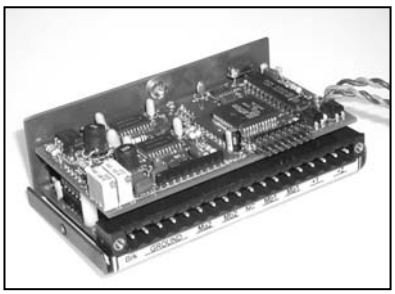
VANTEC

Orders: **(800)882-6832**

R/C DUAL FORWARD & REVERSE SPEED CONTROL - Mixed Steering

RDFR2x



- **MODELS RDFR21 - RDFR23**
- **ROBOTS, TANKS & TWIN SCREW BOATS**
- **INSTALLATION, WIRING, PROGRAMMING**
- **DUAL CONTROLS IDEAL FOR STEERING WITH RIGHT & LEFT MOTORS**

OVERVIEW: The **RDFR** DIRECTORs perform speed, direction and steering functions for **R**adio/**C**ontrolled vehicles powered by two independent electric motors employed as a right drive and a left drive. They're used for **robots** with tank tread drives or separate drive wheels, and twin-screw boats or subs where maneuverability is enhanced by differential props combined with rudder steering. They require two R/C channels, one to command throttle speed & direction and the other steering. Each **RDFR** unit has two rugged forward/reverse speed controls coupled together through special logic that generates the differential right and left motor rotation needed to guide the vehicle. When used with a spring centered joy stick: hands off is stopped, up stick gets straight ahead, and down yields backwards. Pure right or left twirls the vehicle as the motors turn opposite directions. In between stick positions are completely proportional, including reverse. Other modes of operation are available. **RDFR** DIRECTORs are compatible with most model R/C systems, including Futaba and Direct Current Permanent Magnet field brush commutated iron core wound rotor type motors.

These instructions are for the **RDFR21** through **RDFR23**. ***PLEASE*** read and understand them before connecting power. The RDFR32 through RDFR61E have a separate instruction manual.

VERIFY MODEL SEL ECTION: On page 2 the **SPEC CHART** shows ratings for one *single* motor output. Measure your motor's continuous running current under *actual normal mechanical load*. OR use the **SELECTOR CHART** on this page. Begin by determining your motors armature terminal resistance by consulting specifications or measurement. Armature resistance cannot be measured with a normal ohm meter. Instead, take the measurement by mechanically locking the motor shaft and reading the current drawn while briefly powered from a *fresh* alkaline 1.5 volt **"D"** cell. The **SELECTOR CHART** on this page shows armature resistance in **"D"** cell amps or specified ohms. At your operating voltage the **RDFR** model chosen should list *lower* Ohms or *higher* Amps than your motor. VANTEC surge ratings express usable motor starting surge current over a realistic 5 second period. More powerful models not shown on this chart are described at www.vantec.com.

SELECTOR CHART

V	Ohm	"D"Amp	Part#	V	Ohm	"D"Amp	Part#
5	0,09	12	**RDFR21**	18	0,34	3.7	**RDFR21**
5	0,06		**RDFR22**	18	0,24	5.2	**RDFR22**
5	0,04		**RDFR23**	18	0,18	6.5	**RDFR23**
9	0.17	7	**RDFR21**	24	0.46	2.9	**RDFR21**
9	0,12	9	**RDFR22**	24	0,32	4	**RDFR22**
9	0,07	13	**RDFR23**	24	0,23	5.7	**RDFR23**
12	0,23	5.3	**RDFR21**	30	0,57	2.3	**RDFR21**
12	0,16	7	**RDFR22**	30	0,40	3.2	**RDFR22**
12	0,11	10	**RDFR23**	30	0,28	4.6	**RDFR23**

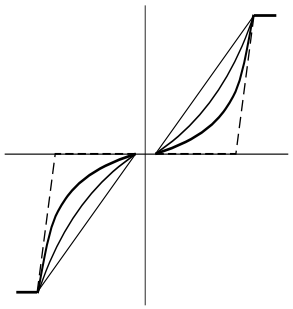
JUMPERS: The Jumpers are factory set for the most popular single joystick mixed tank type steering mode and we suggest the unit first be tested in this default mode. The default is noted in the jumper tables by the shaded sections. Jumper ON= installed=present=closed.

DUAL IN PUT MODES : These modes use both R/C **S**ervo **C**ommand **P**ulse inputs.

MIXED FOR TANK STE ERING: Five algorithms are jumper selectable: **LINEAR**, mild **EXPO**nential**1**, moderate **EXPO**nential**2**, & **SKIP.** The **EXPO**nential modes spread the steering to provide a gently increasing steering function for very precise neutral steering.

MANUAL

The **SKIP** algorithm is for boats with rudders. It mixes steering into the speed commands only near the extremes of rudder steering. This gives maximum speed and stable roll forces and still offers maneuverability, especially for subs. A Y-connector splits the steering command to the **RDFR** and the rudder servo.



Gain selection: most users prefer **HI** gain to get the maximum possible speed with the stick straight up. However, when the vehicle turns at full speed the wheel on the inside slows down but the outside wheel can't go any faster because it's already at top speed. The **MED** Gain provides a reserve for the outside wheel to speed up. The calibration is based upon a Futaba FP-8UAP with 100% ATV, 100% Dual Rate, no trim, centered at 1.53 ms, and factory defaults. This works well with other popular radios. Adjustment of gain may also be made at the transmitter using the ATV servo travel adjustment potentiometer. The Notch defines the starting duty cycle so your motor isn't driven with a non-rotating but power wasting duty cycle. Deadband is the joystick movement around center that produces no action; it makes "off" easy to find.

NON-MIXED D UAL INP UT: The mixing function may be defeated to realize two independent speed controls with two independent Servo Command Pulse inputs. This enables you to control your vehicle with a separate joystick for each motor and do the turning algorithm with your thumbs. **SCP** Input **S**=Motor **#1**, SCP input **T**=Motor **#2**. To implement: install jumper **JP2**. The **RDFR** is the only controller that gives you your choice. Note this configuration may have matching curve pairs or different algorithms for each output.

The default PWM chopping frequency is the recommended 338 Hz. Install jumper **JP1** to select 21.6 KHz . The **RDFRs** operate optimally in a radio environment at the default 338 HZ. At 21.6 KHz much more RFI is generated which requires additional RFI filters and the amperage must be *derated* to 30%.

BRAKING AND REVERSING: the optically isolated outputs are **P**ulse **W**idth **M**odulated full H-bridge circuits. For speed control the bottom half of the bridge is modulated while the diagonal upper bridge leg is held on. Sequenced electro-dynamic braking shunts the motor by modulating both top legs of the bridge. With a command to "stop" the brake is gently ramped from 0 to 100% duty cycle. When an R/C command changes direction the brake is quickly sequenced to first bring the motor to a halt, then the reversing **PWM** power is accelerated up to the commanded speed. This forced sequencing minimizes motor "plugging" and stress on your mechanical components. Jumpers **JP3** and **JP4** select the appropriate ramping for your application.

BRAKING/ACCELERATION RAMP SELECTION in milliseconds 0 to 100%					
ARMATURE AT REST	GENTLE BRAKING (Normal Stop)	QUICK BRAKING (Change Direction)	ACCELER-ATION	JP3	JP4
Shunted	320 ms	71 ms	74 ms	OFF	OFF
Open	71 ms	640 ms	590 ms	ON	OFF
Shunted	1300 ms	320 ms	290 ms	OFF	ON
Shunted	640 ms	160 ms	150 ms	ON	ON

WIRING: Follow the layout schematic. Do not power the **RDFR** from batteries under charge, battery eliminators or chargers without consulting factory.

POWER & MOTOR: Observe battery polarity. The **SPEC CHART** shows the minimum size wire for battery power and motor wiring using the double

SPECIFICATION CHART

PART Number	VOLTAGE Range	Con't Amps Single Output	Start'g Output	TypLoss /LegOhms	Approximate Size	Wgt Oz	Wire AWG
RDFR21	5-30	14	45	.009	4.25 x 2.9 x 1.3	8	20
RDFR22	5-30	20	60	.005	4.25 x 2.9 x 1.3	8	16
RDFR23	5-30	30	80	.003	4.25 x 2.9 x 1.3	9	14

wire technique described below. The **RDFR21-23's** have two screw connections for each node to assure solid high current connections for the handy plug-in terminal block. Mis-wiring will destroy the controller. Run double wires, one from each screw connection for a node, to the respective motor terminal or fuse.. Alternatively use a single wire 2 sizes lower and split into two bundles at the terminal block; one bundle for each screw.

Run 4 wires from the 4 screws for the **GROUND** node; the ground supports the current for both motors. Alternatively use a ground wire that is 4 sizes lower than chart and split into four bundles at the terminal block; one bundle for each screw. Wire with the minimum length wire practical and keep this wiring separated from the **R/C** receiver and **SCP**ulse cables. Ground your chassis at a single point but don't use the chassis to conduct current. Use separate regular-blow fuses to feed the **+1** and **+2** power terminals. Begin initial operation with 10 amp regular blow automotive fuses and un-loaded motors. When correct function is established load the motors normally and select the smallest value fuse that will support normal operation. Think of the fuse as an inexpensive recording amp meter.

A 39VAC Black Disc **MOV** should be installed directly across motor brushes and a .001 ufd ceramic disc capacitor directly across motor brushes and between each brush and motor case for RFI protection.

SERVO COMMAND P ULSE: The inputs plug into your receiver like a servo and the connectors are engraved: Steering = **S**, and Throttle = **T**. The **RDFR** neither takes power from nor supplies power to the **R/C** receiver; thus the plus (red) wire is not used. Only the receiver common and your Servo Command Pulse signal wires are required to drive the optical isolators within the **RDFR**. Available with Futaba J or universal JR connectors, it works with **FM** or **PCM** radios. The universal connector can be plugged in the wrong way without harm on certain makes of radios but it won't operate the **RDFR.** With two connectors there are 3 ways to do it wrong and only 1 way to do it right. The brown wire should line up with an adjacent servos brown or black wire. Old Airtronics not supported.

If you decide to Y-connect the **RDFR** with the rudder servo or another **RDFR** be aware some **R/C** receivers don't have adequate **SCP**ulse drive without a "peanut" amplifier; contact the factory for this easy solution if a direct Y fails to work. Use the full length supplied R/C antenna and locate it away from other wires and metal structures.

BRAKE RELEASE or CLUTCH ENGAGEMENT EXTRA COST OPTION: provides 2 Amp output current sink that turns on when there's an R/C "motion" command to release mechanically actuated brakes built into certain types of motors. With a "stop" R/C command it goes off after a short delay. Connect at the single terminal block connection **BRK.** Install a flyback diode across your coil to protect the **RDFR.**

MOUNTING: Don't mount the unit directly adjacent to the R/C receiver. All competitive robot applications such as BattleBots which involve simultaneous operation of both halves at maximum ratings will require mounting the **RDFR** side-opposite-the-terminal-block to an additional heat sinking surface. Usually the metal frame of your vehicle is sufficient. No *special* heatsinks required. While mounting remove the cover to monitor the mounting screw length; screws should not thread into the case more than 1/8".

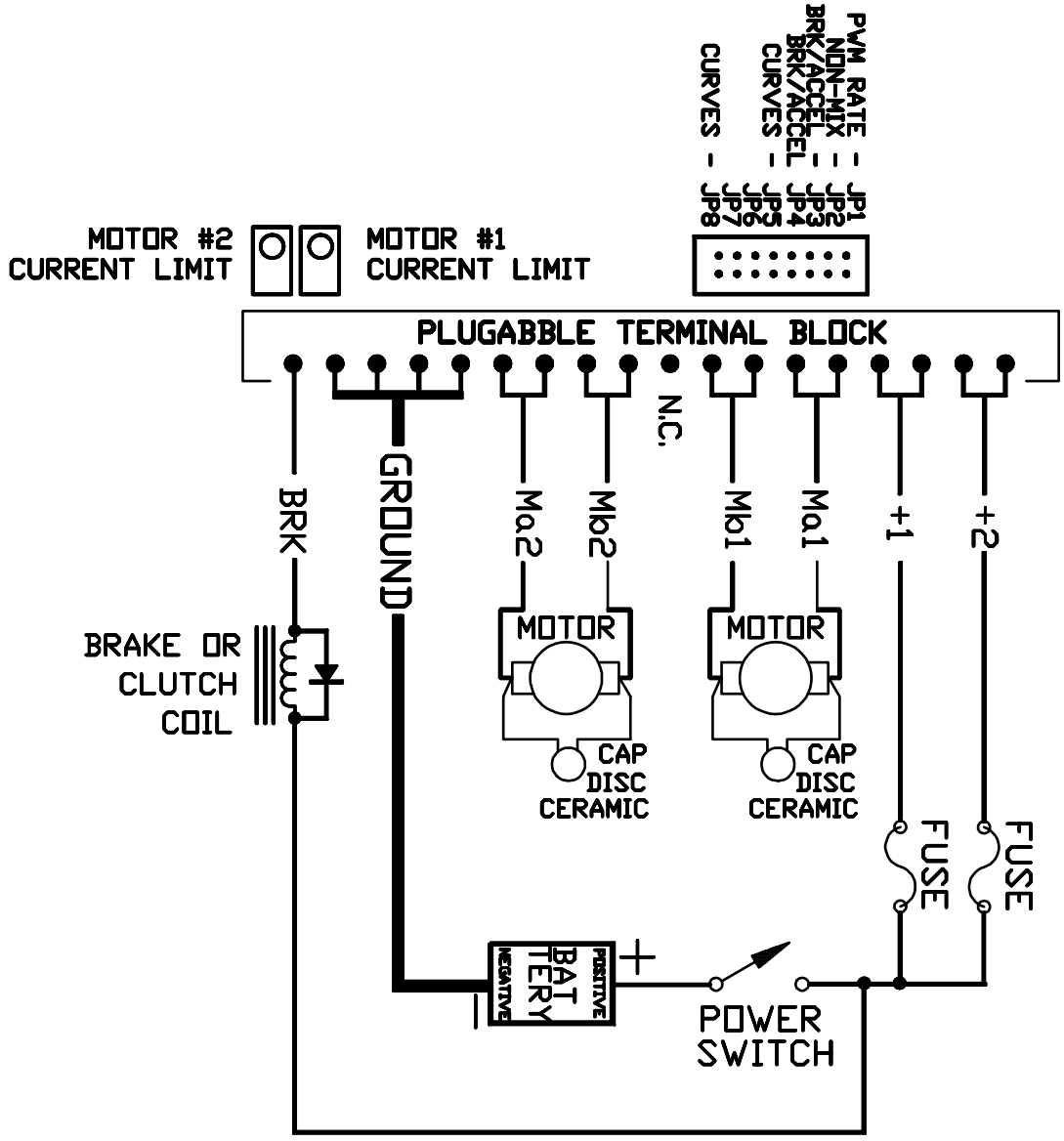
OPERATION: If the **RDFR** becomes too hot to hold continuously cease operation and investigate the cause. In the popular tank steering mixed mode both servo connectors must be plugged in for the unit to operate even one motor. Use transmitter trims of *both* channels to set motors off with centered deadband. Assignment of right/left motors to #1 or #2 outputs, motor(s) polarity, and transmitter servo reversing switches have numerous combinations; select the correct combination experimentally but **NEVER** reverse the motor battery polarity. Noise in sound systems is due to a poor power distribution scheme.

Output current through the **MOSFET**ransistors is compression limited above a threshhold by **PWM** duty cycle limiting. It works well for settings over 8 amps. As the controller heats up the current threshold is lowered. The threshhold adjustment trimpot for each output is factory set to defeat current limiting because most customers desire absolute maximum torque for their applications. CCW rotation decreases the limiter threshhold.

IMPORTANT DISCLAIMERS: These products are not safety devices nor for use in life-critical or life-support systems. For single channel controllers with these features see our **RSFR** spec sheet. Specifications and price subject to change without notice. Patented. Some tradenames & trademarks owned by others

DUAL INPUTS						SYNCOPATED COMBINED ALGORITHMS			
MIXED MODES					NON-Mixing	B0 (1)	B1 (2)	B2 (4)	B3 (8)
Curve Pairs		STEER GAIN Curve	THRTL GAIN Curve	Dead Band at center	**JP2**	**JP5**	**JP6**	**JP7**	**JP8**
LINEAR	A7	HI	HI	NONE	OFF	ON	ON	ON	OFF
	B6	HI	HI	NORM	OFF	OFF	ON	ON	OFF
	C8	HI	HI	WIDE	OFF	OFF	OFF	OFF	ON
EXPO1	D0	HI/Expo	HI	NORM	OFF	OFF	OFF	OFF	OFF
	E9	MED/EXPO	HI	NORM	OFF	ON	OFF	OFF	ON
	F4	HI/Expo	HI/expo	NORM	OFF	OFF	OFF	ON	OFF
	G15	HI/Expo	HI	WIDE	OFF	ON	ON	ON	ON
	H5	HI/Expo	HI/expo	WIDE	OFF	ON	OFF	ON	OFF
EXPO2	I11	HI/**EXPO**	HI/expo	NORM	OFF	ON	ON	OFF	ON
SKIP	J13	HI	HI	Special	OFF	ON	OFF	ON	ON
	K3	HI	HI/expo	Special	OFF	ON	ON	OFF	OFF
UNDEFINED	L1	CUSTOM	NA	NA	OFF	ON	OFF	OFF	OFF
UNDEFINED	M12	NA	NA	NA	OFF	OFF	OFF	ON	ON
UNDEFINED	N2	NA	NA	NA	OFF	OFF	ON	OFF	OFF
UNDEFINED	O14	NA	NA	NA	OFF	OFF	ON	ON	ON
UNDEFINED	P10	NA	NA	NA	OFF	OFF	ON	OFF	ON

NON MIXED MODES					NON-Mixing	INDEPENDENT OPERATION			
MATCHED PAIRS	Curve	Gain	Notch	Dead Band	**JP2**	**JP5**	**JP6**	**JP7**	**JP8**
LINEAR	4	HI	NONE	NONE	ON	OFF	OFF	OFF	OFF
LINEAR	5	HI	NONE	NORM	ON	ON	OFF	OFF	OFF
expoA	8	HI	NONE	NORM	ON	OFF	ON	OFF	OFF
EXPOB	10	HI	NONE	NORM	ON	ON	ON	OFF	OFF
LINEAR	12	HI	MED	NORM+	ON	OFF	OFF	ON	OFF
LINEAR	13	HI	MED	WIDE	ON	ON	OFF	ON	OFF
expoA	14	HI	MED	NORM+	ON	OFF	ON	ON	OFF
expoA	15	HI	MED	WIDE	ON	ON	ON	ON	OFF
UNMatched PAIRS	Curve	MOTOR1= S input	MOTOR 2= T input	see curves above	**JP2**	**JP5**	**JP6**	**JP7**	**JP8**
Curves		13	15		ON	OFF	OFF	OFF	ON
as		5	8		ON	ON	OFF	OFF	ON
described		5	14		ON	OFF	ON	OFF	ON
above		5	10		ON	ON	ON	OFF	ON
by		12	8		ON	OFF	OFF	ON	ON
curve		12	14		ON	ON	OFF	ON	ON
number		8	10		ON	OFF	ON	ON	ON
pairs		8	14		ON	ON	ON	ON	ON



LAYOUT SCHEMATIC

RDFR21-23 manual end