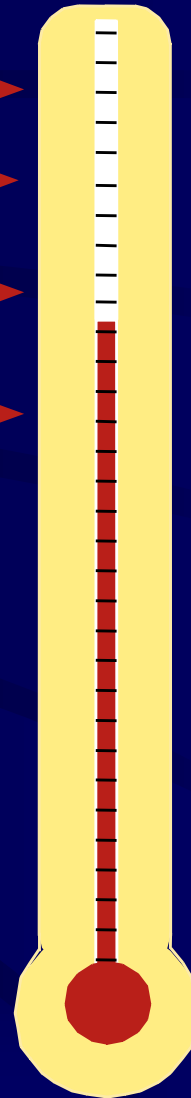
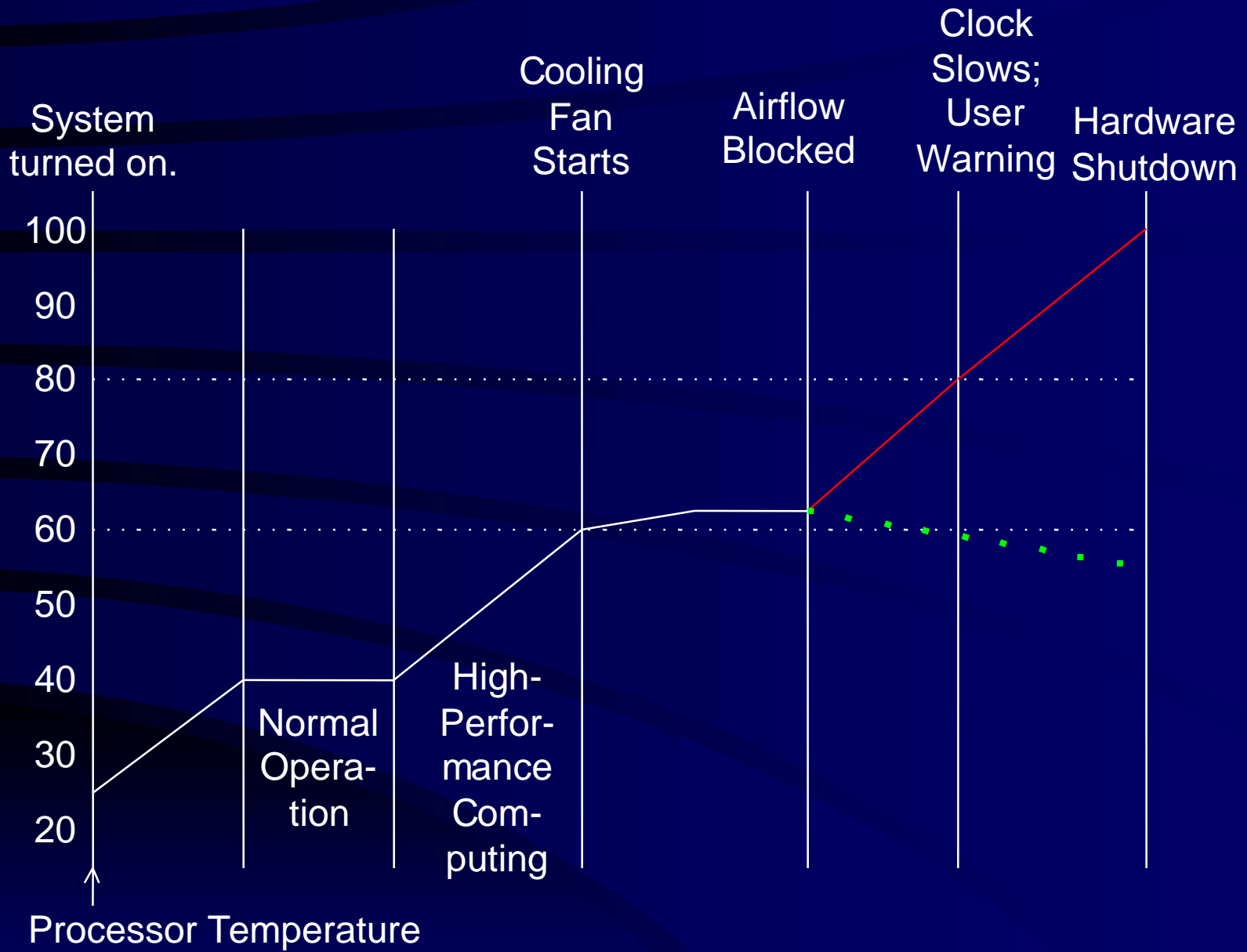


Sensing and Monitoring for Control and Protection

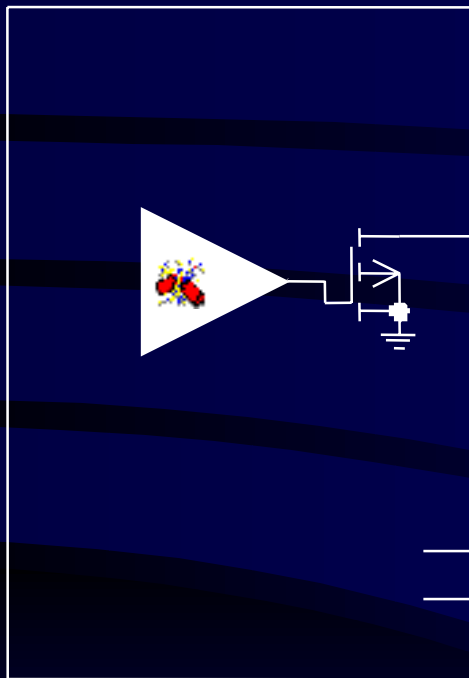
Thermal Management in Electronic Systems

- System Shuts Down
- User Warning
- System Clock Slows
- Cooling Fan Activates





Single-Comparator Sensors



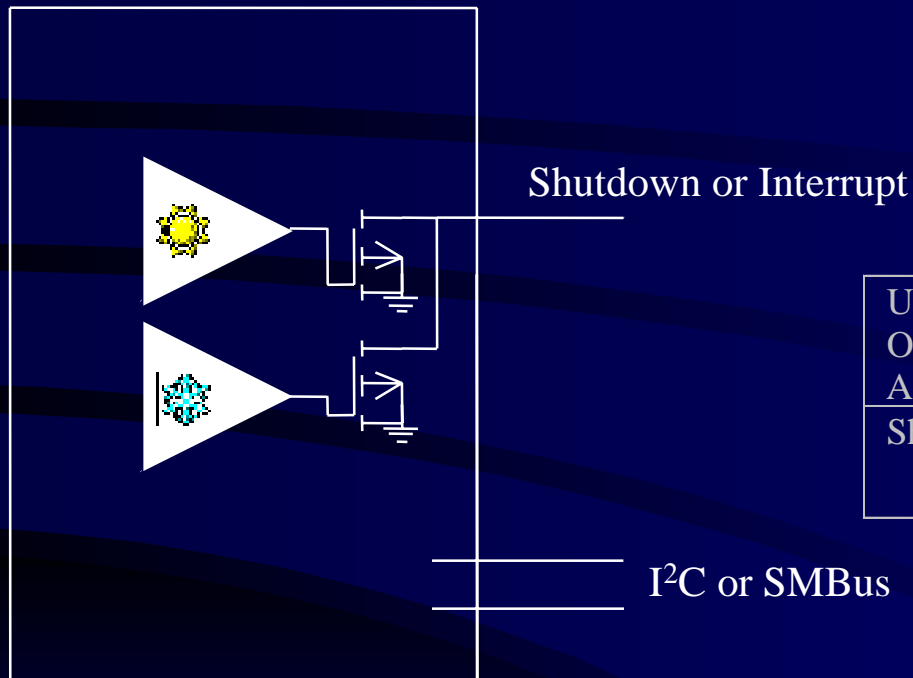
Shutdown or Interrupt

	Optimized for Software Efficiency	Optimized for System Reliability
Overtemperature Alarms	Interrupts	Polling via I ² C or SMBus
Shutdown	Software-Controlled	Software-Controlled If software doesn't work: Hardware

I²C or SMBus

Two Comparators, One Output

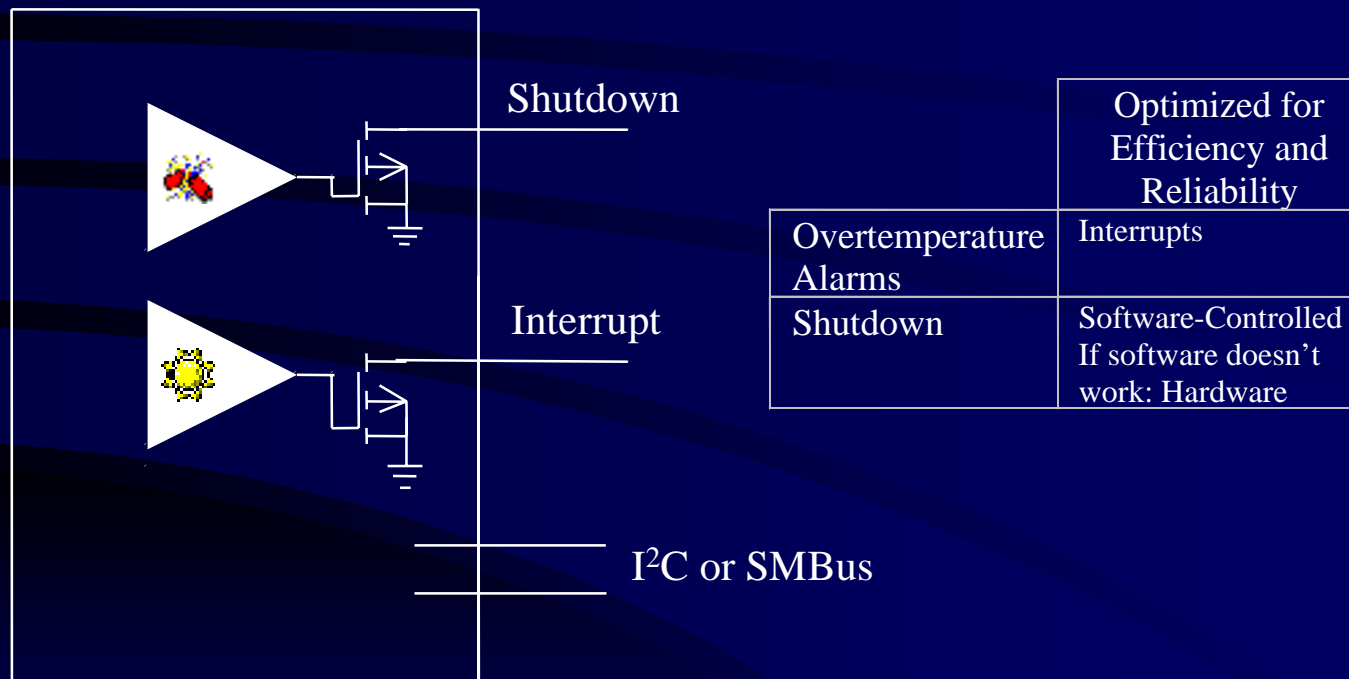
Similar, but you can also have low-temperature alarms.



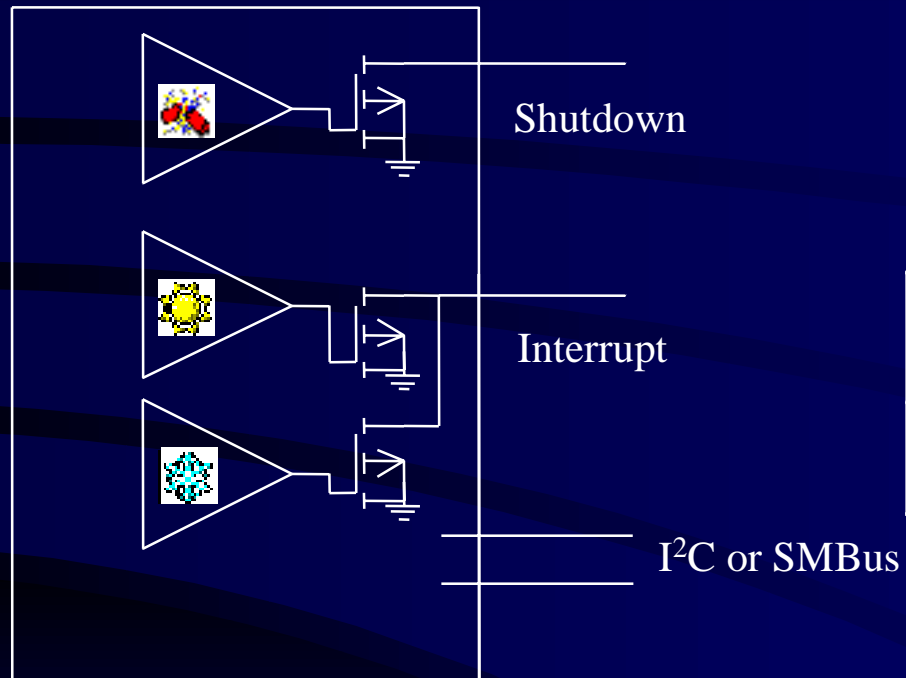
	Optimized for Software Efficiency	Optimized for System Reliability
Under- and Overtemperature Alarms	Interrupts	Polling via I ² C or SMBus
Shutdown	Software-Controlled	Software-Controlled If software doesn't work: Hardware

Two Comparators, Two Outputs

Efficient and Reliable

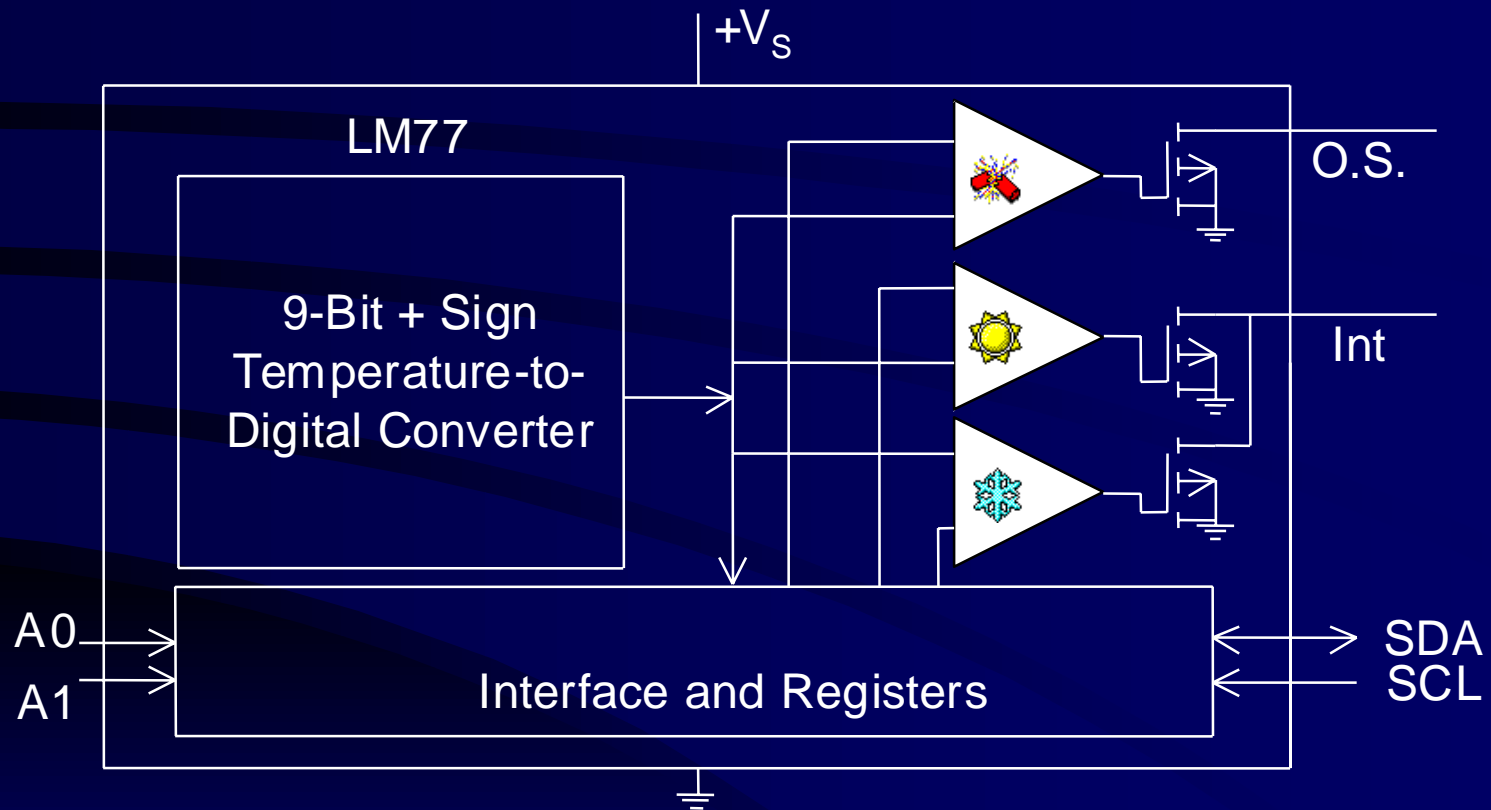


Three Comparators, Two Outputs

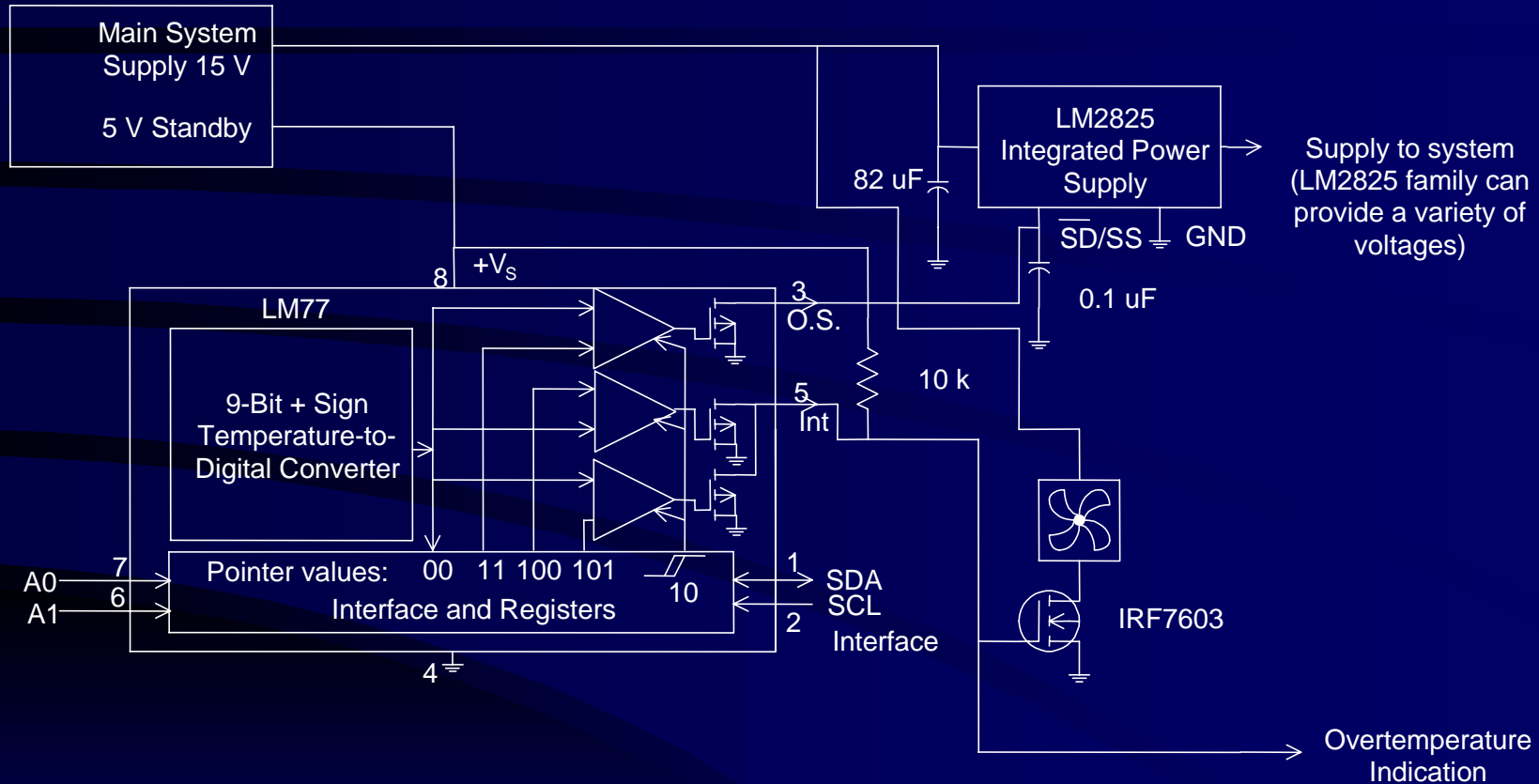


	Optimized for Efficiency and Reliability
Under- and Overtemperature Alarms	Interrupts
Shutdown	Software-Controlled If software doesn't work: Hardware

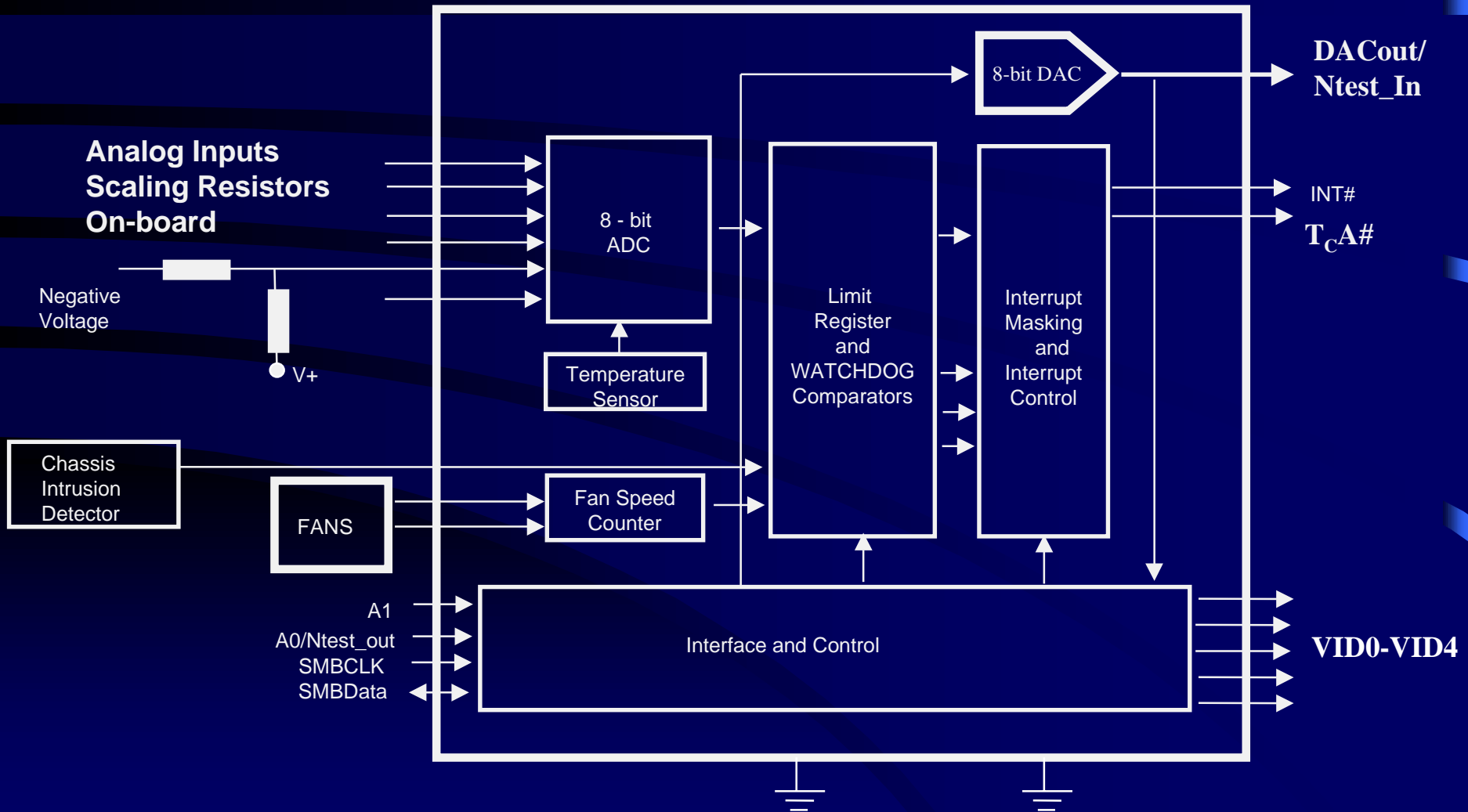
Digital Temperature Sensor Optimized for System Reliability



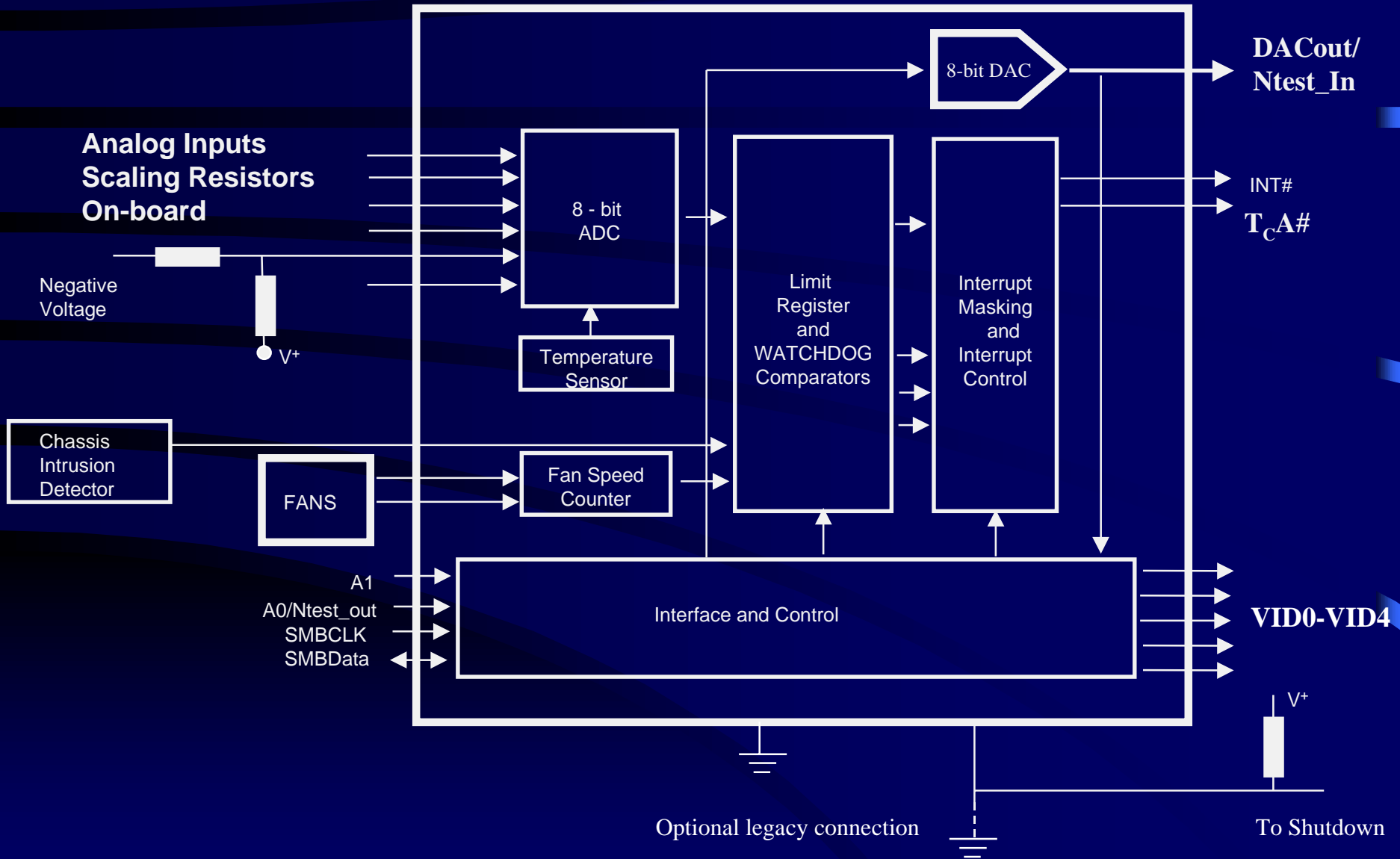
LM77 Provides Thermal Warning, Control, and Protection



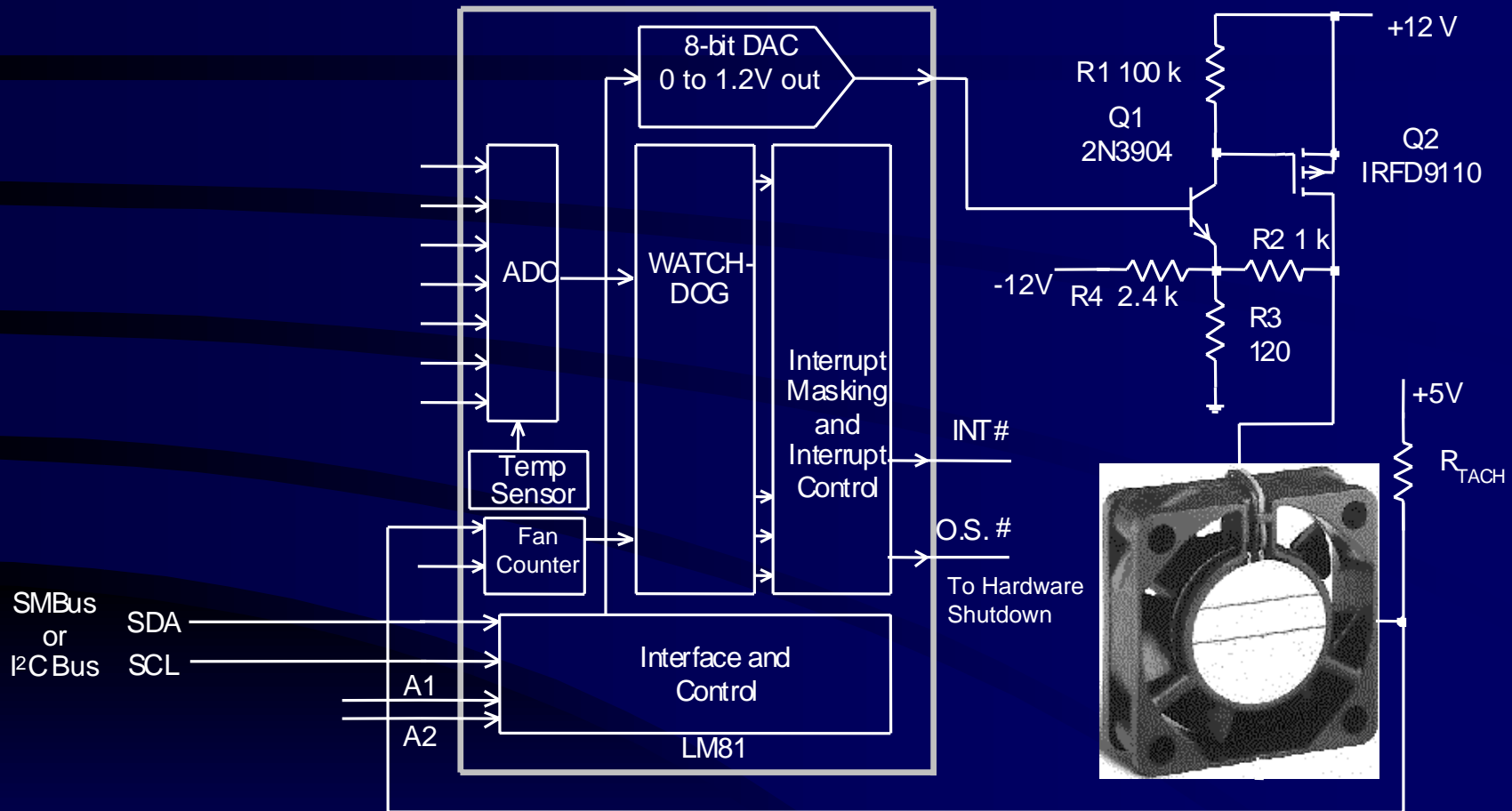
Temperature Sensing, Voltage Monitoring, and Fan Monitoring: Heceta II Block Diagram



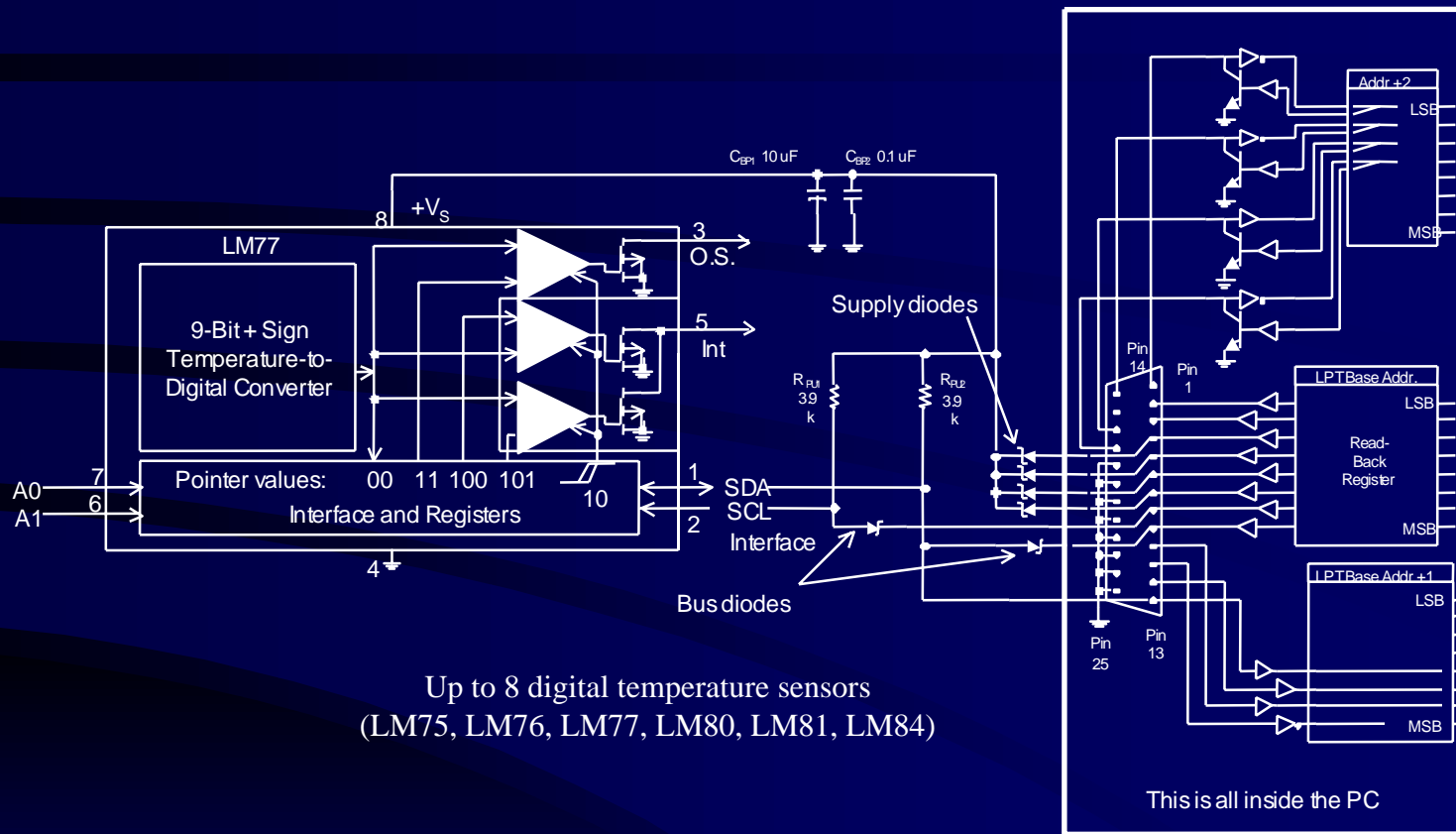
LM81: Three Comparators, Two Outputs



Fan Control With the LM81's DAC

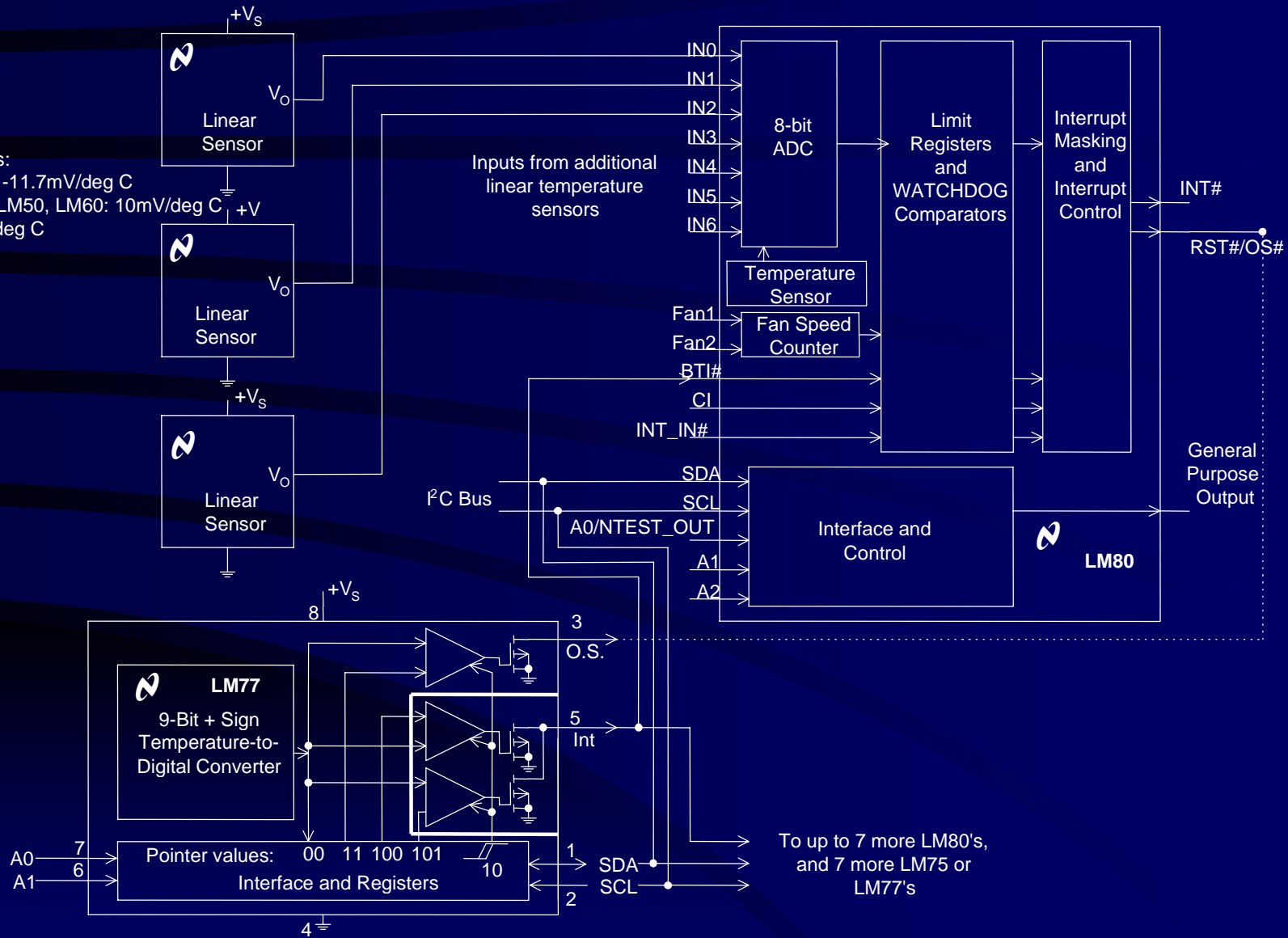


Multiple Sensors on the Parallel Printer Port



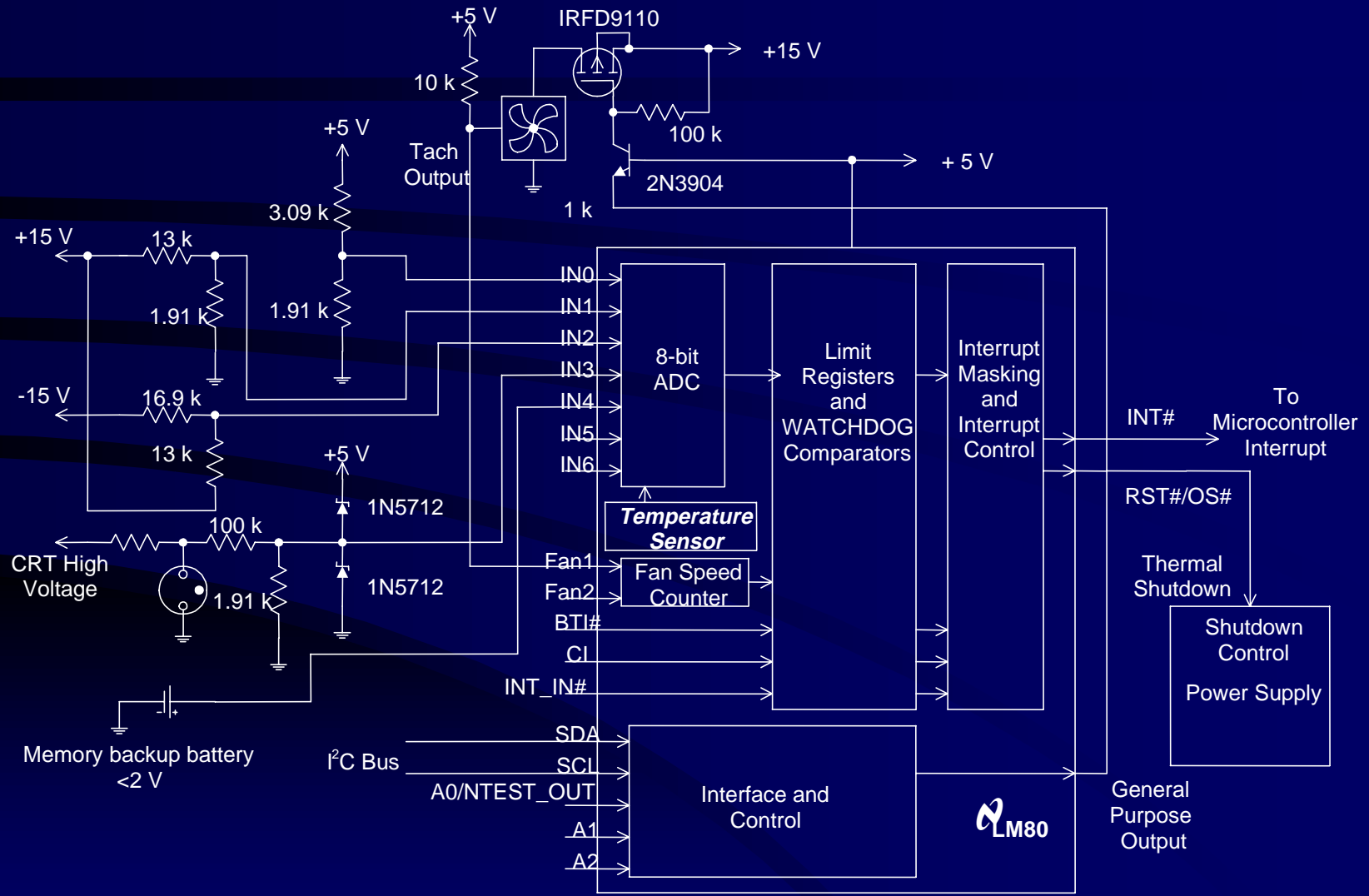
64 Temperatures via I²C

Linear sensors:
 LM20: SC-70, -11.7mV/deg C
 LM35, LM45, LM50, LM60: 10mV/deg C
 LM62: 16mV/deg C

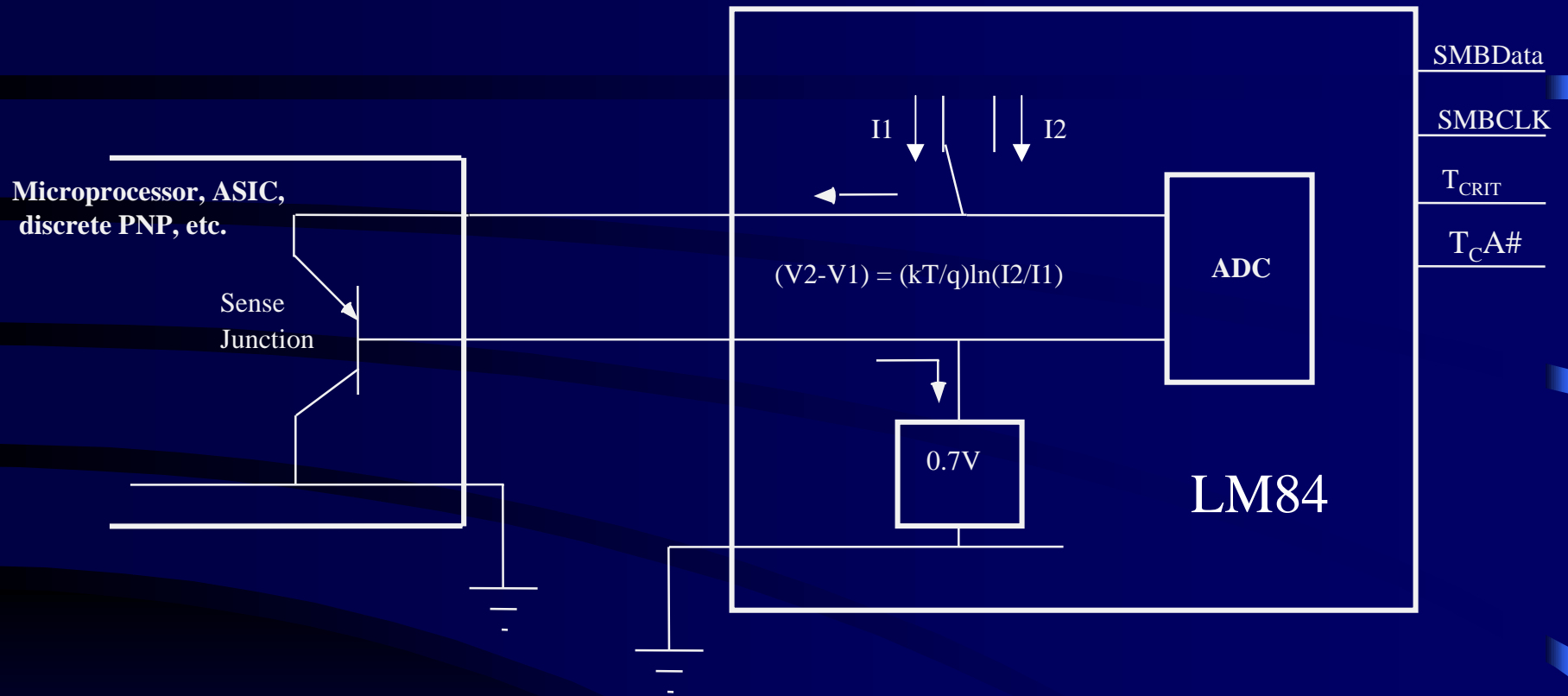


To up to 7 more LM80's,
 and 7 more LM75 or
 LM77's

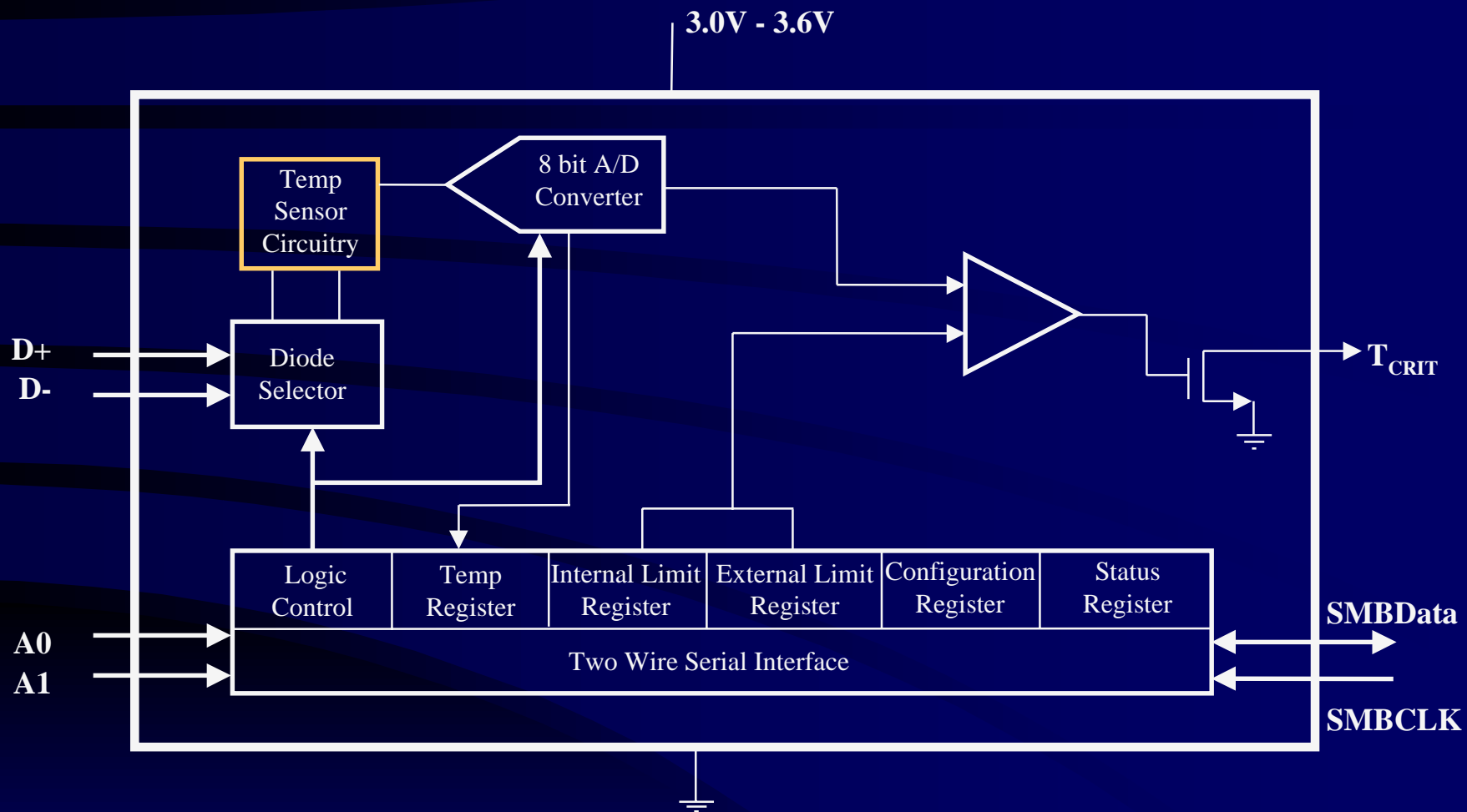
LM80 Data Acquisition: Instrument Health Monitor



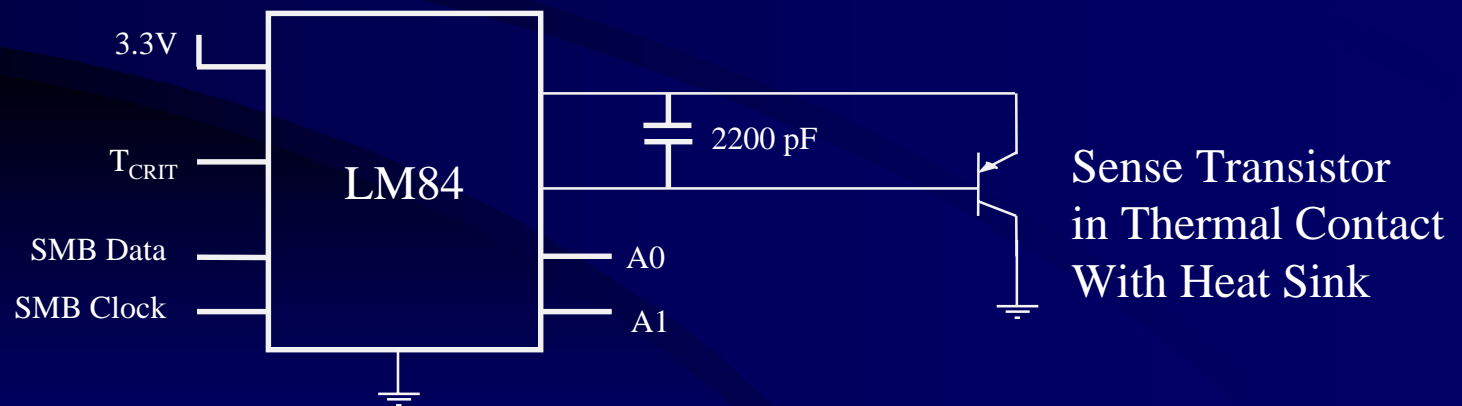
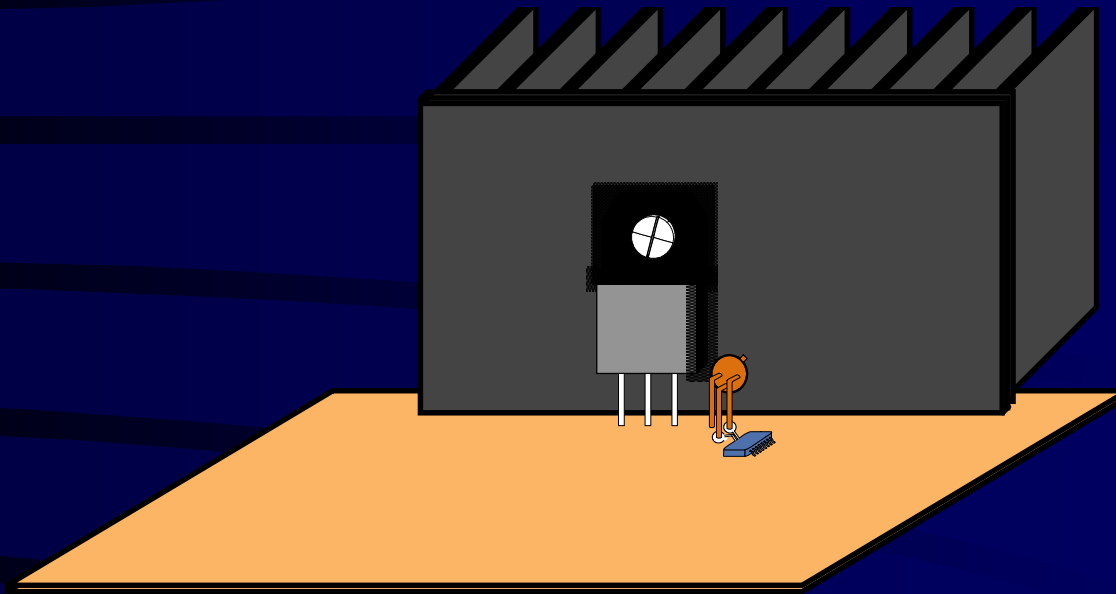
Sensing Temperature of an External PN Junction



LM84 Block Diagram



Measuring Heat Sink Temperature



Accuracy Matters!

If your sensor is inaccurate:

- Your system is too noisy.

- Your system is too slow.

- Your system shuts down when it doesn't need to.

Things to check:

- Accuracy/stability with your power supply (supply noise)

- Accuracy/stability with system operating (noisy signals)

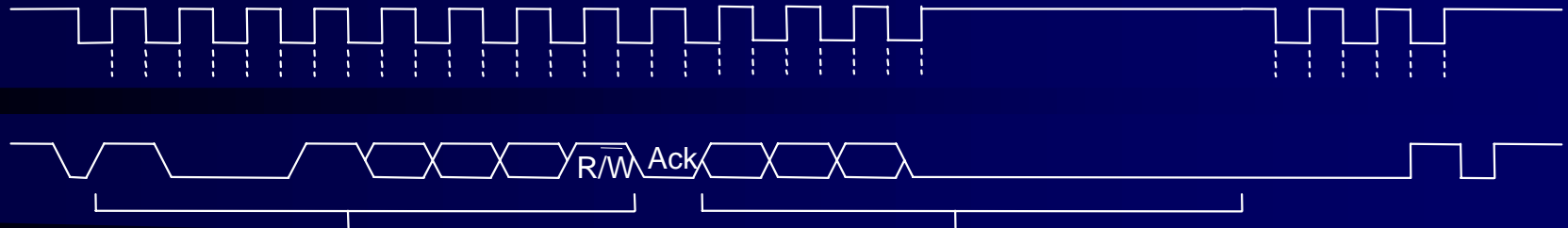
Keys to success:

- Avoid noise - Use supply bypass, minimize sense traces.

- Use sensors with low noise sensitivity.

I²C vs SMB

I²C



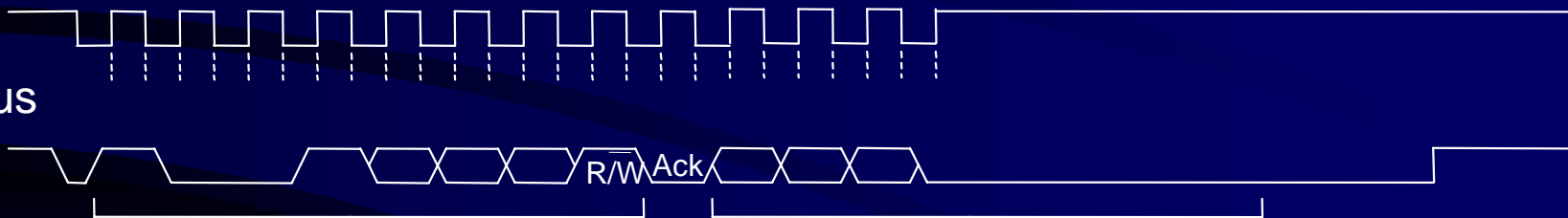
Start

Address Byte

Read Data Byte, Master forgets to finish, SDA is Held low by slave.

Master can recover by clocking until SDA high, then Start & Stop. Some masters (PIIX4) can't do this.

SMBus



Start

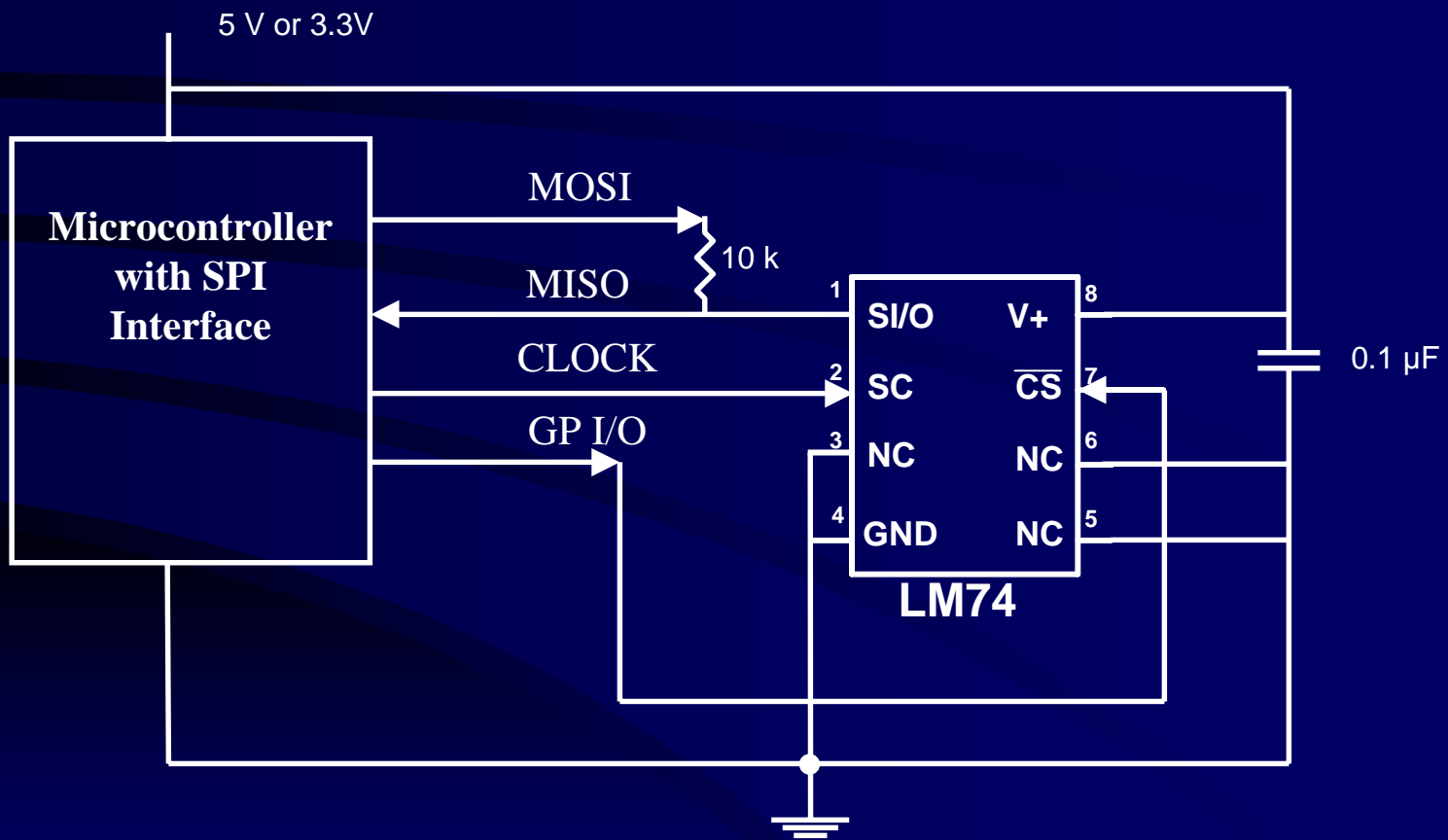
Address Byte

Read Data Byte, Master forgets to finish, SDA is Held low by slave.

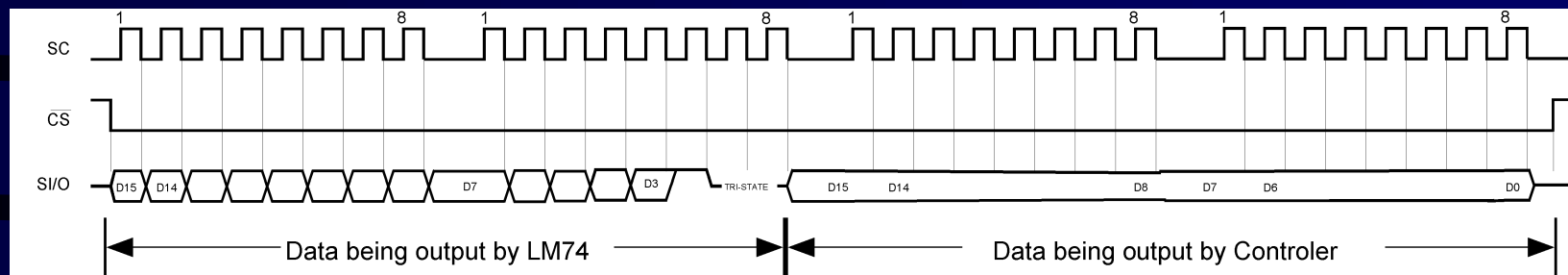
Slave releases SDA after 25 mSec. and returns to initialized state without intervention by Master

SMB timeout prevents slave from locking up bus.

LM74 Read and Write Connection for SPI and MICROWIRE™

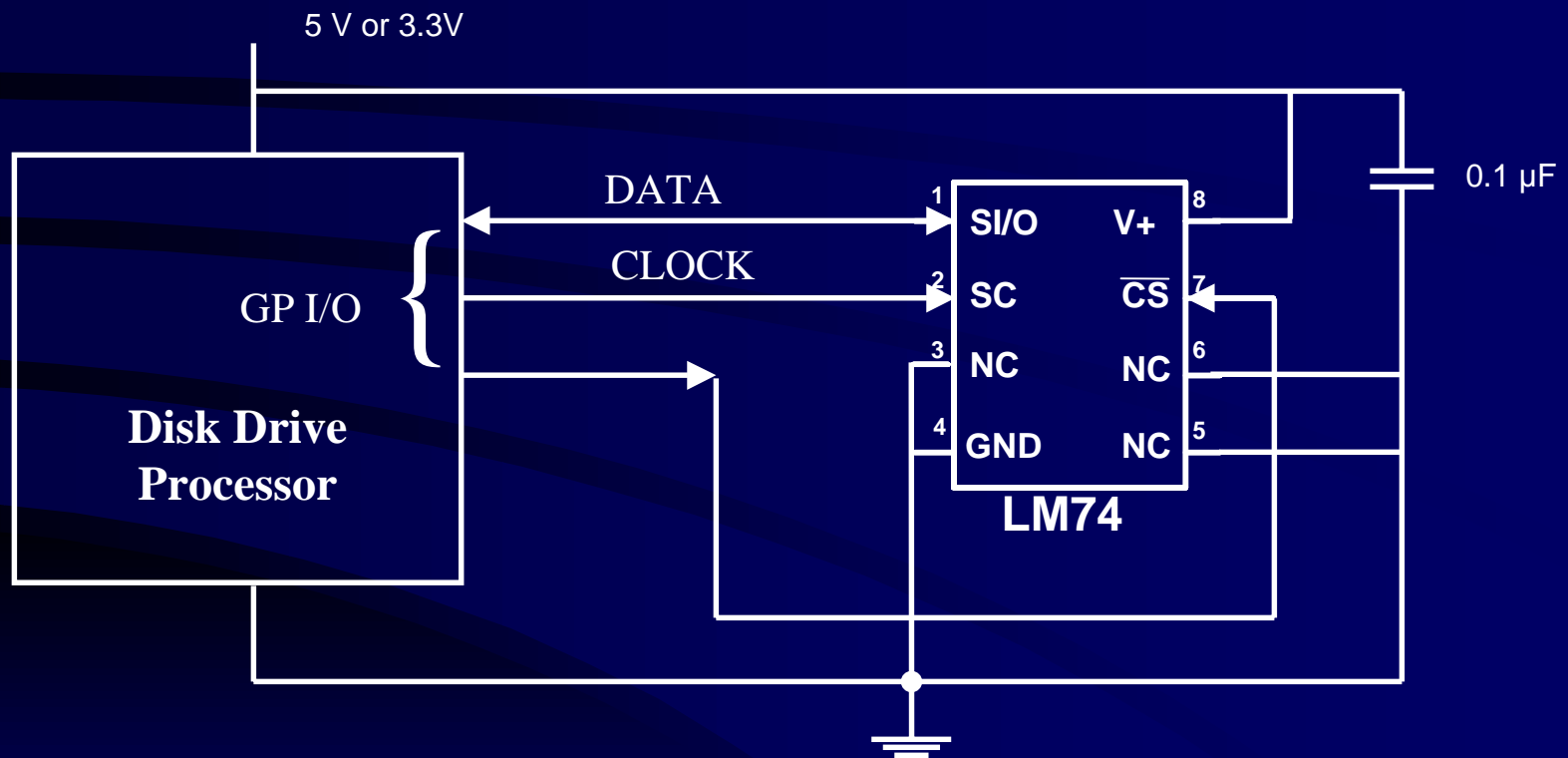


SPI/MICROWIRE Compatible Interface

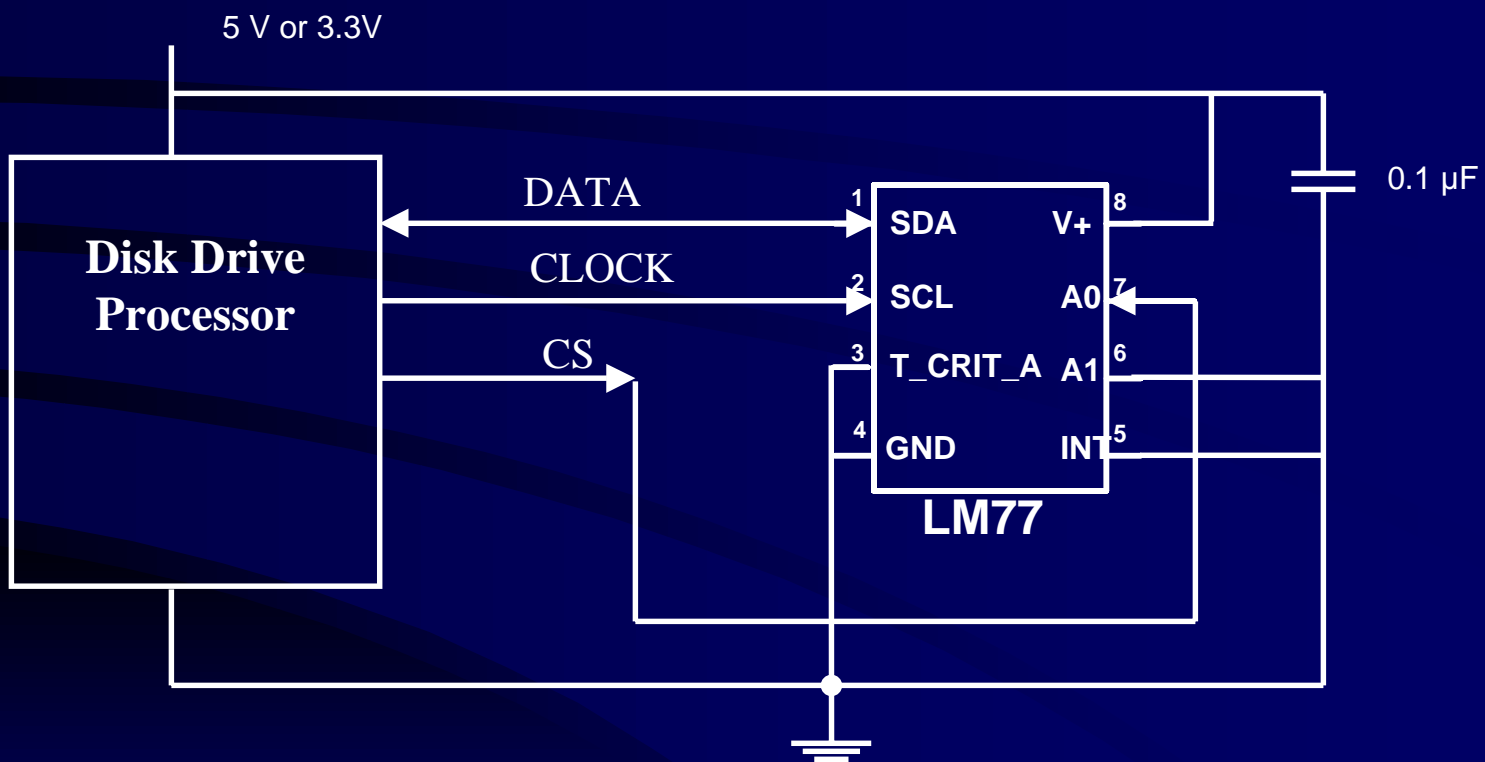


- Identification is the first word transmitted after power up
- Can place the part in shutdown to lower power consumption
- When in shutdown identification is transmitted, not temperature data

Increase Disk Drive Reliability With Temperature Monitoring



LM77 in LM74 Socket



Temperature Sensor Selection Guide

Product	Product Description	Operating Temp. Range	Accuracy	Sensor Gain	Supply Voltage Range	Quiescent Current
ANALOG OUTPUT						
LM20B	SC-70 Precision Celsius Temperature Sensors	-55 °C to +125 °F	±2.5 °C	-11 mV/°C	+2.4 V to +5.5 V	7 µA
LM20C		-55 °C to +125 °F	±5.0 °C	-11 mV/°C	+2.4 V to +5.5 V	7 µA
LM34A	Precision Fahrenheit Temperature Sensors	-50 °F to +300 °F	±2.0 °F	10 mV/°F	+5 V to +30 V	163 µA
LM34		-50 °F to +300 °F	±3.0 °F	10 mV/°F	+5 V to +30 V	181 µA
LM34CA		-40 °F to +230 °F	±3.0 °F	10 mV/°F	+5 V to +30 V	142 µA
LM34C		-40 °F to +230 °F	±3.0 °F	10 mV/°F	+5 V to +30 V	159 µA
LM34D		-32 °F to +212 °F	±4.0 °F	10 mV/°F	+5 V to +30 V	159 µA
LM35A	Precision Celsius Temperature Sensors	-55 °C to +150 °C	±1.0 °C	10 mV/°C	+4 V to +30 V	133 µA
LM35		-55 °C to +150 °C	±1.5 °C	10 mV/°C	+4 V to +30 V	161 µA
LM35CA		-40 °C to +110 °C	±1.5 °C	10 mV/°C	+4 V to +30 V	116 µA
LM35C		-40 °C to +110 °C	±2.0 °C	10 mV/°C	+4 V to +30 V	141 µA
LM35D		0 °C to +100 °C	±2.0 °C	10 mV/°C	+4 V to +30 V	141 µA
LM45B	SOT-23, Celsius Temperature Sensors	-20 °C to +100 °C	±3.0 °C	10 mV/°C	+4 V to +10 V	160 µA
LM45C		-40 °C to +125 °C	±4 °C	10 mV/°C	+4 V to +10 V	160 µA
LM50B	SOT-23, Single Supply, Celsius Temperature Sensors	-20 °C to +100 °C	±3.0 °C	10 mV/°C	+4.5 V to +10 V	180 µA
LM50C		-40 °C to +125 °C	±4.0 °C	10 mV/°C	+4.5 V to +10 V	180 µA
LM60B	2.7 V, SOT-23, Single Supply Celsius Temperature Sensors	-25 °C to +85 °C	±3.0 °C	6.25 mV/°C	+2.7 V to +10 V	125 µA
LM60C		-40 °C to +125 °C	±4.0 °C	6.25 mV/°C	+2.7 V to +10 V	125 µA
LM61B		-25 °C to +125 °C	±3.0 °C	10 mV/°C	+2.7 V to +10 V	140 µA
LM61C		-40 °C to +125 °C	±4.0 °C	10 mV/°C	+2.7 V to +10 V	140 µA
LM62B		-20 °C to +85 °C	±3.0 °C	15 mV/°C	+2.7 V to +10 V	180 µA
LM62C		-20 °C to +85 °C	±4.0 °C	15 mV/°C	+2.7 V to +10 V	180 µA
DIGITAL OUTPUT						
LM56B	Low Power Thermostats	-40 °C to +125 °C	±3.0 °C	6.2 mV/°C	+2.7 V to +10 V	230 µA
LM56C		-40 °C to +125 °C	±4.0 °C	6.2 mV/°C	+2.7 V to +10 V	230 µA
LM74	SPI/MICROWIRE Temperature Sensor	-40 °C to +125 °C	±1.25 °C	0.0625 °C/LSB	+3.0 V to +5.5 V	1 mA
LM75	I2C Temperature Sensor	-40 °C to +125 °C	±3.0 °C	0.5 °C/LSB	+3.0 V to +5.5 V	1 mA
LM76	12-bit Plus Sign I2C Temperature Sensor	-40 °C to +125 °C	±1.5 °C	0.0625 °C/LSB	+3.0 V to +5.5 V	1 mA
LM77	I2C ACPI Temperature Sensor	-40 °C to +125 °C	±1.5 °C	0.5 °C/LSB	+3.0 V to +5.5 V	1 mA
LM84	SMBus Remote Diode Temperature Sensor	-40 °C to +125 °C	±2.0 °C	1 °C/LSB	+3.0 V to +5.5 V	1 mA
SYSTEM HARDWARE MONITORS						
LM78	ISA Bus / I2C Bus System Hardware Monitors	-40 °C to +125 °C	±3.0 °C	1 °C/LSB	+4.25 V to +5.75 V	1 mA
LM79		-40 °C to +125 °C	±3.0 °C	1 °C/LSB	+4.25 V to +5.75 V	2 mA
LM80	I2C System Hardware Monitor	-20 °C to +125 °C	±3.0 °C	0.0625 °C/LSB	+3.0 V to +5.5 V	2 mA
LM81	SMBus System Hardware Monitor (D/A Output)	-30 °C to +125 °C	±3.0 °C	0.0625 °C/LSB	+2.8 V to +3.8 V	2 mA