Evaluation of SiC-based MOSFET in Electronic Power Technology

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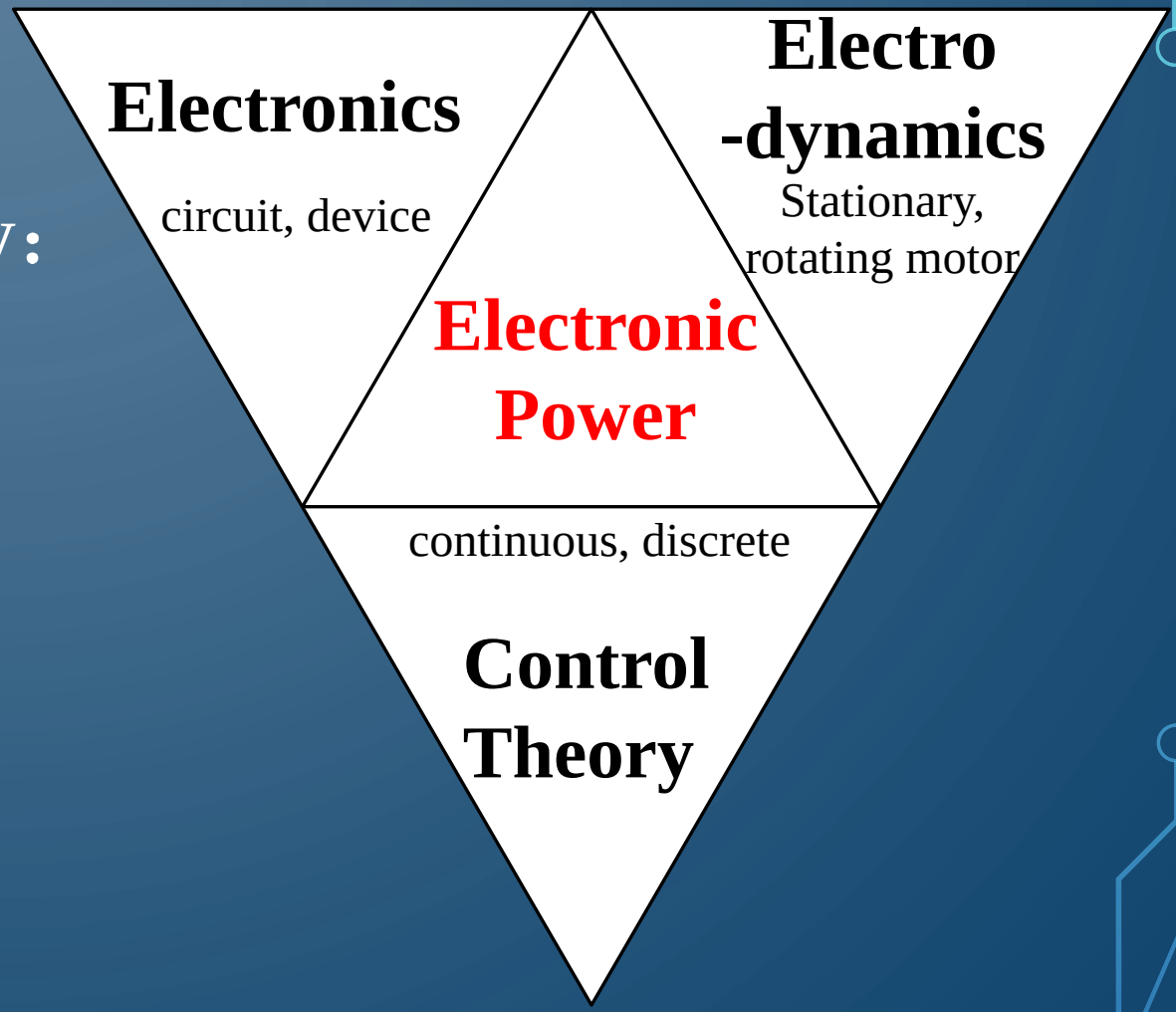
CATALOGUE

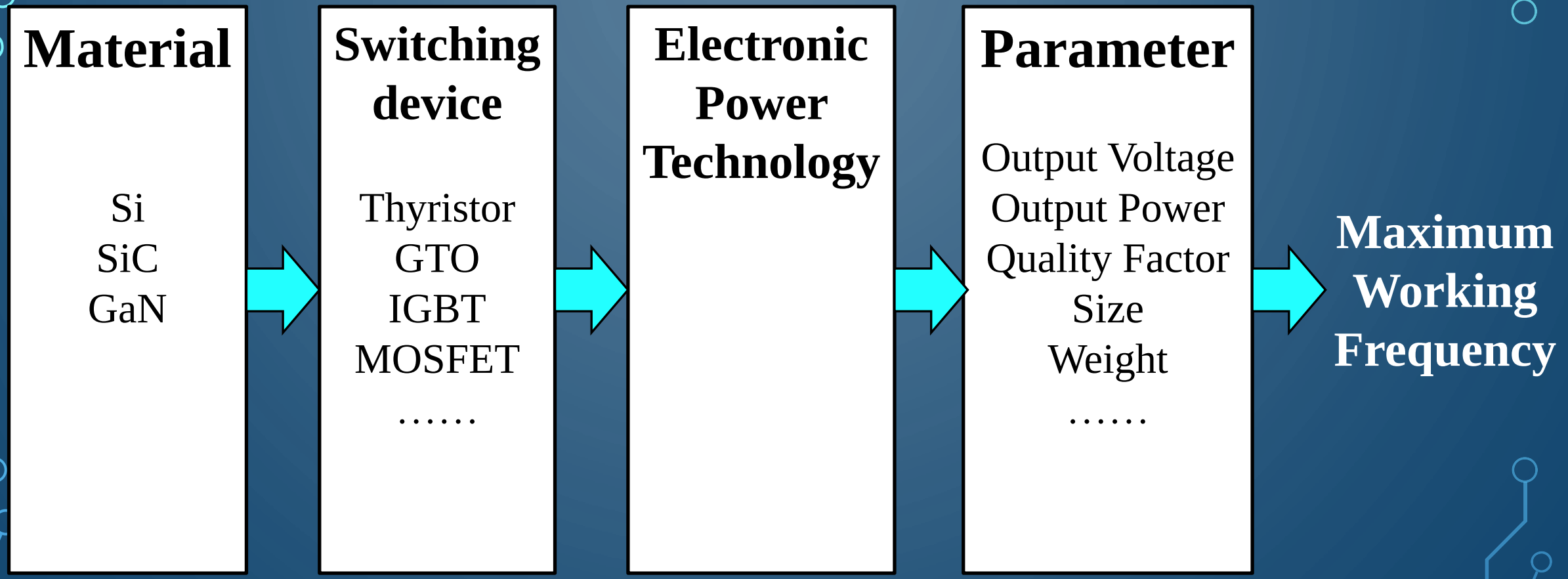
I. RESEARCH BACKGROUND

Electronic Power Technology：

uses power electronic devices to transform and control electric energy



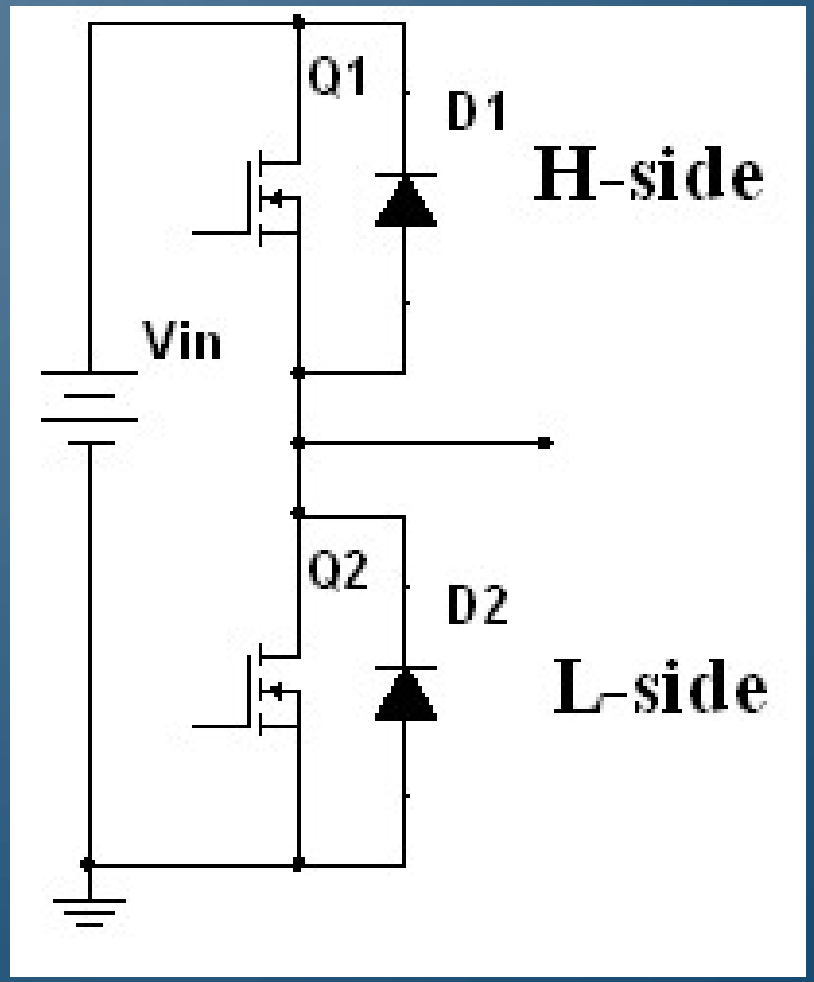
I. RESEARCH BACKGROUND



II. THEORETICAL ANALYSIS

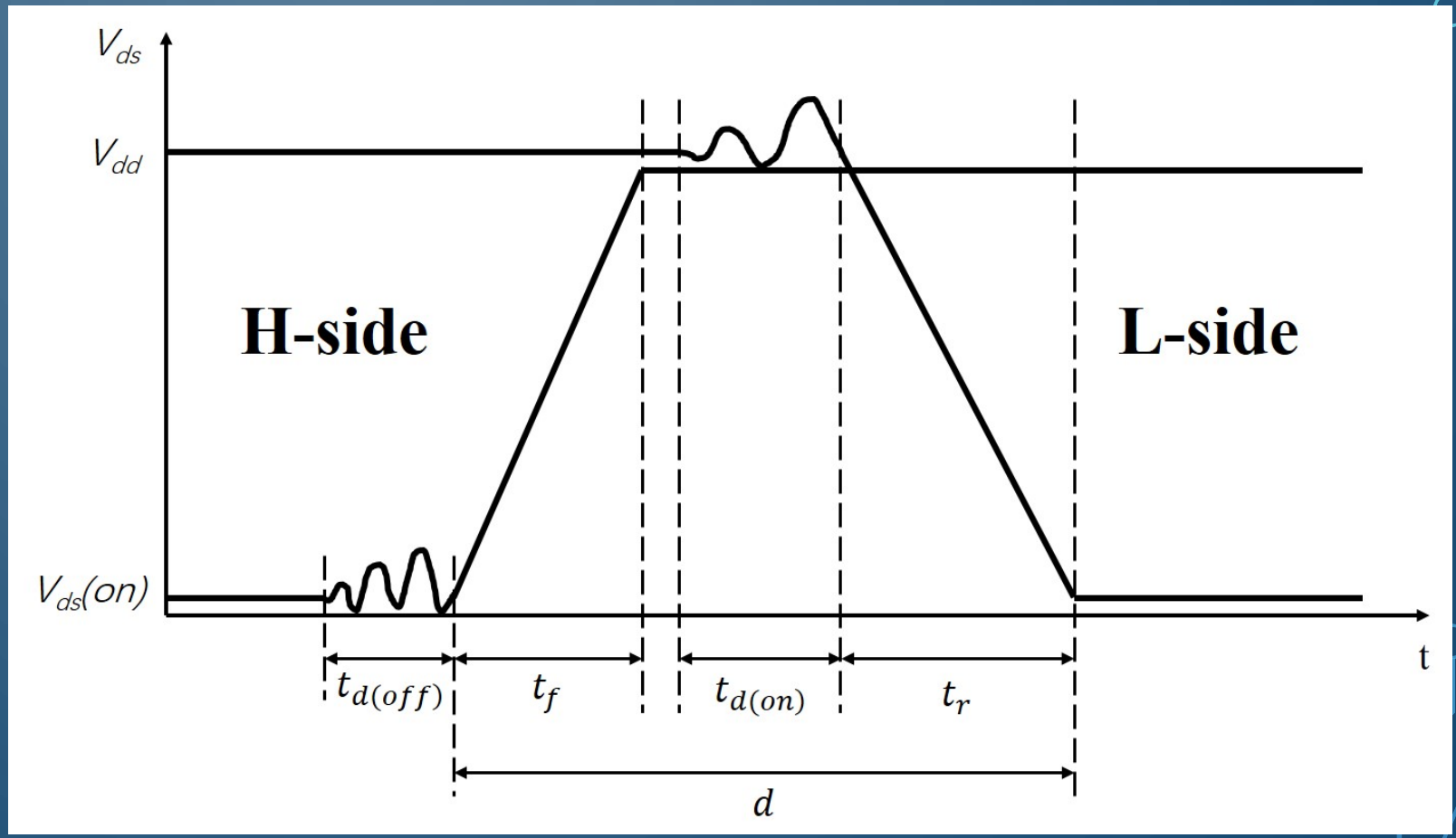
Dead Time：

The limit of maximum operating frequency.



II. THEORETICAL ANALYSIS

Symbol	*Parameter*
$t_{d(on)}$	Turn-On Delay Time
t_r	Turn-On Rise Time
$t_{d(off)}$	Turn-Off Delay Time
t_f	Turn-Off Fall Time
d	Dead Time



II. THEORETICAL ANALYSIS

$$q_d = \frac{d}{T}\Big|_{\max}$$

$$f_{\max} = q_d / d$$

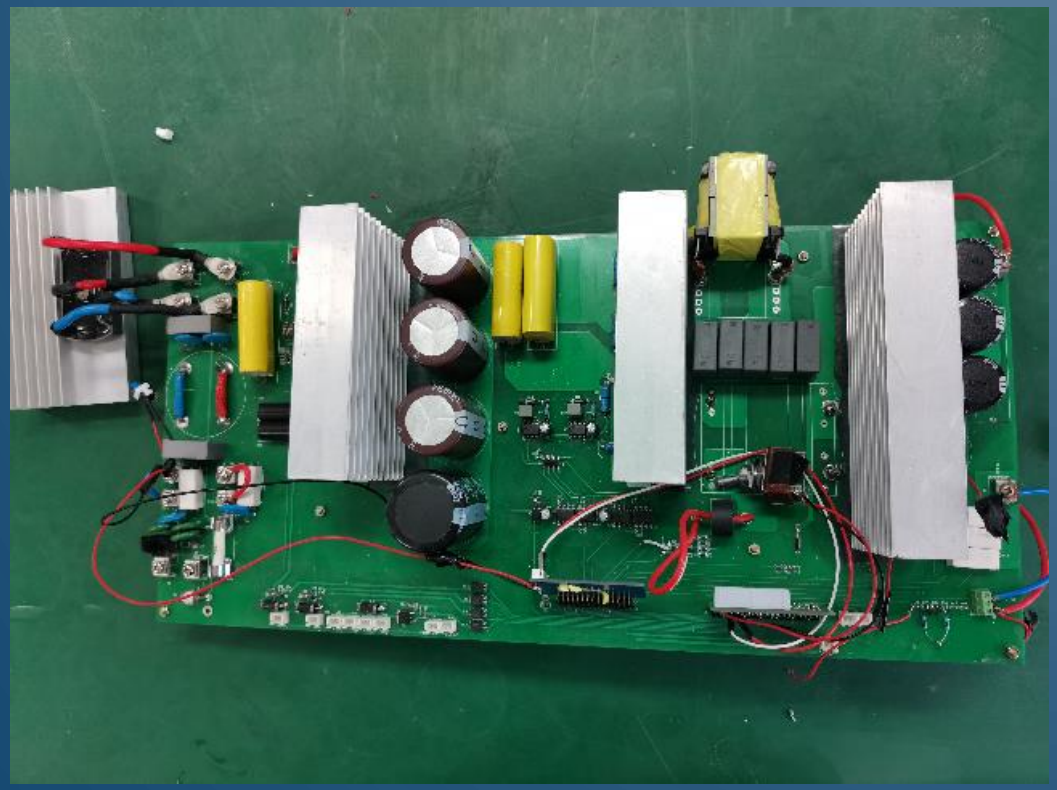
$$d_{\min} = t_r + t_f$$

$$f_{\max} = \frac{q_d}{t_r + t_f}$$

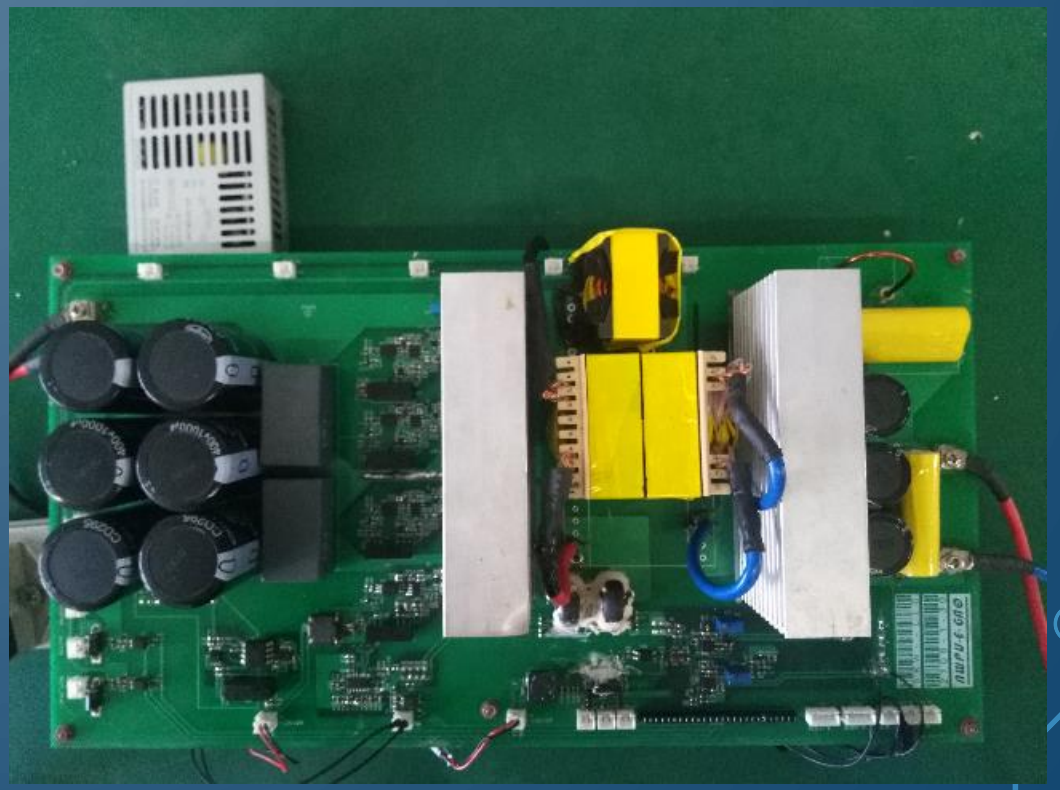
$$\frac{f_{\max}(SiC)}{f_{\max}(Si)} = \frac{q_d/d\,(SiC)}{q_d/d\,(Si)} = \frac{t_r(Si) + t_f(Si)}{t_r(SiC) + t_f(SiC)}$$

III. EXPERIMENTAL RESEARCH

Full bridge LLC resonant converter



Si-based MOSFET



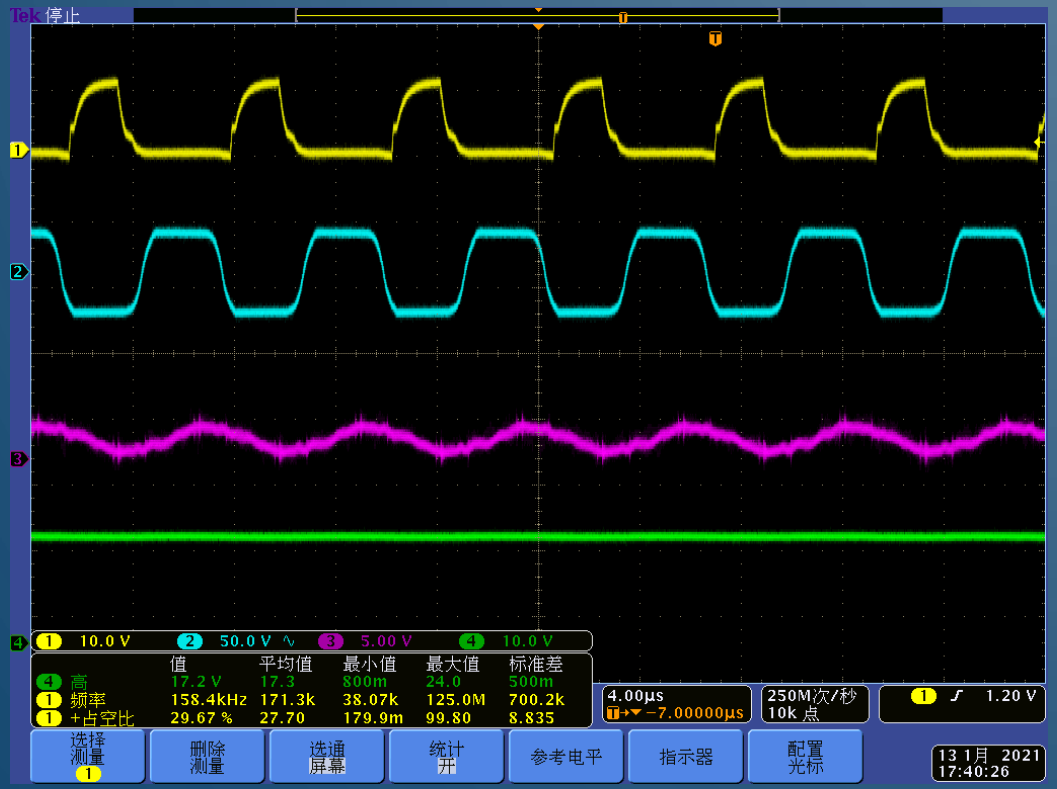
SiC-based MOSFET

III. EXPERIMENTAL RESEARCH

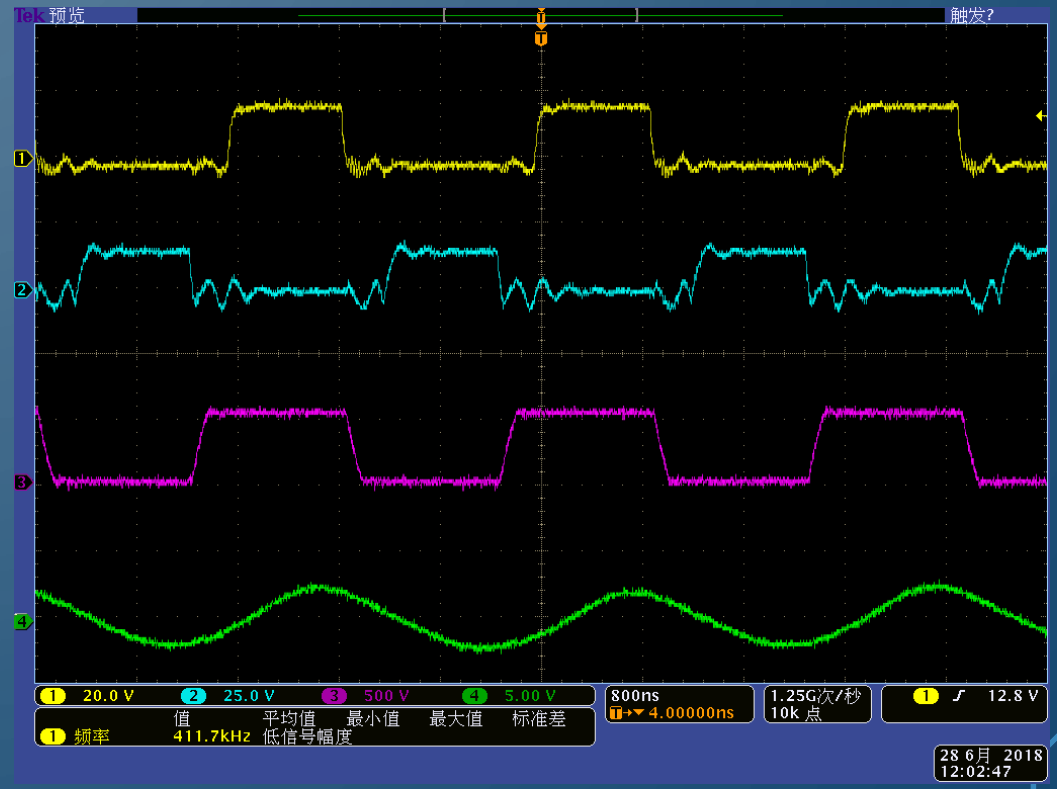
Symbol	*Parameter*	*Unit*	*FCH47N60 (Si)*	*C3M0065100K (SiC)*
$t_{d(on)}$	Turn-On Delay Time	ns	185	20
t_r	Turn-On Rise Time		210	10
$t_{d(off)}$	Turn-Off Delay Time		520	19
t_f	Turn-Off Fall Time		75	8
d	Dead Time		470	38

III. EXPERIMENTAL RESEARCH

Converter working waveform



Si-based MOSFET



SiC-based MOSFET

III. EXPERIMENTAL RESEARCH

$$f_{\max} = \frac{q_d}{t_r + t_f}$$

Calculated value: $\frac{f_{\max}(SiC)}{f_{\max}(Si)} = \frac{t_r(Si) + t_f(Si)}{t_r(SiC) + t_f(SiC)} = \frac{850ns}{274ns} = 310\%$

Actual value: $\frac{f_{\max}(SiC)}{f_{\max}(Si)} = \frac{412kHz}{141kHz} = 292\%$

$$\delta = \frac{310\% - 292\%}{292\%} = 6.16\%$$

Thanks~