## **VEX Online Electronics Challenge**

RjTECH RJ-4100

LCHS 55885X

By

Liam Hays and Kevin Tran



The Rjtech RJ-400 from the top down. Note the amount of empty space as it is a miniaturized modern design.

The main control board for the system.

Our team decided to disassemble a Ritech RJ-4100, a combination DVD player and karaoke machine, also capable of static image display and audio file play. The main interface and media controller is based around the SUNPLUS SPHE8200A, a RISC-based multi-purpose video interface and DVD processor, capable of MPEG, WMA, and MP3 decoding, simple on-screen display geometry drawing, and analog video encoding for output to a screen. Supporting this main processor is another SUNPLUS chip, the SPHE6300A, an audio pre-amp for output to a television and surround sound system. Interestingly, we could find nearly no information on this chip. We speculate that it is responsible for amplifying the karaoke microphones, combining signals from the DVD processor for audio output, and managing the multiple signals needed for the surround sound output. An EON EN29F040A, 512 kB of flash memory, provides the operating system for the 8200A. The fact that this



is flash (as opposed to write-once ROM) suggests that the manufacturer had initially intended to make firmware upgrades available, but this isn't mentioned in the manual, so they likely never finished it or cut it to reduce costs. However, it's also possible that flash was more available and cheaper than standard ROM, so the manufacturer went with it instead. Next up is the chip to the far right of the photo to the right, a TMC TM54S16T6, which holds 4 MB of CMOS RAM. This is likely so large, in comparison to the flash ROM, to allow the processor to hold multiple frames (for example, to allow scanning through a DVD at high speed, or to read high-resolution JPEGs from a CD-ROM).

The audio outputs are driven by the SPHE6300A chip.



Moving on, the DVD motor is driven by a simple four-channel Shaoxing D5954 motor driver, designed specifically for optical disk reading and



laser lens control. Interestingly, the DAC is actually the tiny chip nestled between the pile of capacitors, the red jacks, and the white ribbon cable in the second picture above. It is a KasH DA1196H, a cheaper version of the same company's DA1196 DAC, and it is a 24-bit/192kHz 6-channel (for surround sound) DAC, specifically designed for DVD and MP3 decoding. Near this chip, too, is an AAT 4558AM, a dual op-amp. We aren't sure what this chip is here for---two channels isn't enough to support surround sound, and there's already a much more complicated amplifier elsewhere on the board, which is also likely providing amplification

*The internal motors are driven by the D5954.* board, which is also likely providing amplification for the microphones in the karaoke function. Finally, there is an EEPROM chip, likely used for storing user settings, to the lower left far corner in the second picture above. This is an Atmel 24C02N, 256 bytes of serial EEPROM, optimized for low-power operation.



Karaoke microphone input and volume control.

## Parts Table

Part Number	Manufacturer	Purpose	Notes
SPHE8200A Supplies Sphes200A 0431 -1-L MDG0240.00	SUNPLUS	DVD and media processor	RISC-based 32-bit machine that drives the whole system.
SPHE6300A	SUNPLUS	Some kind of audio pre-amp.	Amplifies the karaoke mic input, mixes sound, and amplifies the audio output for the TV.

SUNPLUS SPHE6300A 0513-A7 MH10161.1			
EN29F040A <i>Eov</i> <i>En29F040A</i> -70JC2 -J10324A 0505TJA	EON	512 kB flash	Provides the supporting OS for the DVD processor.
TM54S16T6	ТМС	4 MB CMOS RAM	Provides the DVD processor RAM to do its job.
D5954	Shaoxing	Optical disk motor driver	Controls the axle, lens, and tray motors in the DVD carriage.
4558AM	ААТ	Wedon't really know.	We can't identify this chip's purpose. Maybe it's an emergency solution for a design issue.
AT24C02N	Atmel	Serial EEPROM	Used for storing user settings.