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Improving Your HIP1011 Hot Plug Design

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The Quest to Higher Efficiency and Lower Cost When Implementing the HIP1011

The quest to a more efficient ($V_{(OUT)}/V_{(IN)}$) HIP1011 application has been answered with changes in existing component values. The simplicity of this change allows existing designs to be retrofitted with only a BOM change.

Implementing a Higher Efficiency HIP1011 PCI Hot Swap Application

Many HIP1011 designs have been implemented with parallel N-Channel MOSFETs in an effort to maximize efficiency. These FETs controlled by the HIP1011 act as supply bus voltage switches. This approach was chosen to address the cumulative voltage losses from wiring, connectors, PCB traces, and the external current sense resistors by lowering the $V_{DS(ON)}$ loss of the power bus switch FETs.

Addressing the voltage loss across the current sense resistors by reducing their value from 10mΩ to 5mΩ resistors decreases the voltage loss by 15mV to 30mV across a 3A to 6A output current range. This change in R_{SENSE} resistor value must also be coupled with a change in the R_{OCSET} resistor value to 6.04kΩ in order to keep the 3.3V and 5V OC trip points the same as before. By making these changes the OC trip points for the +12V and -12V supplies decrease but to a value above the PCI maximum current specification for these two supplies. The +12V OC trip point is now a nominal 0.75A and for the -12V supply, 0.18A.

See Table 1 for effects on overcurrent set points by changing R_{SENSE} and R_{OCSET} resistor values.

How Does this Change Make My Design Less Expensive?

Incidental to this change comes an opportunity to reduce BOM cost as well, using higher $r_{DS(ON)}$, less expensive FETs. Now that you have 5mΩ x output current less of V_{OUT} losses, the opportunity exists to:

A. Reduce the number of parallel FETs used, or

B. Change the BOM requirement to a less expensive and higher $r_{DS(ON)}$ FET.

Either of these choices may not result in a net efficiency gain but will reduce the BOM total cost.

Both 5mΩ and 10mΩ current sense resistors in the 1W to 3W range are widely available with no price difference between the different ohmic values.

As expected there are numerous applicable N-channel MOSFETs available for this application. Since this is a DC application, switching characteristics are of no concern and the choice of an FET for this application boils down to cost and $r_{DS(ON)}$. Many manufacturers demand a high premium for low $r_{DS(ON)}$ and the BOM changes described here allow an alternative.

See Figure 1 for typical $r_{DS(ON)}$ vs current curves for many popular N-Channel MOSFETs.

See Intersil Corporation for your N-channel MOSFET needs, including the RF1K49211, the best $r_{DS(ON)}$ value for cost, and the industry standard HP4410, along with the new UltraFet Family of FETs.

TABLE 1.

R_{OCSET}	R_{SENSE}		NOMINAL OVER CURRENT SET POINT IN AMPS (+/-10%)			
	3.3V	5.0V	3.3V	5.0V	12.0V	-12.0V
12.1kΩ	10mΩ	10mΩ	9.0Ω	7.1	1.5	0.36
6.04kΩ	10mΩ	10mΩ	4.5Ω	3.5	0.75	0.18
6.04kΩ	5mΩ	5mΩ	8.9Ω	7.1	0.75	0.18

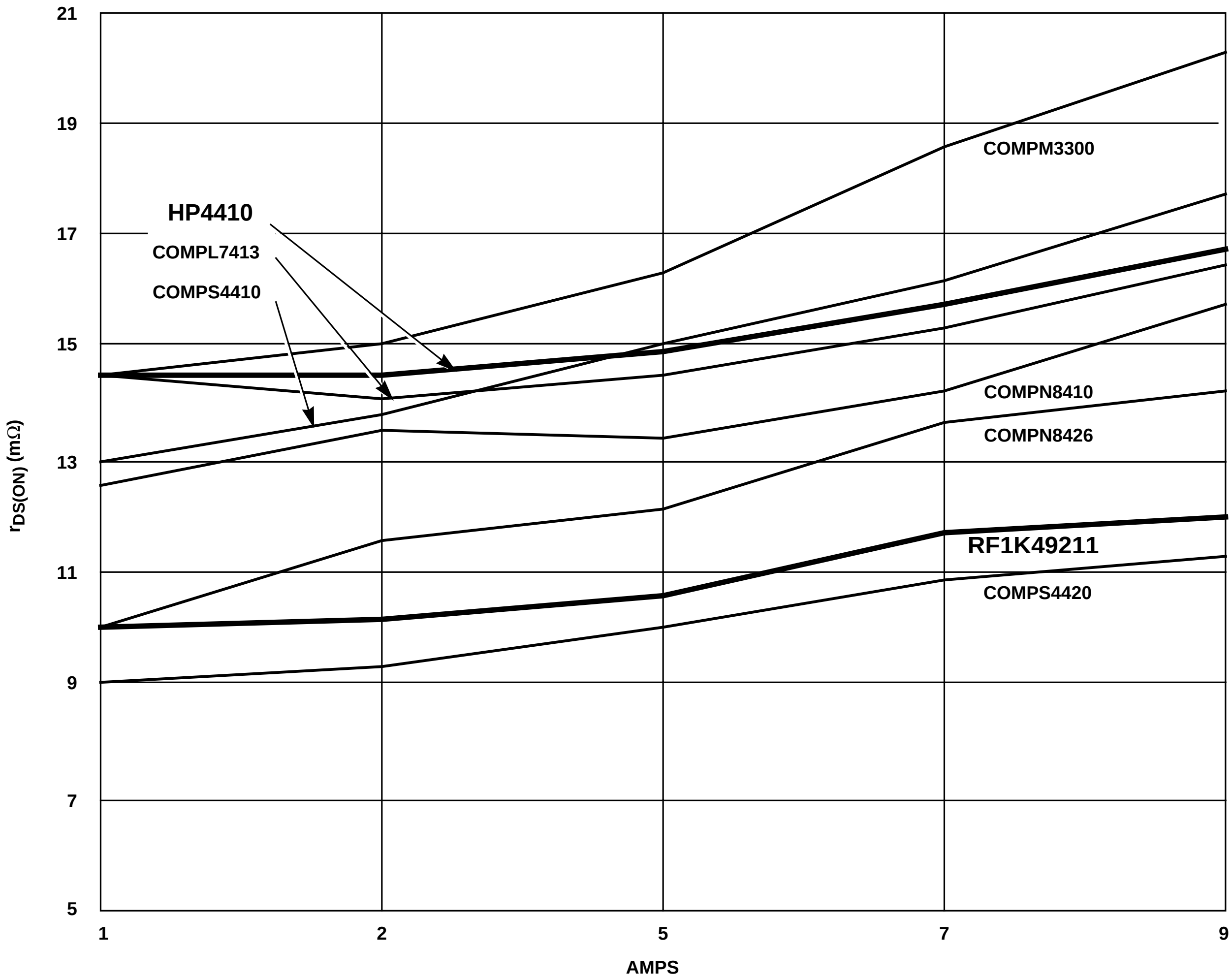

FIGURE 1. COMPETITIVE FET $r_{DS(ON)}$