

Hybrid Flyback Controller XDPS22-Series - Controllers

Overview

- Infineon's hybrid flyback controllers XDPS22-series
  - Roadmap
  - Key features
  - Target applications
  - Benefits of using Infineon's hybrid flyback controllers
  - Design resources

- Control mechanism
  - Equivalent circuit of the hybrid flyback topology
  - The hybrid flyback operation
    - The hybrid flyback operation - continuous resonant mode (CRM)
    - The hybrid flyback operation - ZV-RVS mode
    - The hybrid flyback operation - Burst mode

Please check Infineon product web page for more information
https://www.infineon.com/products/power/ac-dc-power-conversion/ac-dc-pwm-pfc-controller/**hybrid-flyback-ics**

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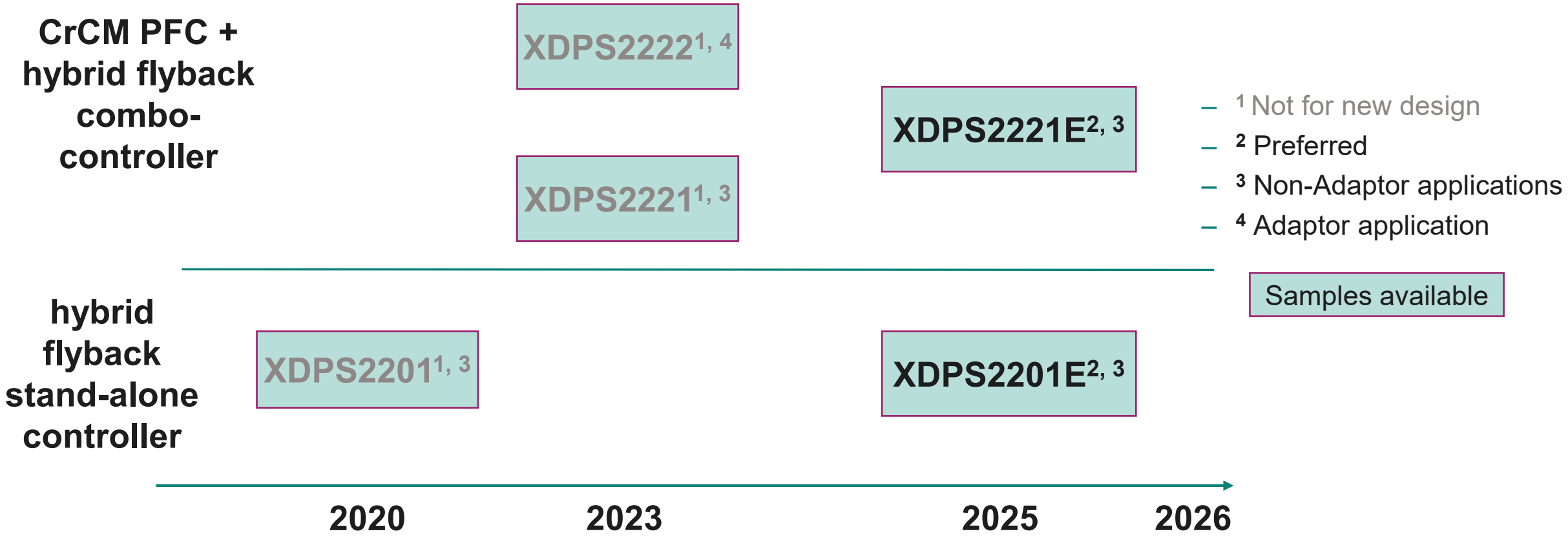
Infineon's hybrid flyback controllers XDPS22*

- Overview



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Infineon's hybrid flyback controllers XDPS22*
- Key features

- A 600 V high-voltage start-up cell for fast VCC charge-up
- Integrated gate drivers supporting GaN and Si switches directly
  - Providing flexibility in choosing power components based on performance and cost objectives
- Burst-mode operation control for the lowest no-load standby power
- Adaptive bus voltage control of all combo controllers
  - Varying the PFC bus voltage according to operating conditions
  - To achieve high efficiency and a flat efficiency curve over the entire load condition
- Comprehensive protection feature set
  - Providing very reliable protection and robust operation
  - Save time and effort during the test phase of the power supply
- The E-version controllers offering following additional benefits
  - Enhanced performance
  - Only limited parameters opened in the .csv file

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Infineon's hybrid flyback controllers XDPS22*
- Target applications

Chargers



USB type-C



E-bike



Power tool

AC-DC power supplies









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Infineon's hybrid flyback controllers XDPS22*
- Benefits of Using Infineon's hybrid flyback Controllers

- Offering users great benefits, including but not limited to:
  - Adjustable FW parameters
    - Offering design flexibility and easy system fine-tune
    - Enabling customers to use one controller across multiple applications in a platform approach
  - Comprehensive protection feature set and mature concept for a reliable system
  - Adjusted bus voltage level of the combo controller according to the line and load condition making not only efficiency high but also the efficiency curve across the entire operating range flat, and easing the customer design to pass industry standards
  - Broad portfolio of fundamental IPs for hybrid flyback and the strongest market position
  - Strong technical support
    - New Excel design spreadsheets with additional features
    - Updated dpVision tool with advanced features for the E-version controllers
    - New hybrid flyback cookbook providing more information about the hybrid flyback topology and a proposal for an optimal design flow

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Infineon's hybrid flyback controllers XDPS22*
- Design resources: Reference and evaluation boards

Board	IC	Type	Output	Input voltage [V]	Nominal output power [W]	Nominal output voltage [V]	Nominal output current [A]	PFC switch	HB switches	SR switch	Load switch	Magnetic core	PD controller
REF_XDPS2221E_250W_BPA	XDPS2201E	EvaB	BPA	90 - 264	250	18 to 55	5	IPA60R060P7	IPAN60R180CM8 x2	ISC073N12LM6	-	PQ2725 PQ2710	-
EVAL_XDPS2221E_120W_3C	XDPS2221E	EvaB	PD 3C	90 - 264	120	5, 9, 15, 20	5	GSD1623-N1	IGI65D1414A3M	BSC034N10LS5	BSZ063N04LS6	RM10 x2	CYPD7171
REF_XDPS2201E_170W_BPA	XDPS2201E	EvaB	BPA	100 to 130 or 198 to 264	170	18 to 42	4		IPA60R280P7S x2	BSC160N15NS5	-		-
EVAL_XDPS2222_240W1	XDPS2222	EvaB	PD 1C	90 - 264	240	5, 9, 15, 20, 28, 36, 48	3 A @ 5 V 5 A otherwise	IPP60R070CFD7	IGLD60R190D1 x2	BSC074N15NS5	IPB110P06LM	RM10 x2	CYPD3175
REF_XDPS2222_240W1	XDPS2222	FFB	PD 1C	90 - 264	240	5, 9, 15, 20, 28, 36, 48	3 A @ 5, 9, 15 V 5 A otherwise	IPP65R065C7	IGLD60R190D1 x2	ISC073N12LM6	RS1L151ATTB1	PQ2625 PQ2620	CYPD3175
REF_XDPS2221_140W1	XDPS2221	FFB	PD 1C	90 - 264	140	28	5	IGLD60R190D1	IGLD60R190D1 x2	BSC040N10NS5	IRF7240	RM10	CCG3PA
DEMO_XDPS2201_65W1	XDPS2201	FFB	PD 1C	90 - 264	65	20	3.25		IPD60R180C7, DPAK IPP60R180C7, I2PAK	BSC093N15NS5	BSZ086P03NS3	RM8	CCG3PA
REF_140W_hybrid flyback_PAG2S	XDPS2221	FFB	PD 1C	90 - 264	140	28	5	IGLD60R190D1	IGLD60R190D1 x2	BSC040N10NS5	IRF7240	RM10	PAG2S

Please check Infineon product web page for more information
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Infineon's hybrid flyback controllers XDPS22*
- Design resources: Design guides, tools and simulation reference

- System design guide
  - Design guide XDPS2201: https://www.infineon.com/dgdl/Infineon-Design_guide_hybrid_flyback_topology_design_XDPS2201-ApplicationNotes-v03_00-EN.pdf?fileId=5546d46278d64ffd0178f986b48b089e
  - Latest updated for XDPS2201E and XDPS2221E, pleased check **here** for more information
- Design tool
  - Excel design sheets
    - hybrid flyback only: XDPS2201E and XDPS2201
    - PFC + hybrid flyback: XDPS2221E, XDPS2221 and XDPS2222
  - https://infineon.poweresim.com/
- SIMPLIS simulation tool from Christophe Basso
  - Flyback AHB topology available @ Mr. Basso's web page: https://powersimtof.com/Downloads/Book/Book%20Collection.zip
  - To-do: unzip the file and put the DeadTimeProg subcircuit (in the ZIP subs) in the book collection/subs directory

Please check Infineon product web page for more information
https://www.infineon.com/products/power/ac-dc-power-conversion/ac-dc-pwm-pfc-controller/**hybrid-flyback-ics**

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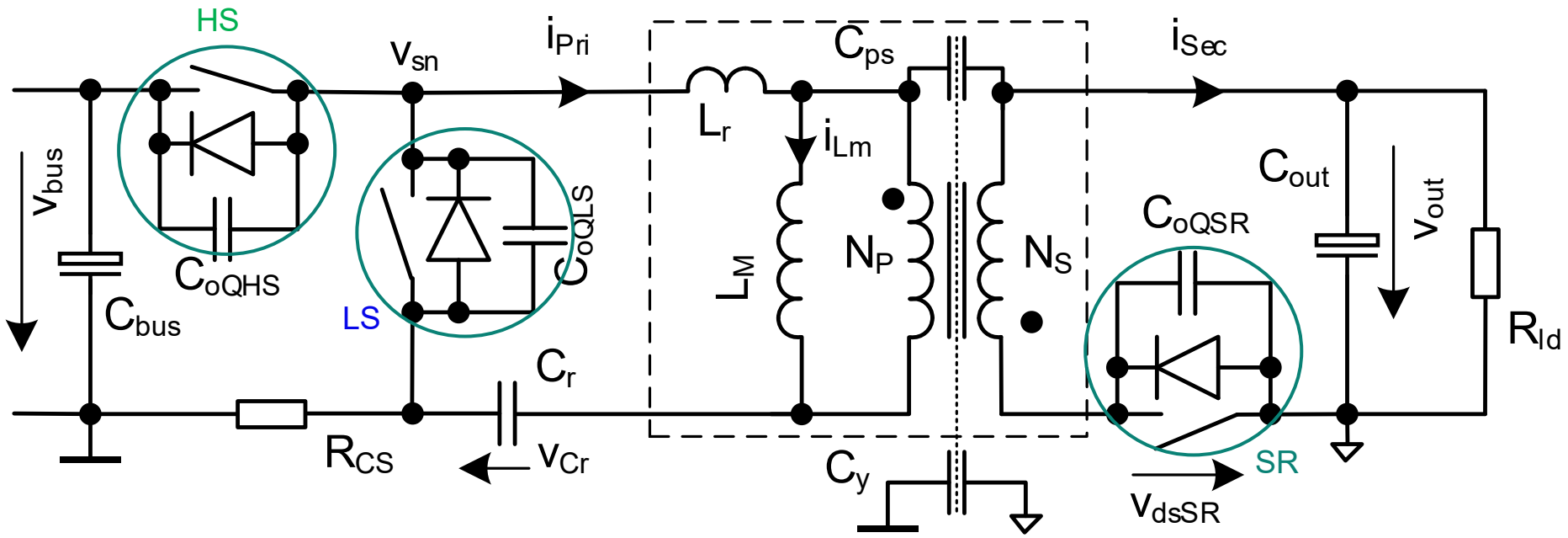
Control mechanism
- Equivalent circuit



– Parasitic components of the switches playing important role for the zero-voltage switching

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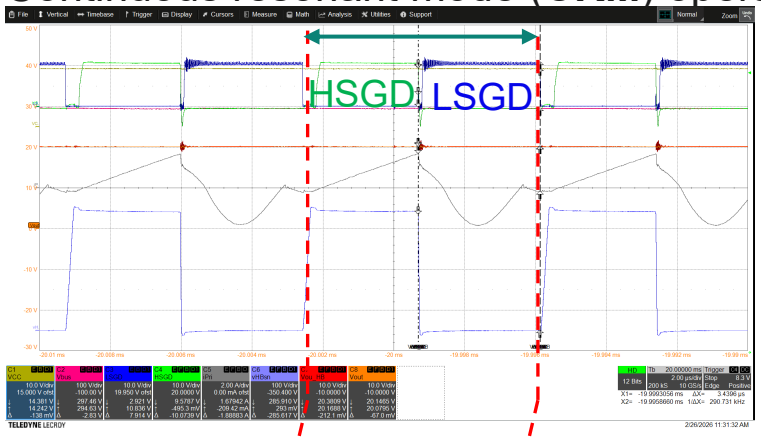
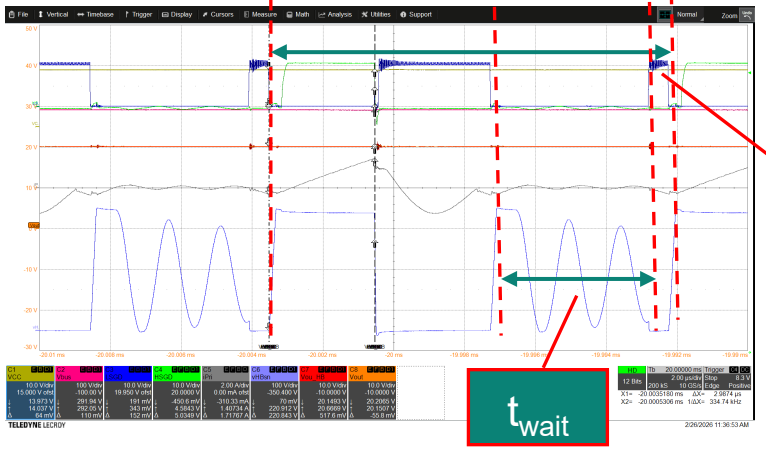
Control mechanism
- Operation: overview

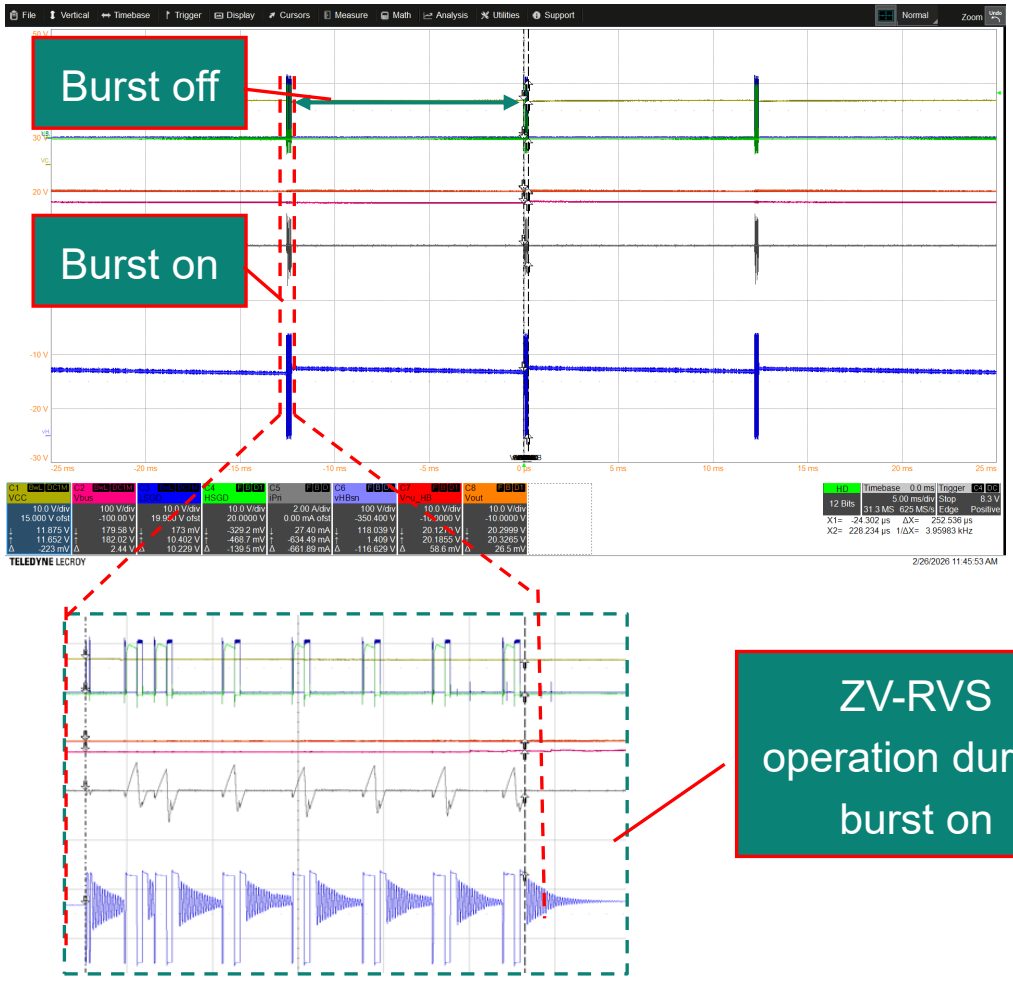
– The **continuous** operation
  – Continuous resonant mode (**CRM**) operation at high load



  – Zero-voltage resonant valley switching (**ZV-RVS**) mode around half-load



– The **non-continuous burst** mode at light load



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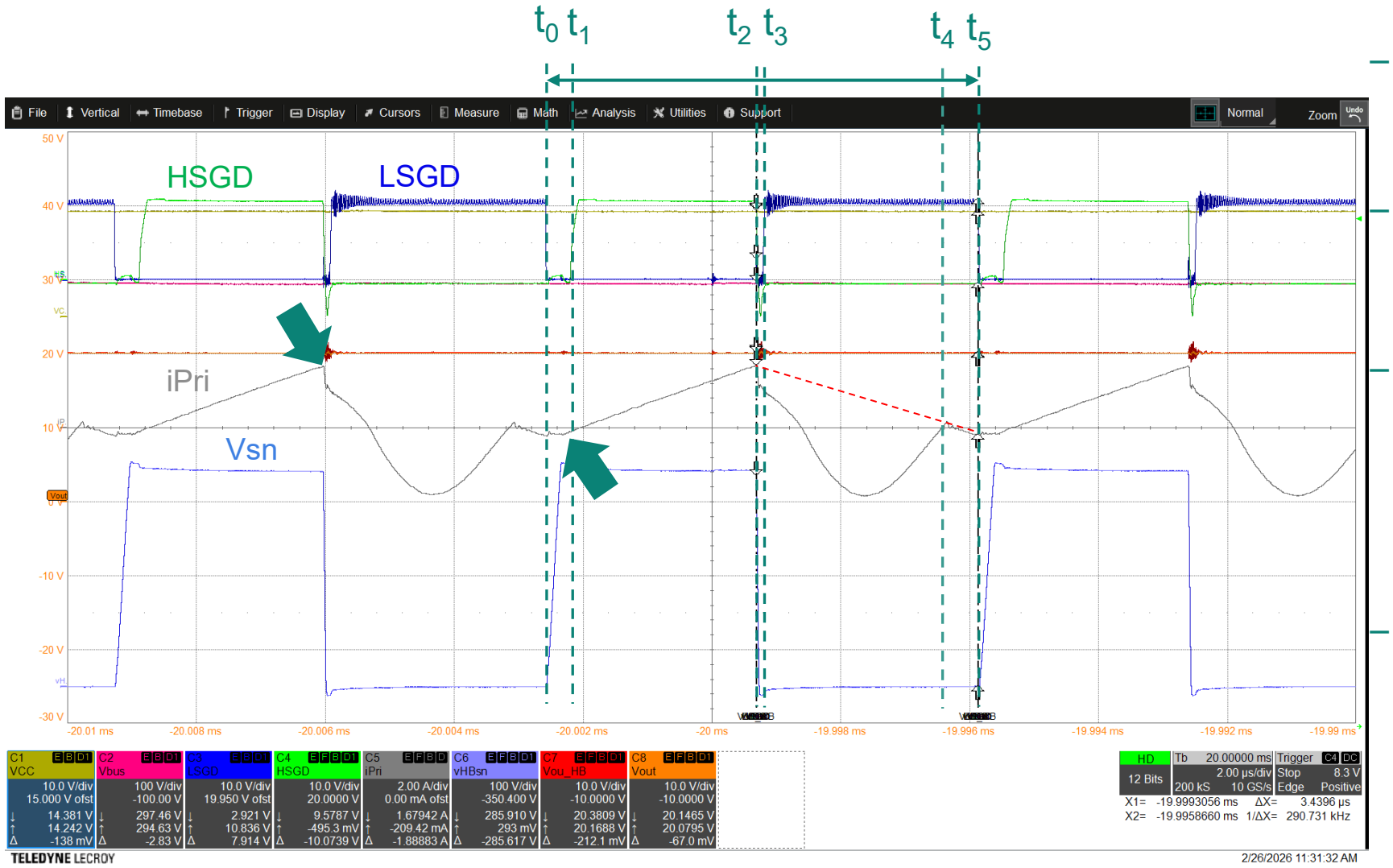
Control mechanism
- CRM operation: overview



- Hybrid flyback utilizing the peak current control for turn-off of the highside switch
- The target magnetizing peak current defined by the feedback voltage
- Lowside gate pulse width defined by the configurable lowside gate pulse width at the nominal output voltage and the actual output voltage
- Zero-voltage turn-on of the highside switch ensured by the negative current at the lowside gate turn-off while zero-voltage turn-on naturally realized for the lowside switch

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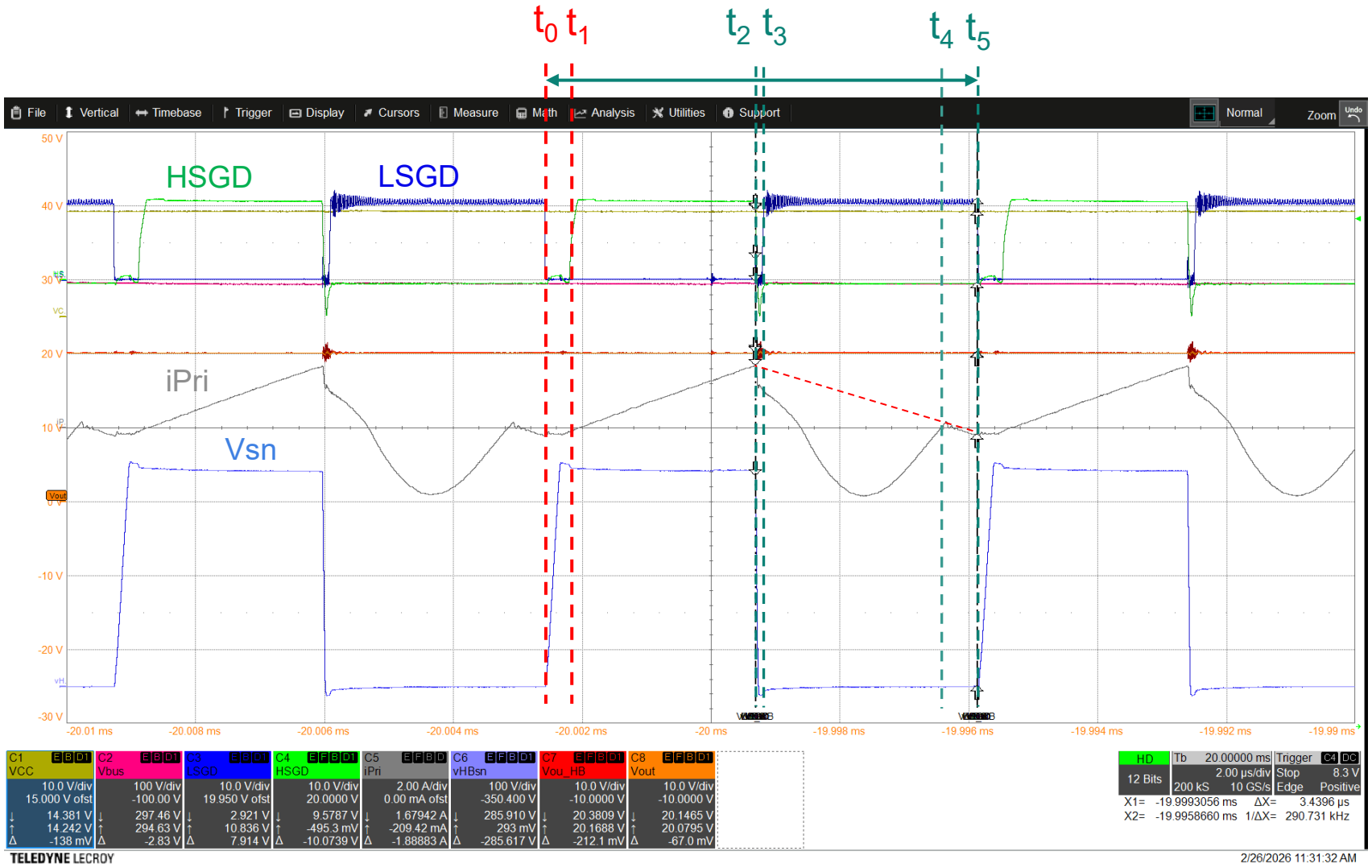
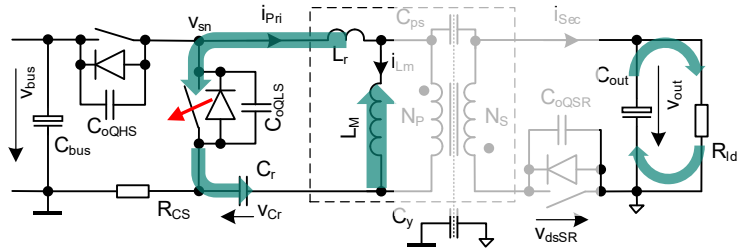
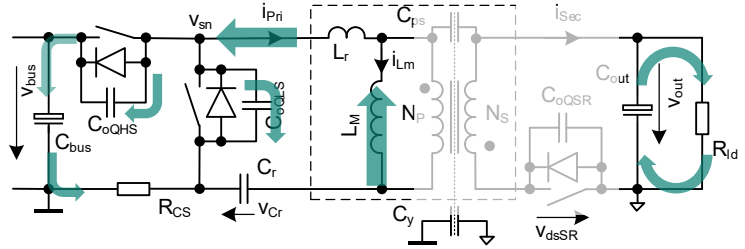
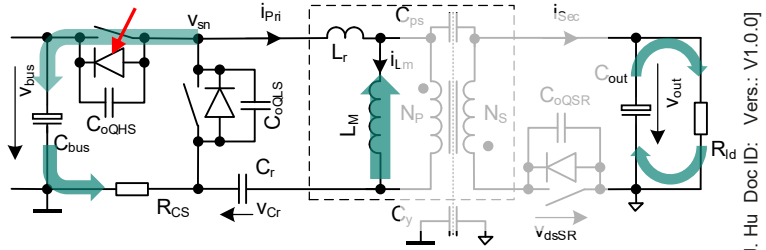
Control mechanism
- CRM operation: t_0 to t_1









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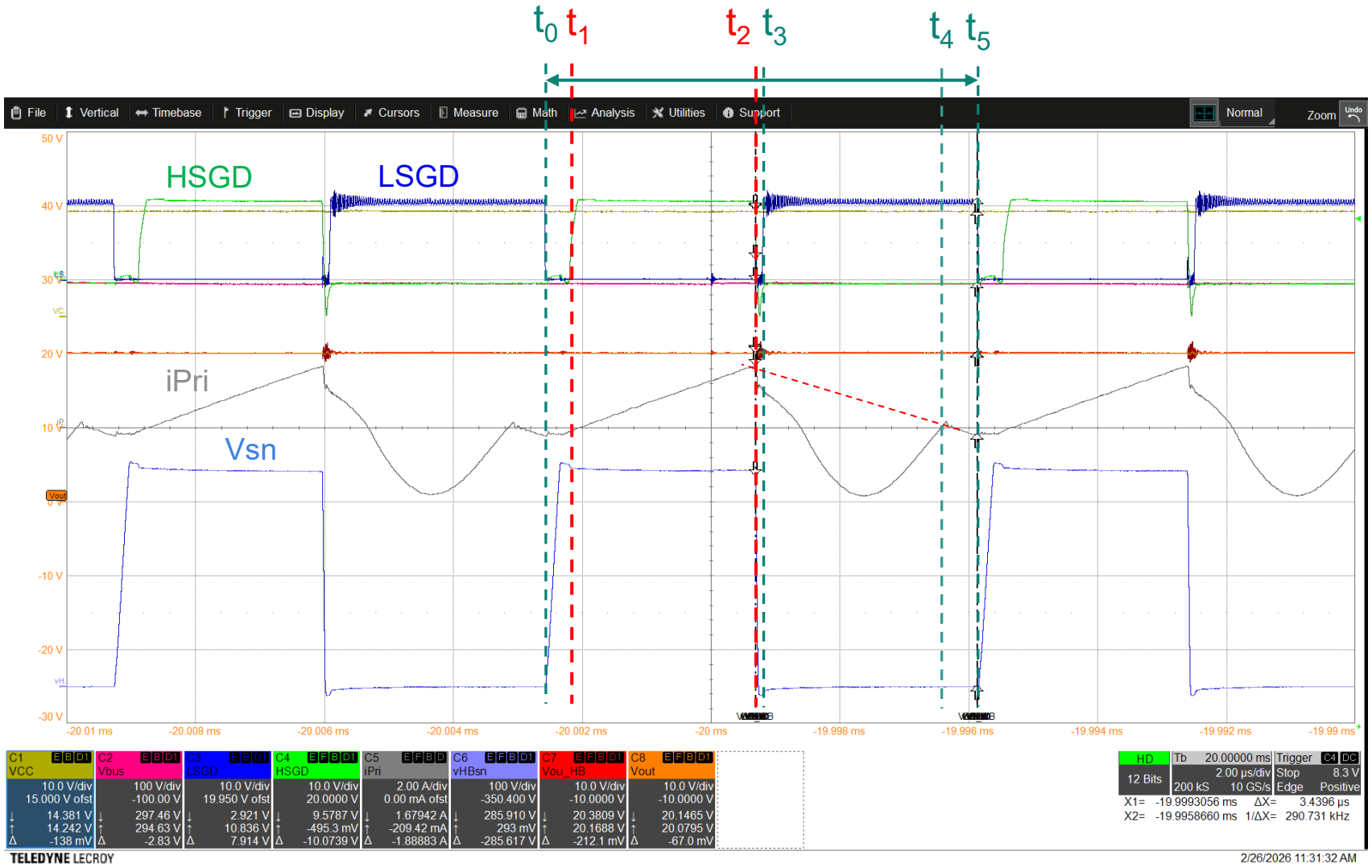
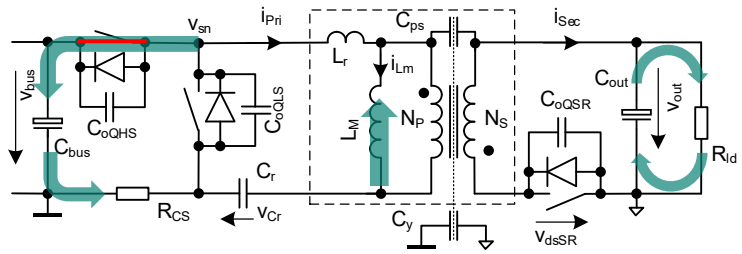
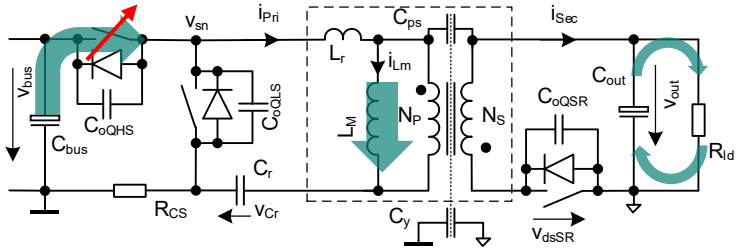
Control mechanism
- CRM operation: t_1 to t_2







$$f_{rHS} = \frac{1}{2\pi\sqrt{L_{Pri} * C_r}}$$

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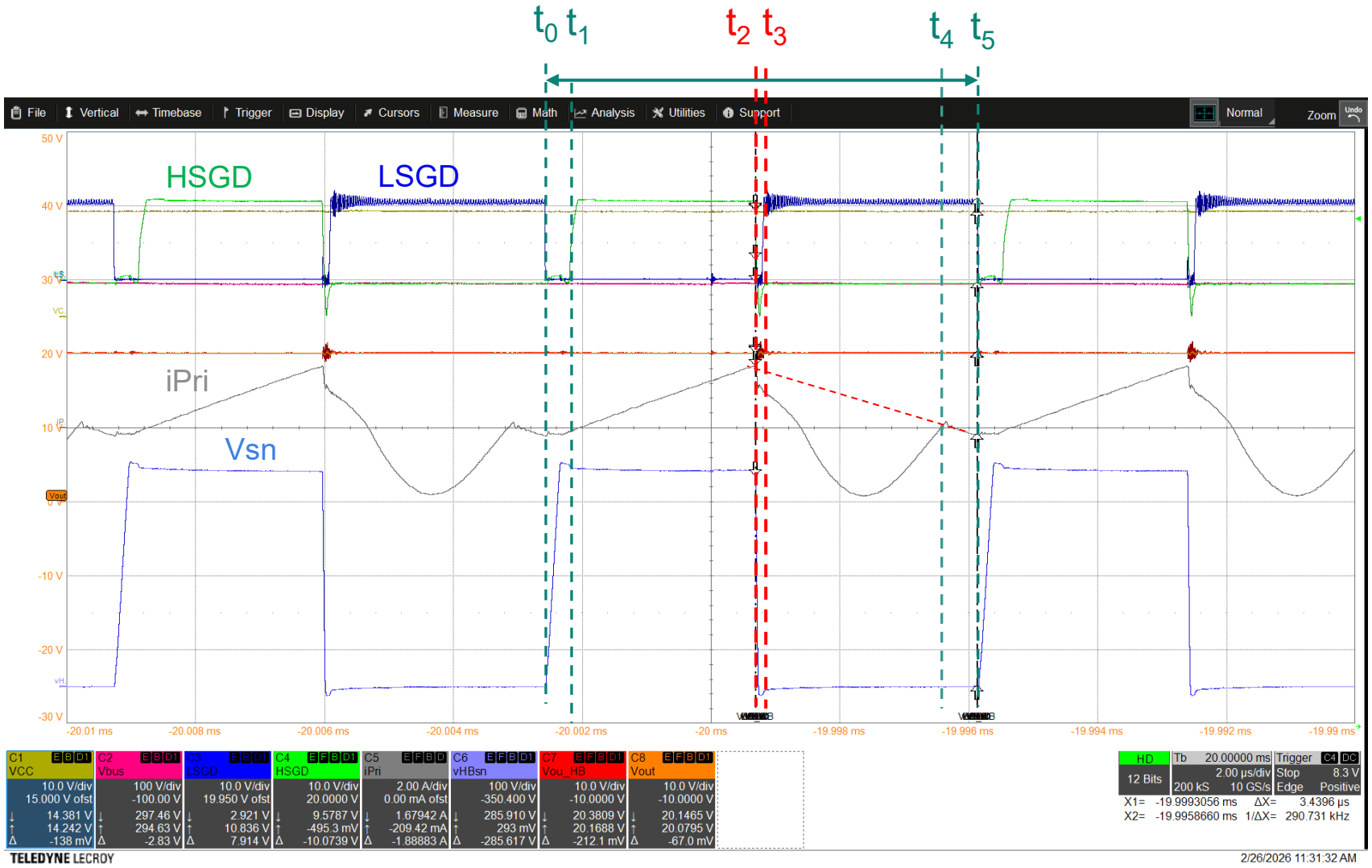
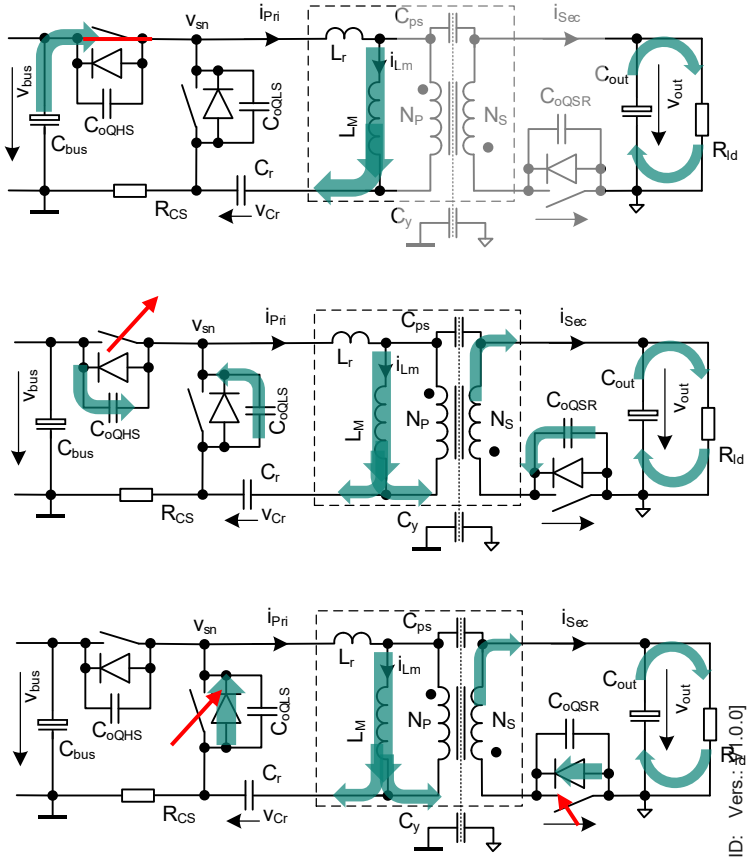
Control mechanism
- CRM operation: t_2 to t_3





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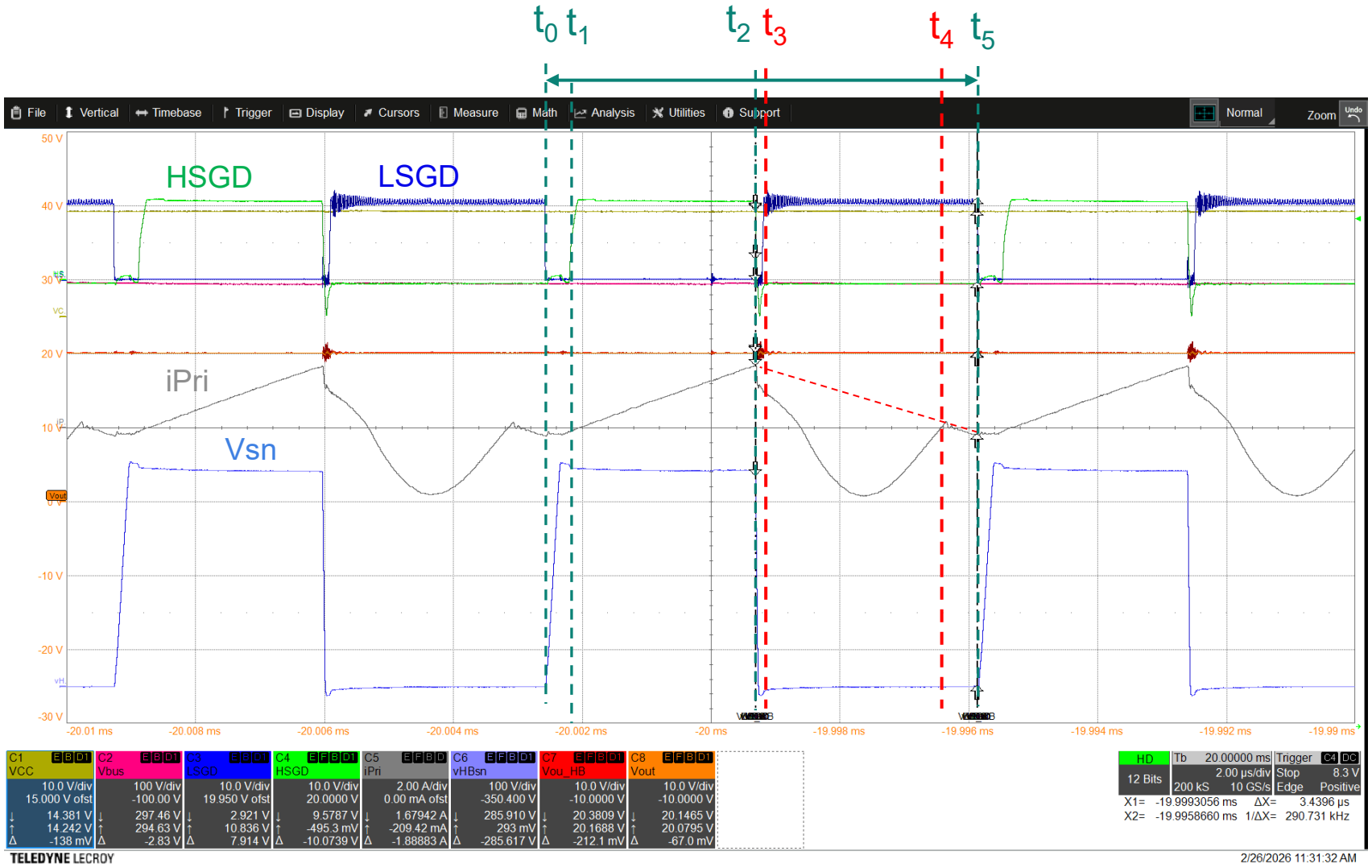
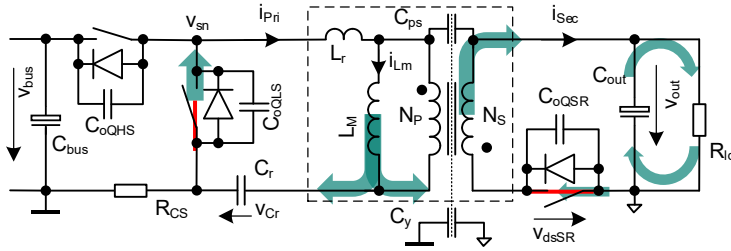
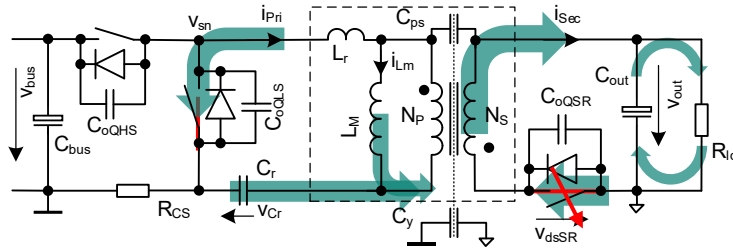
Control mechanism
- CRM operation: t_3 to t_4







$$f_{rLS} = \frac{1}{2\pi\sqrt{L_r * C_r}}$$

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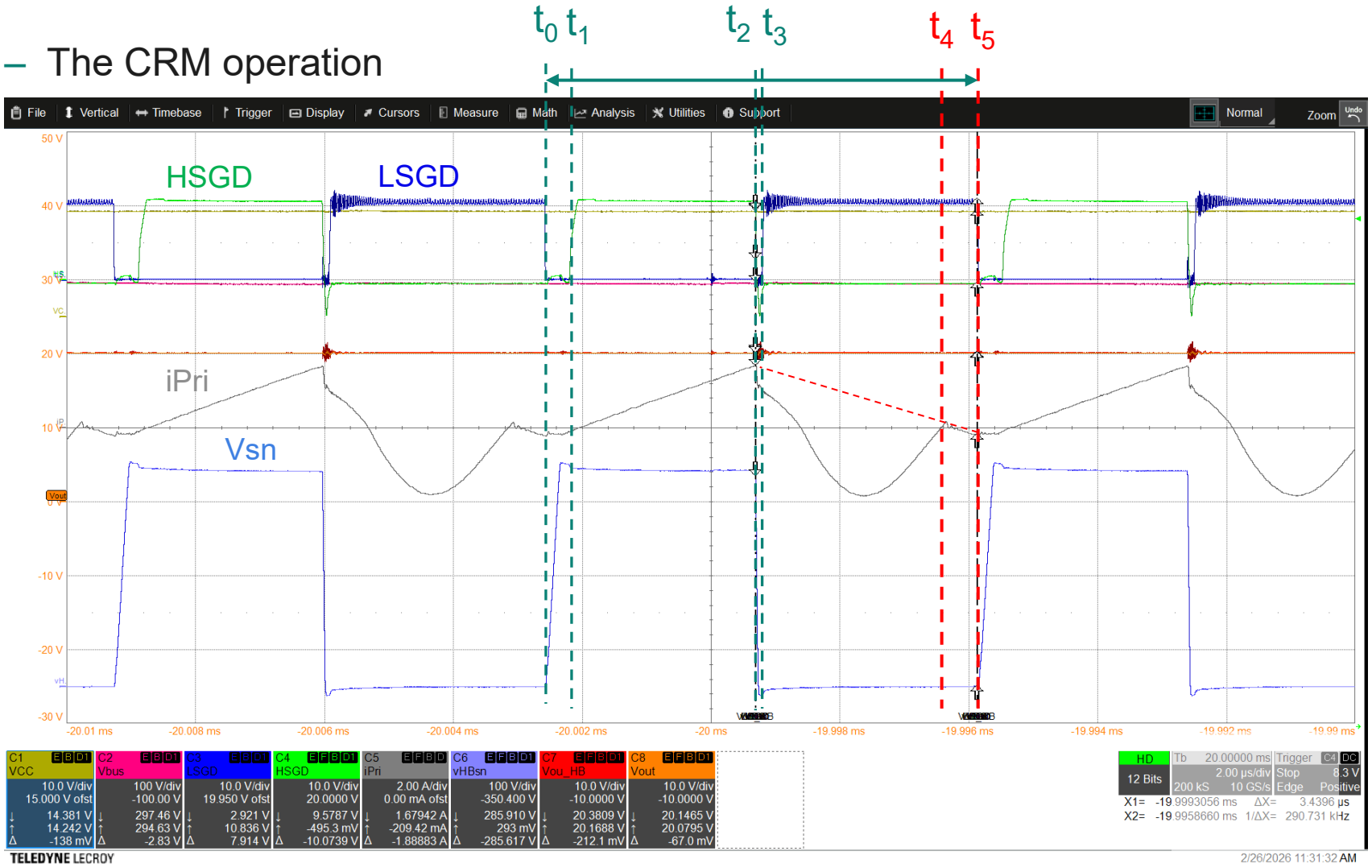
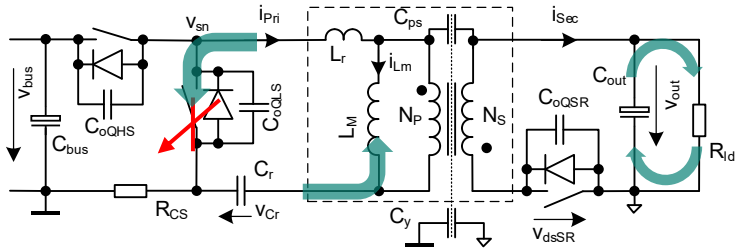
Control mechanism
- CRM operation: t_4 to t_5

– The CRM operation





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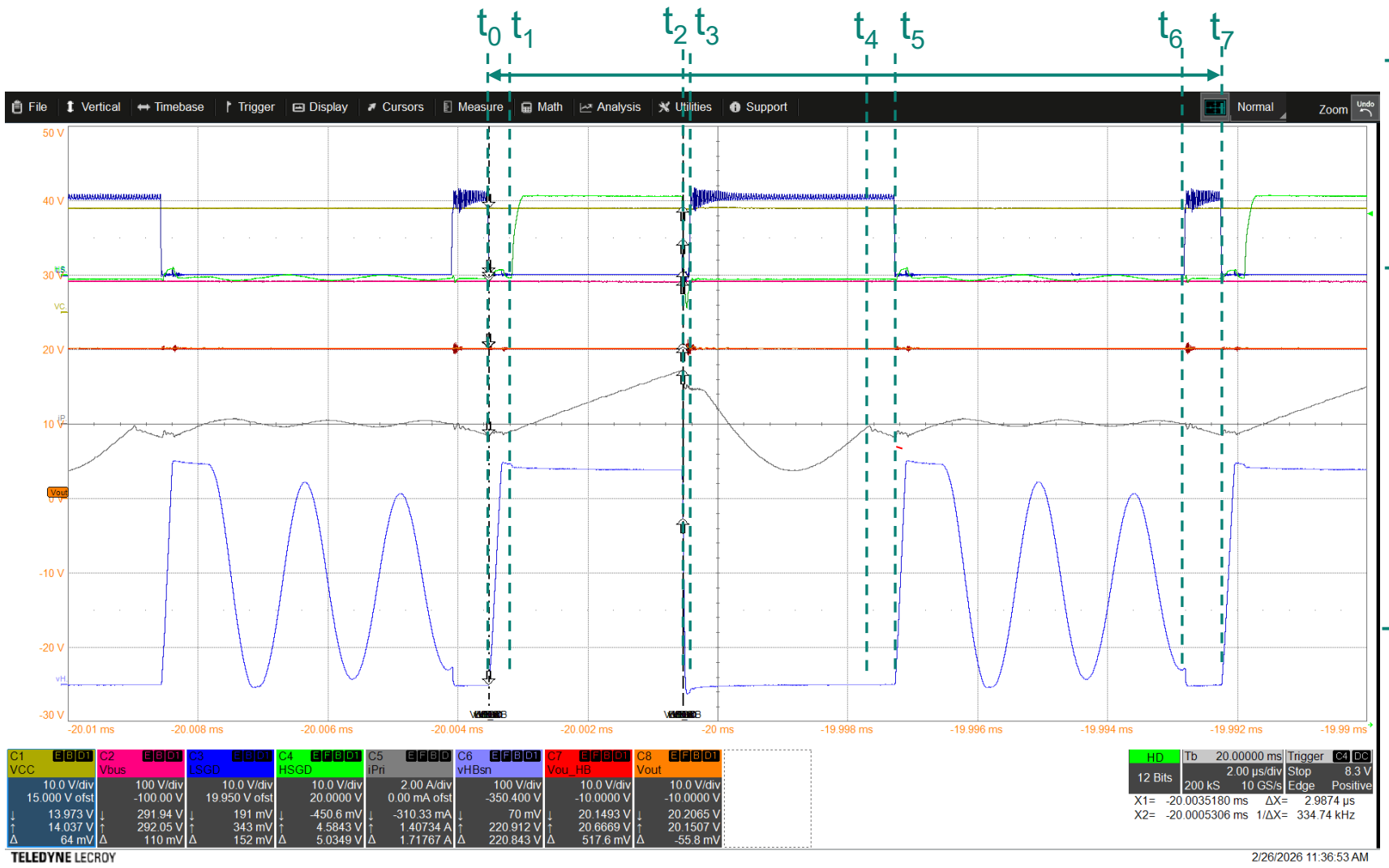
Control mechanism
- ZV-RVS operation: overview



- t_0 to t_5
  - Same pattern as in CRM
- t_5 to t_6
  - Wait time for efficiency improvement
  - Varying according to the load condition
- t_6 to t_7
  - ZVS pulse to generate negative current for ZV turn-on of the next highside gate

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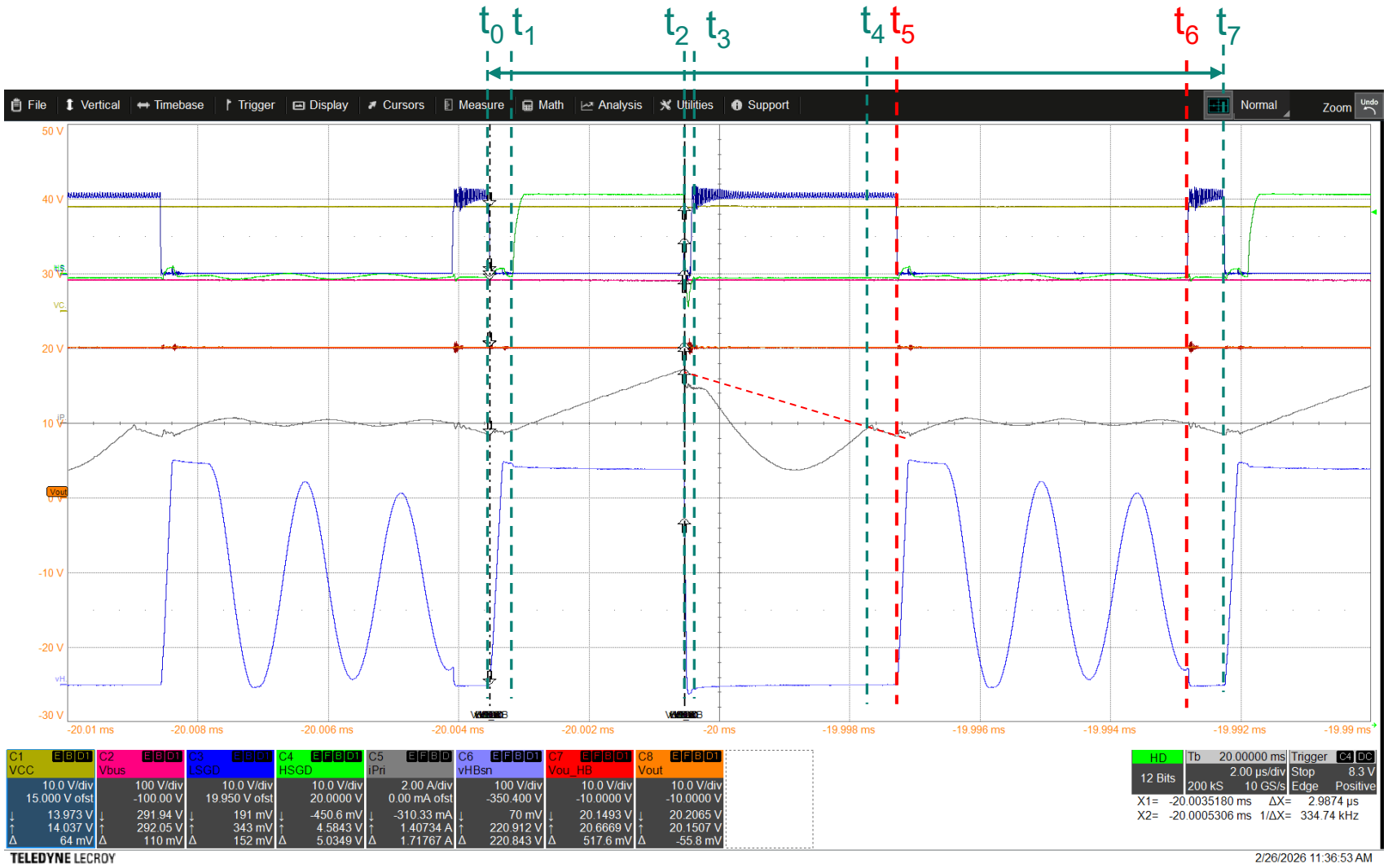
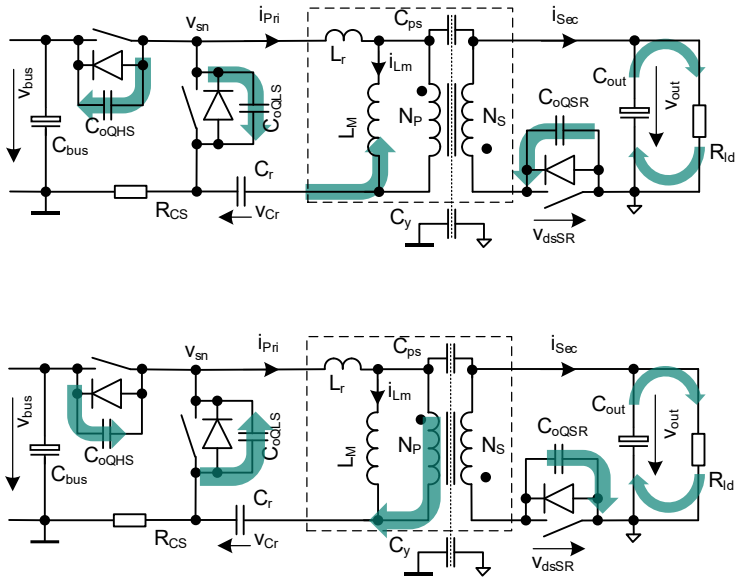
Control mechanism
- ZV-RVS operation: t_5 to t_6





$$f_{rTW} = \frac{1}{2\pi\sqrt{L_r * C_{eqTW}}}$$

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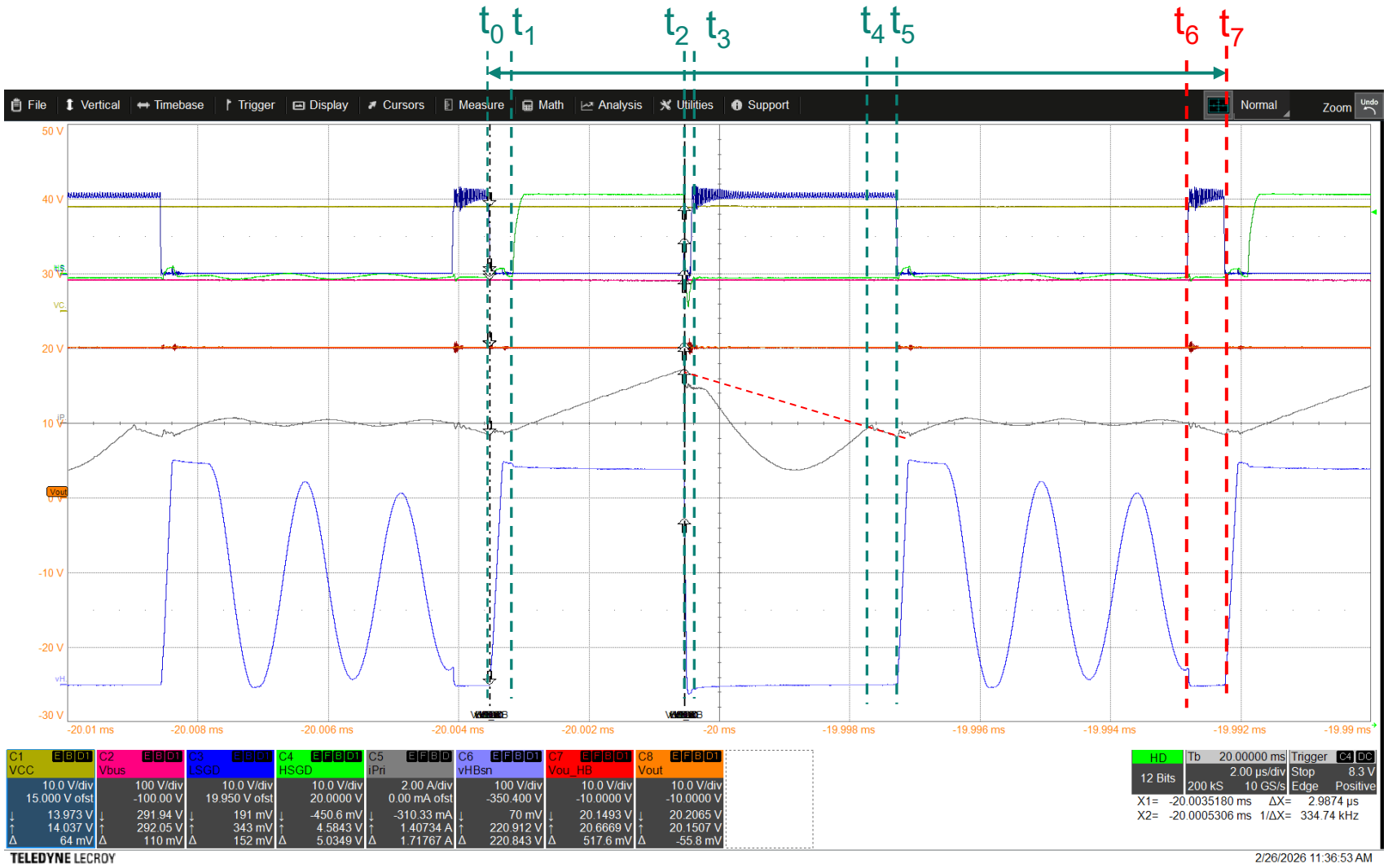
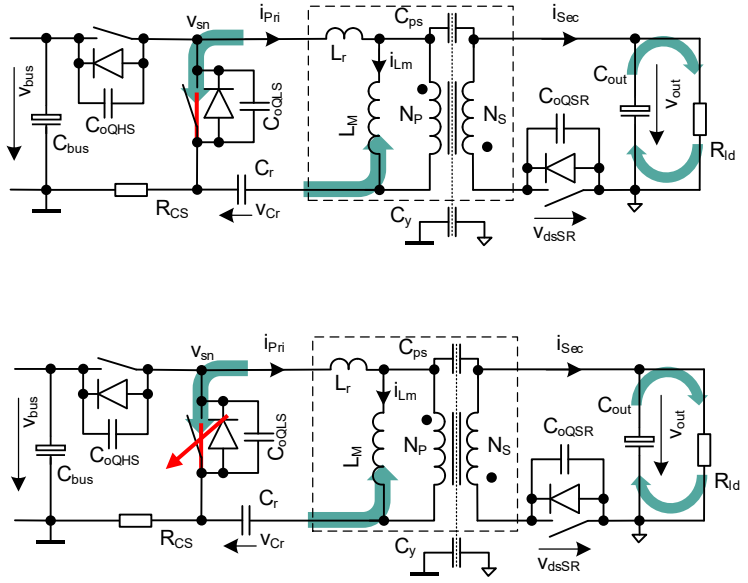
Control mechanism
- ZV-RVS operation: t_6 to t_7





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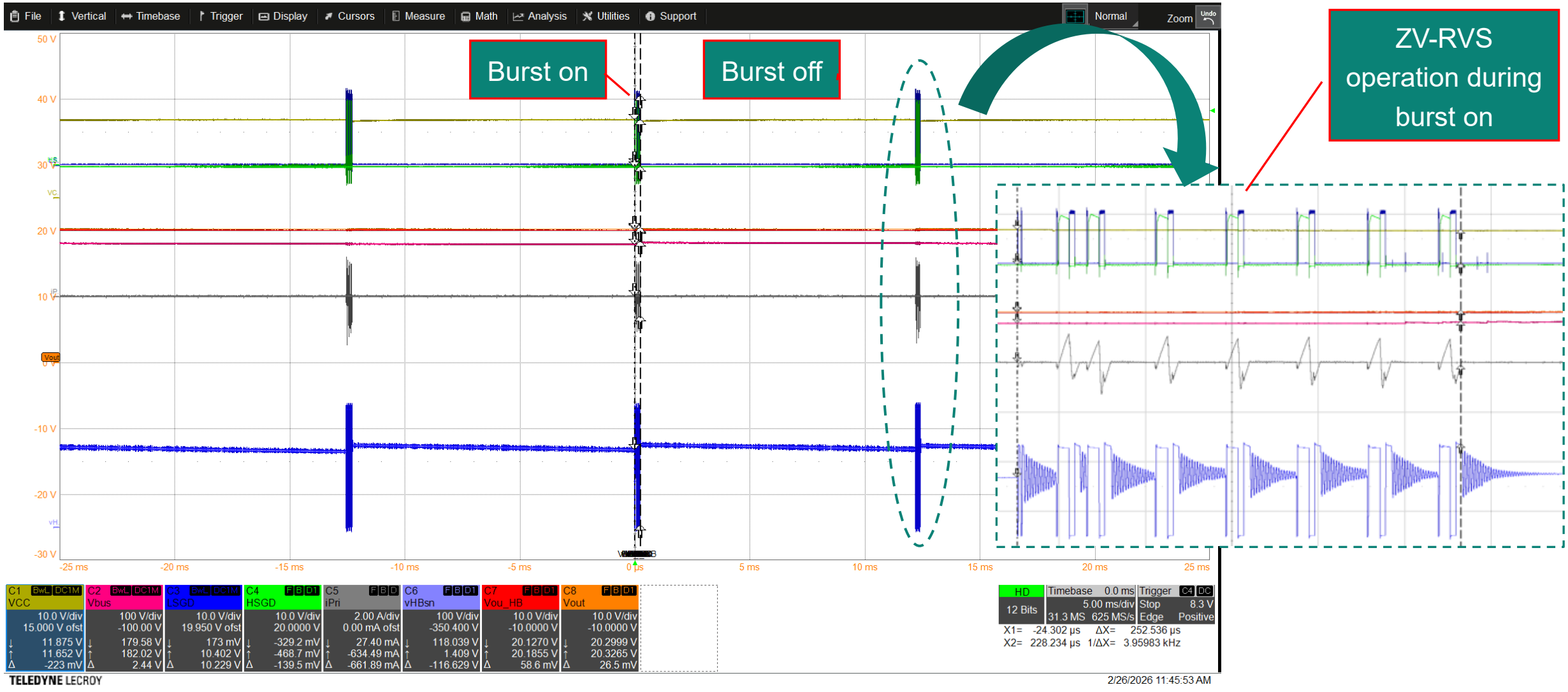
Control mechanism
- Burst mode operation



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