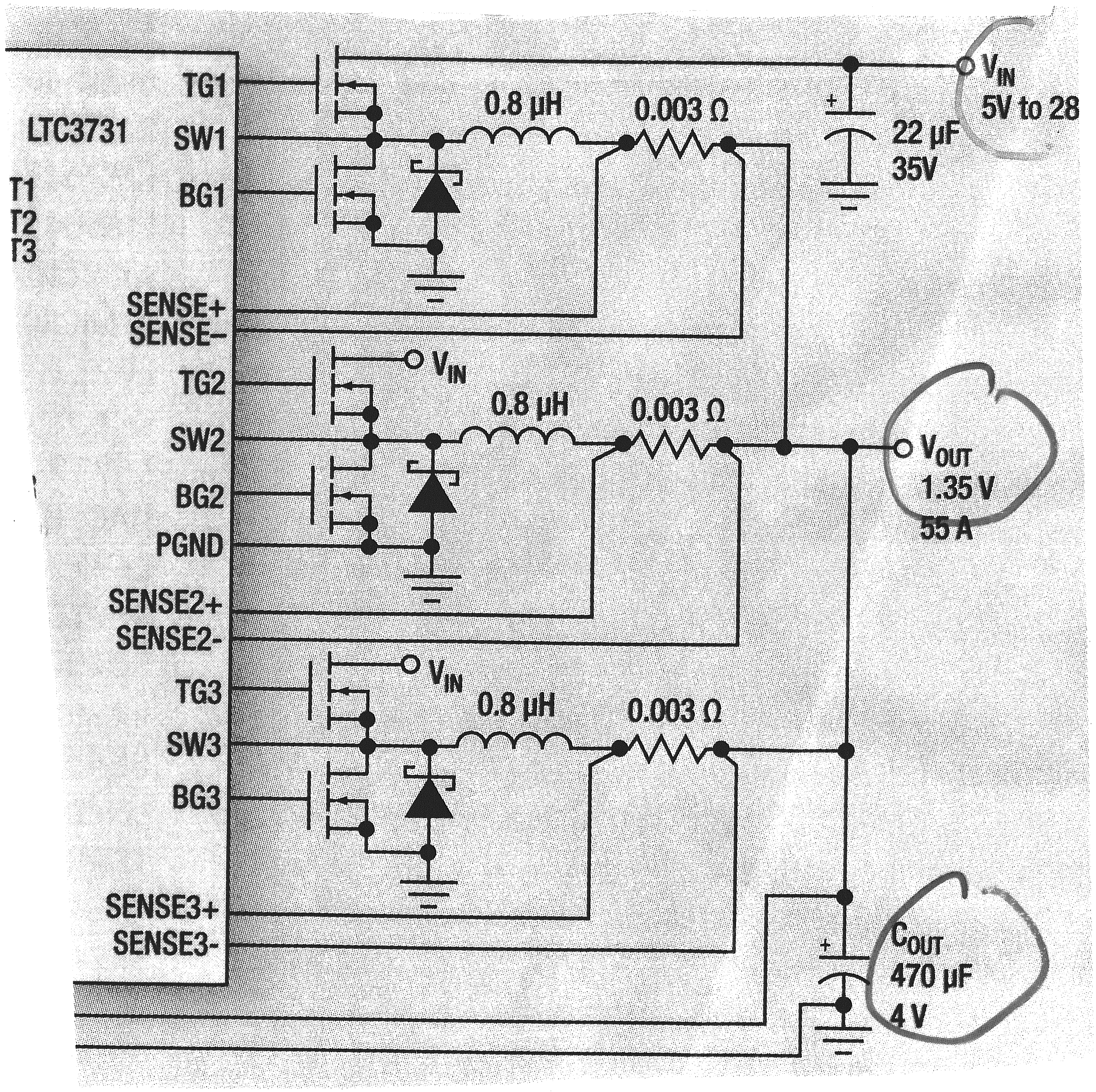
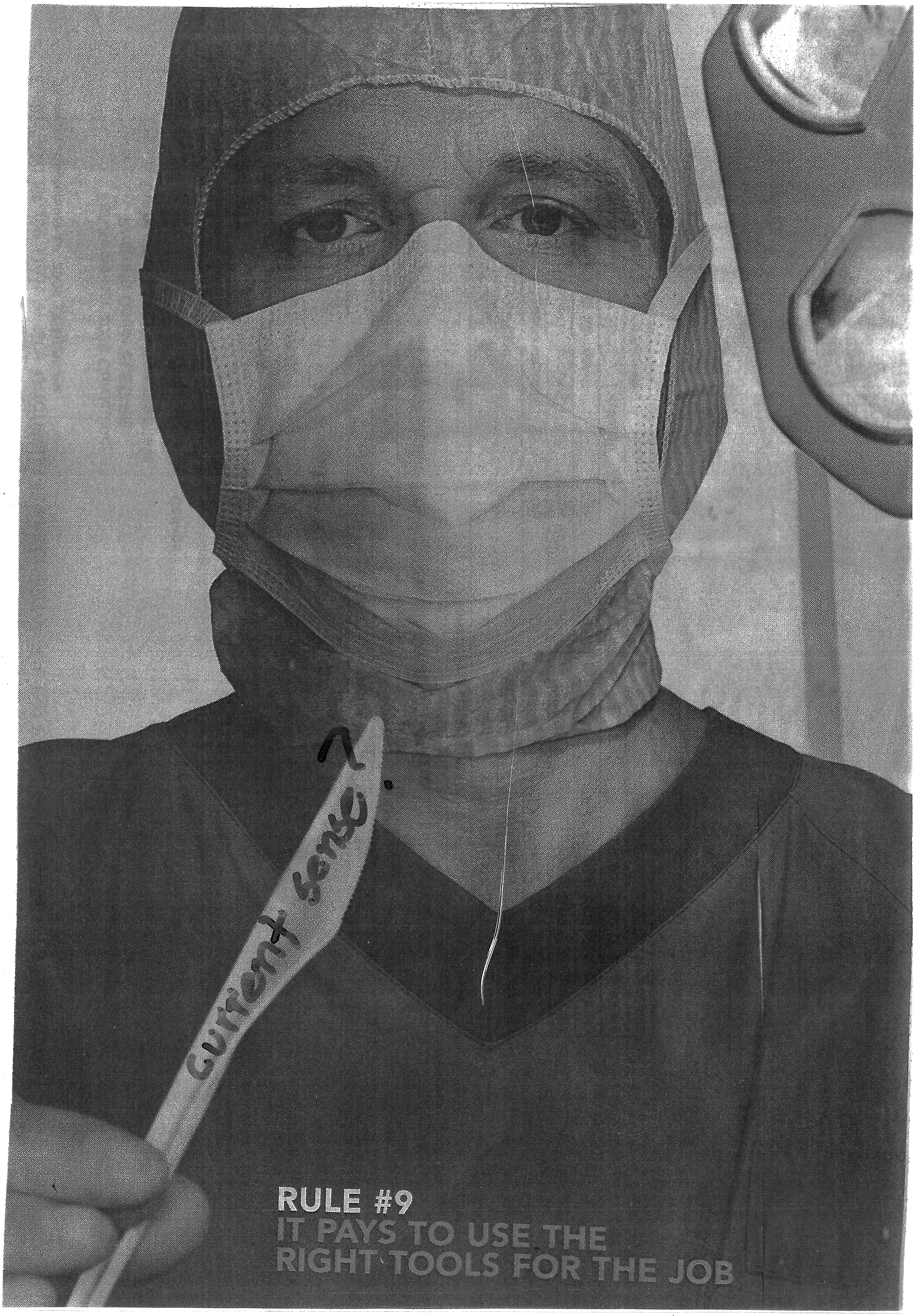
Fig. 1. Linear Technology's LTC3731 is a PolyPhase synchronous step-dow
n switching regulator controller that drives all N-channel external power MOSFET st
in a phase-lockable fixed frequency architecture.



One vendors chip


current sense
RULE #9
IT PAYS TO USE THE
RIGHT TOOLS FOR THE JOB

Applications:

- *Low-voltage, high-density distributed power systems*
- *Point-of-load regulation for high-performance DSPs, FPGAs, ASICs and microprocessors*
- *Broadband, networking and optical communications infrastructure*
- *Portable computing/notebook PCs*

Features:

- *3-V to 6-V input*
- *30-mΩ, 12-A peak MOSFET switches for high efficiency at 6-A continuous output*
- *0.9-V to 3.3-V adjustable output voltage range with 1.0% initial accuracy; fixed versions available*
- *Wide PWM frequency — fixed 350 kHz, 550 kHz or adjustable 280 kHz to 700 kHz*
- *Load protected by peak current limit and thermal shutdown*
- *Complete set of design tools: EVM, software tool and datasheets*
- *TPS5461x starts at $4.99 per device in quantities of 1,000*

Synchronous Rectification in High–Performance Power Converter Design

— *By Robert Selders, Jr., Applications Engineer*

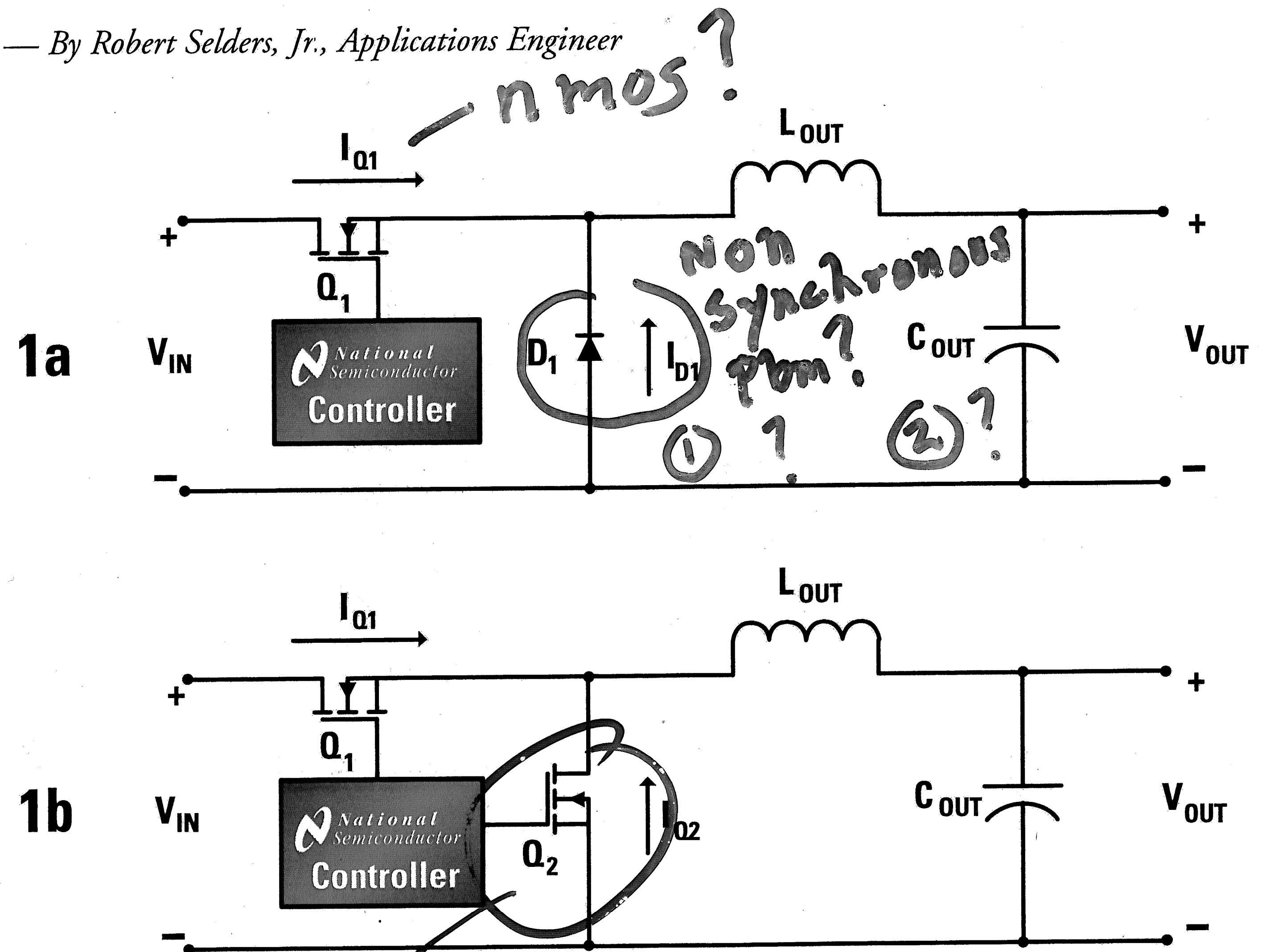


Figure 1. (a) Non-synchronous and (b) Synchronous Buck Converters

replace (Von 1V) power diode

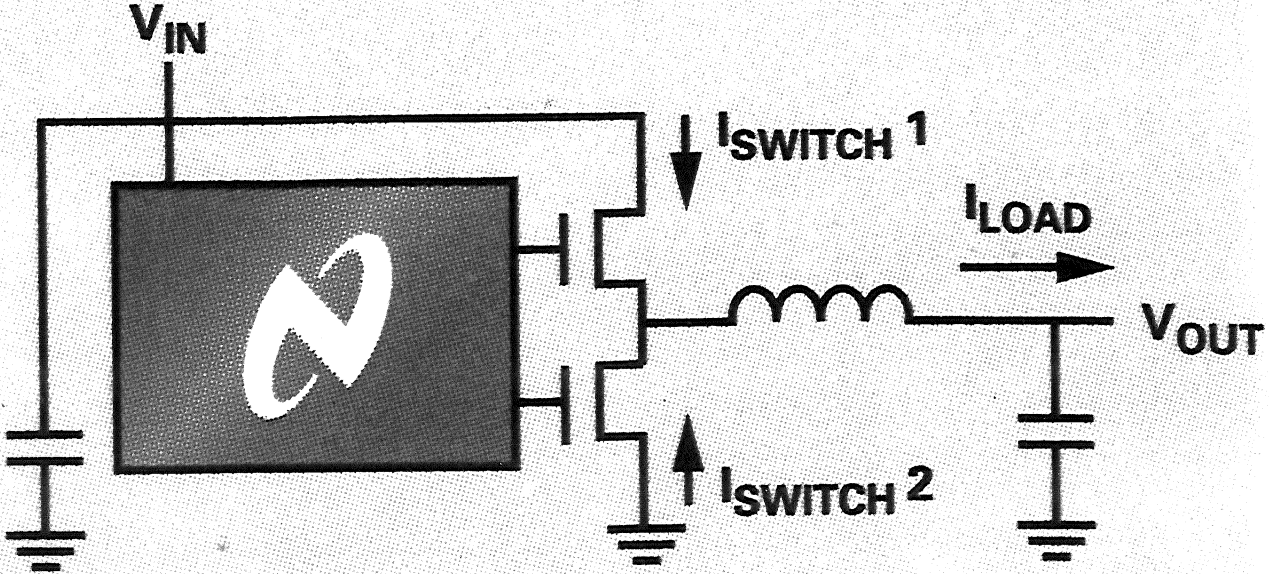
① avoid shoot through from Qrr

② Always CCM (no need Ch5)

③ $V_{ON} = I * R_{ON}^{Q2}$ (parallel FETS

④ Need 100A 1mΩ → 0.1V

Synchronous buck



Function: Step-down ($V_{OUT} < V_{IN}$)

When to use: When high efficiency is required with high-output current (> 5A) or low duty cycles ($V_{IN} > 5 \times V_{OUT}$ and/or $I_{OUT} < 0.5A$)

Characteristics: A second switch replaces the diode in the basic buck topology, reducing losses in the conditions mentioned above

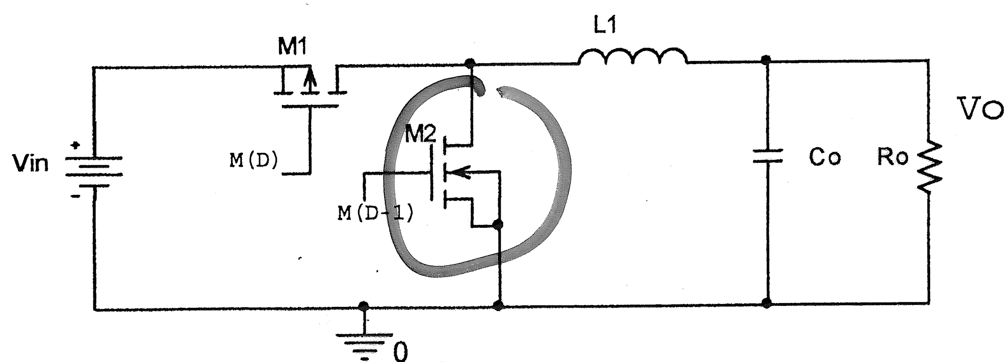
Devices to use: Any "synchronous rectification" buck integrated regulator or controller

Figure 2: Step-down configurations

Cost of FET Drives ?
vs
"Smart" diode

Replace diode with M_2 to reduce switch losses

Synchronous Rectification



Goal:

$$P_{M2\_ON} = R_{M2\_ON} * \left[Iout * (1-D) \right]^2 < P_{diode\_conduction} = V_{diode} * Iout * (1-D)$$

-There are other switching losses in M2

-Additional Circuitry Needed in Controller ($$)

V_{ON} diode say 1/2 V

V_{ON} FET 50 mV

⇒ 10 times lower

$1 \leq R_{ON} \leq 100\ m\Omega$

$V_{FET}(ON) = I R_{ON}$

~~if too high use~~ V_{CE} (bipolar) ~ 0.1V

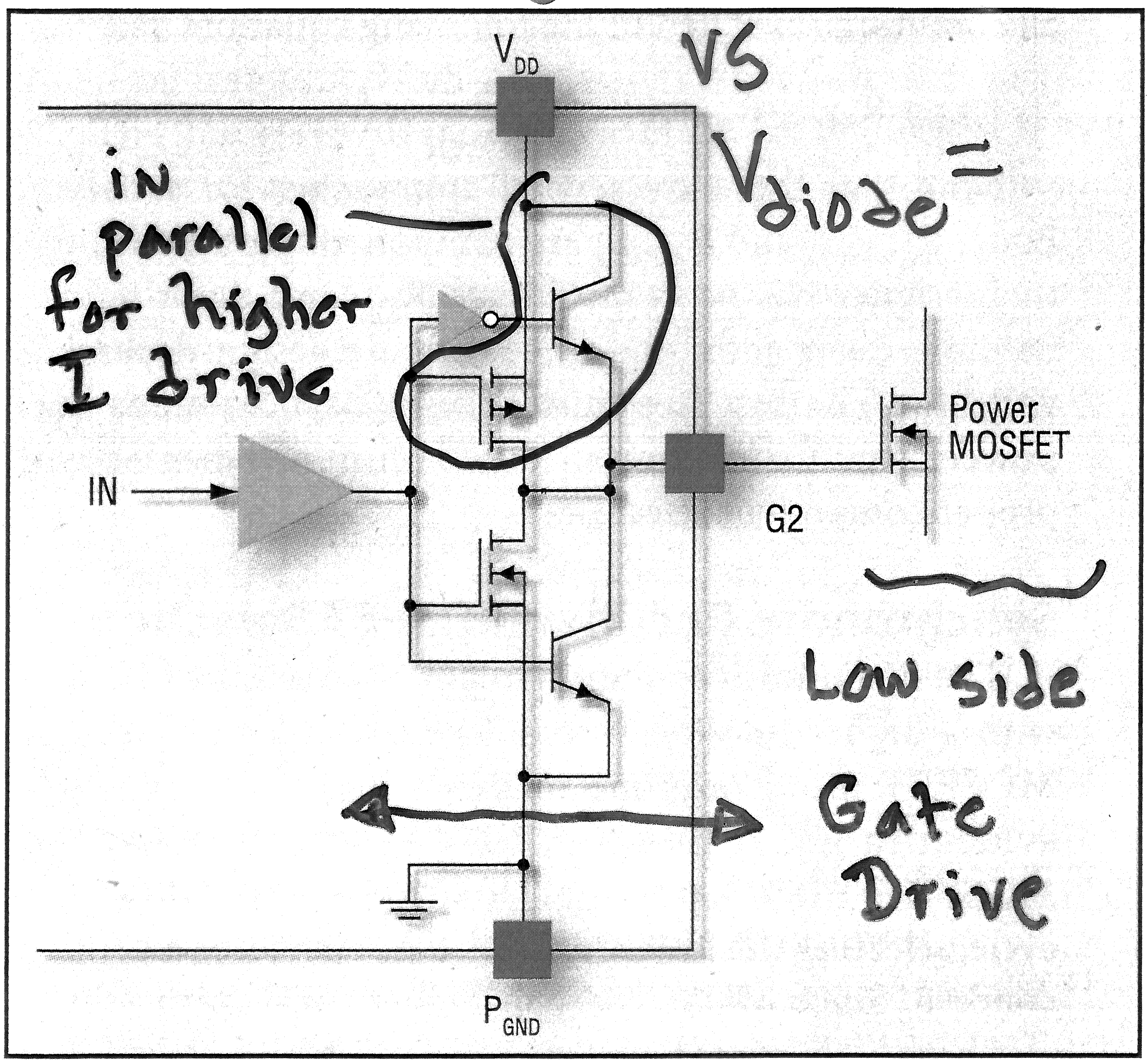


Fig. 3. *The TrueDrive gate-drive architecture (low-side only) from Texas Instruments places bipolar and MOS transistors in parallel to deliver the rated drive current while lowering the pull-down impedance for better dv/dt immunity.*

① Latest f ↑ *5

The Good Stuff

- ② Up to 2.5MHz switching frequency
- >4MHz sync capability
- Minimum pulse width <25ns
- Fast current limit: <35ns
- Built-in 180V start-up circuitry
- <1mA quiescent current
- Built-in MOSFET driver: 3Ω sink, 7Ω source
- Programmable undervoltage lockout
- Programmable soft start
- Resistor programmable current sense threshold
- Primary power limit for fault conditions
- Low current <5μA shutdown mode
- 50% duty cycle limit with MIC9130
- 75% duty cycle limit with MIC9131
- 16-pin SOIC and QSOP packages

③ $5 / chip