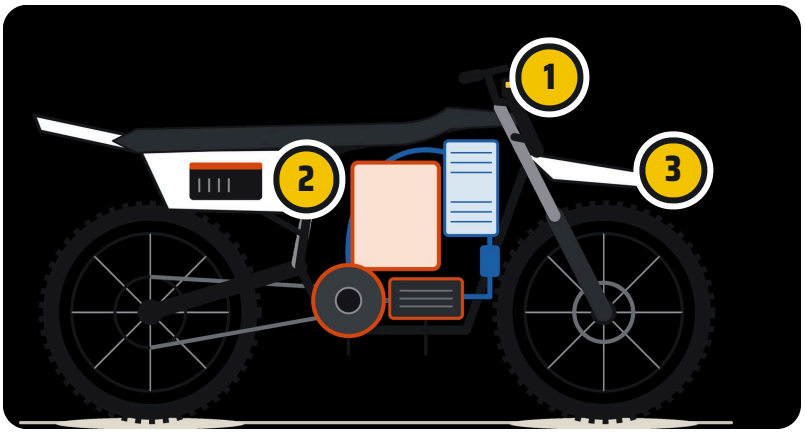
Have a dyno on O‘ahu?

We're looking for a local dyno to test our bike. A motorcycle chassis dyno (like a Dynojet) for a few pulls once the bike runs, or a motor dyno or DC load bank for our bench tests. It would show the real torque and power the Boost Tank is managing. We'd credit you on the bike, our poster and our final report.

LOGO PLACEMENT

WHERE YOUR LOGO GOES

Motocross bikes carry three number plates. That's where sponsors go. We'll confirm the spot and size with you before anything is printed.



1 **Front number plate · Factory $1,000+**
The biggest logo, facing forward in every photo of the bike.

2 **Side number plates · Podium $500+**
Both sides, under the seat.

3 **Fenders and shrouds · Holeshot $250+**
A smaller logo on the bodywork.

P **Poster and final report · Pit Crew $100+**
Your name on our sponsor list.

SPONSOR LEVELS

GET YOUR NAME ON THE BIKE

Each level includes everything in the levels before it.

PIT CREW

$100+

- Your name on our poster and final report
- A thank you in our build updates

HOLESHOT

$250+

- Your logo on the bike, poster and final report
- Build update emails as we test

PODIUM

$500+

- Your logo on a side number plate
- A shout out in our final presentation
- An invite to a bench test or ride day

FACTORY

$1,000+

- Your logo on the front number plate
- Featured in our final presentation and build posts
- We'll present the project to your team if you'd like
- Meet our team, resumes on request

AFTER YOU GIVE

WHAT YOU'LL HEAR FROM US

WITHIN A WEEK

A thank you, plus a receipt if you gave through the foundation.

NOV 16 TO 30

Build updates and photos from the motor bench tests.

AFTER NOV 30

Results from the first rides, and where the money went.

AFTER KAHUKU TRIALS

The A/B test results: stock boost against our Boost Tank.

QUESTIONS

FAQ

Is my gift tax deductible?

Gifts to The 1112 Initiative Foundation are, since it's a 501(c)(3). We'll send a receipt with our EIN. Buying a part and shipping it to us is a purchase, not a gift to the foundation. Check with your tax advisor for your own situation.

Can I give a part instead of money?

Yes. Pick any item marked Needed on the BOM tab and email us first so we don't double up. We'll send the shipping address.

How do you use my logo?

Only in the spots your level includes, and only after you send a logo file and OK the placement.

What happens to money you don't spend?

Gifts through the foundation stay there for the next phase of the bike and future student builds. Gifts through UH stay in that UH fund.

Can I see the bike?

Yes. Email or call and we'll set up a time at the shop, a bench test, or a ride day.

Is this safe?

Every high voltage test has a written risk assessment, an approved location, two people present and a kill switch. See the safety section on The build tab.

CONTACT

LET'S TALK

Email or call for giving details, the shipping address, photos, or a time to come see the bike. Mahalo for considering us.

SPONSOR CONTACT

Riley Lau

EMAIL

rileylau@hawaii.edu

PHONE

808 308 5514

FACULTY ADVISOR

Dr. John Allen, Mechanical Engineering, UH Mānoa

Yeshua Bikes · Team JIK · ME 482 · University of Hawai‘i at Mānoa · Updated Nov 9, 2026