Driver Types

TI Precision Labs – Ultrasonic Sensing

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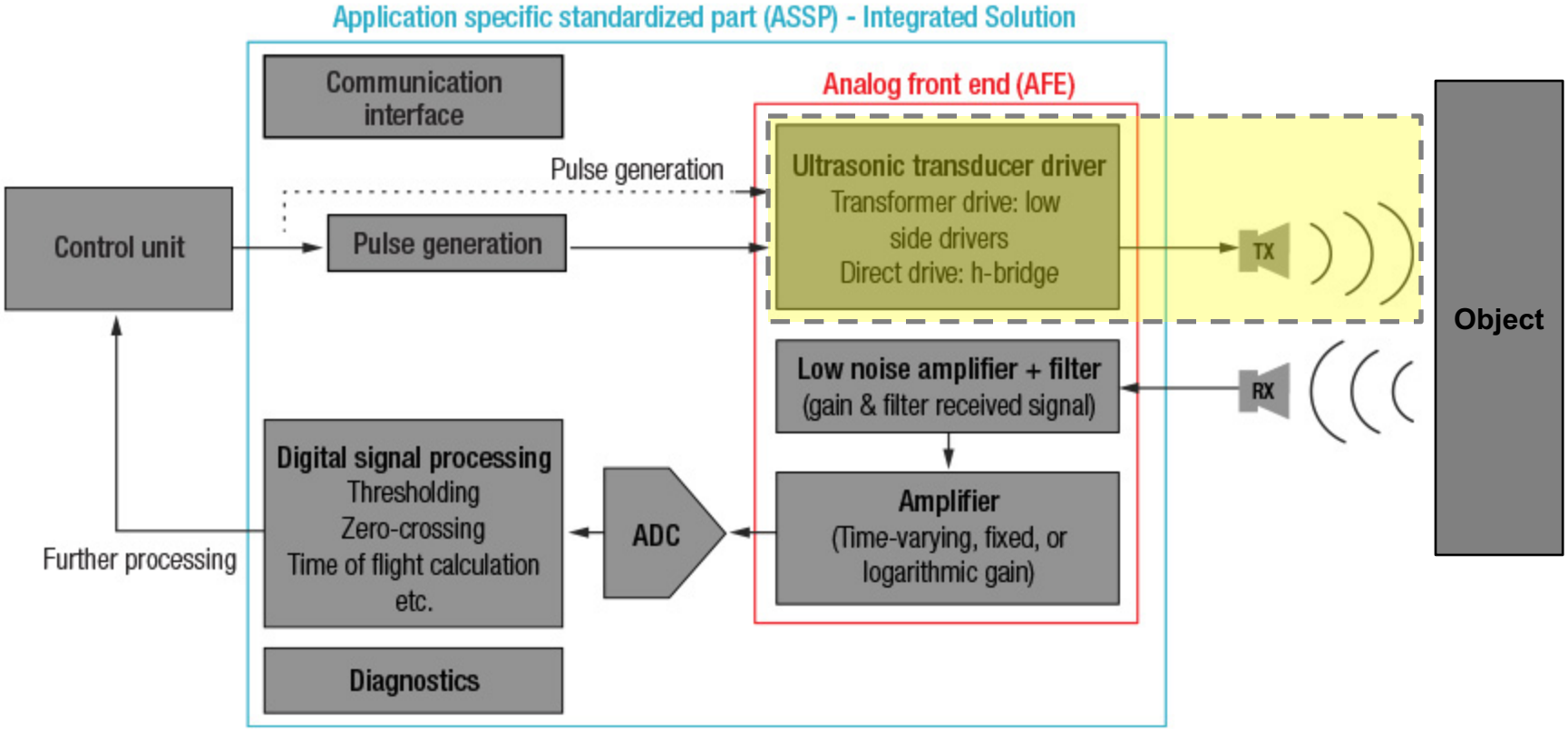
Prepared by Akeem Whitehead

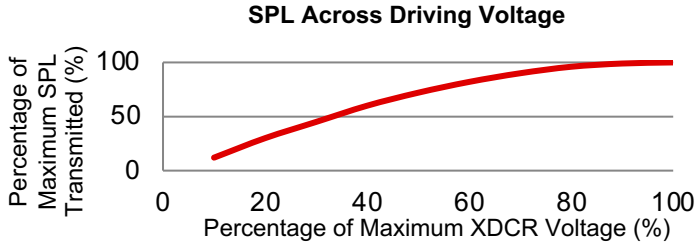
Block Diagram of Ultrasonic System



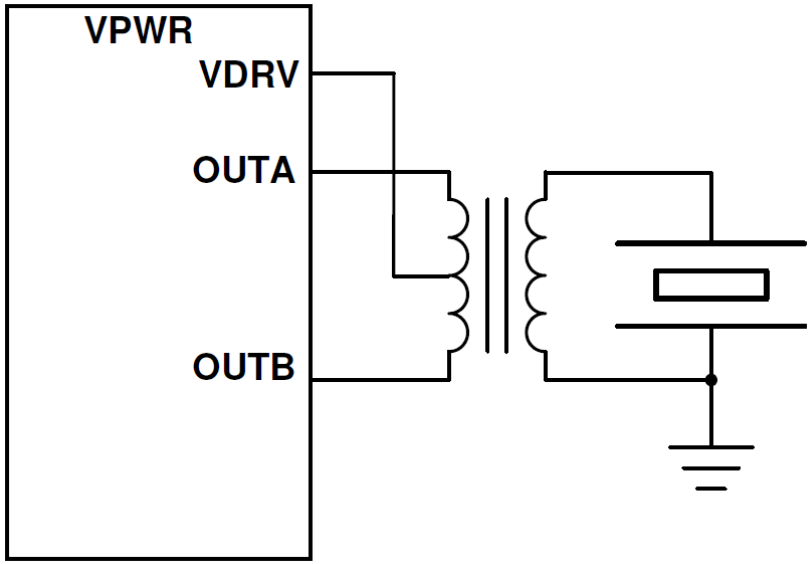
Transformer & Direct Driver Modes

- Two types of driver-modes are available to excite a transducer: *transformer* and *direct*
- Driver selection should be based on the transducer's **maximum drive voltage**
  - What drive voltage will produce sufficient or maximum SPL?

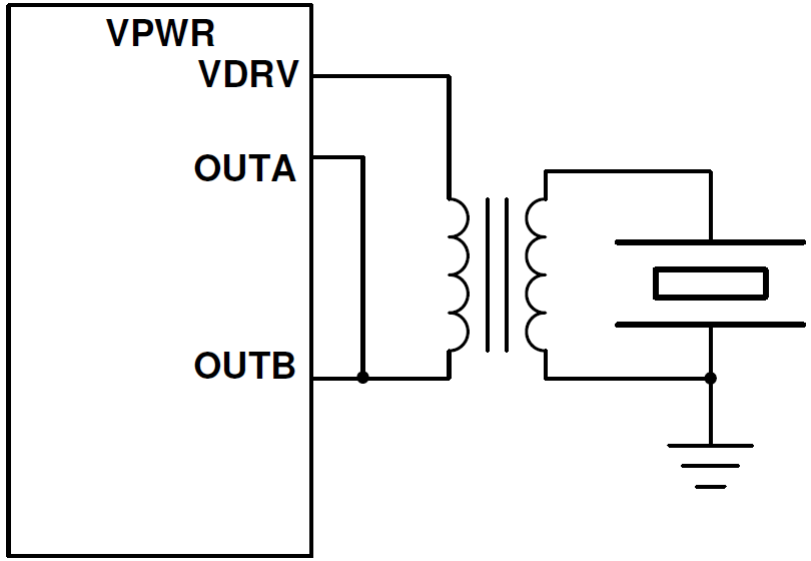
Type	Transformer	Direct
Benefits	• Able to maximize drive requirements for closed-top transducers (beyond 100Vpp) • Equivalent circuit enables de/tuning for short range • Fixed and tunable coil types available • Center-tap push-pull or single-ended available	• Able to maximize drive requirement for open-top transducers • Able to drive closed-top transducer for short range applications • Half-bridge or full-bridge drivers available • Low-cost and small footprint
Disadvantages	• Additional calibration required at mass production • High-cost and large footprint	• Short range tuning limited to damping resistor



Transformer Configurations

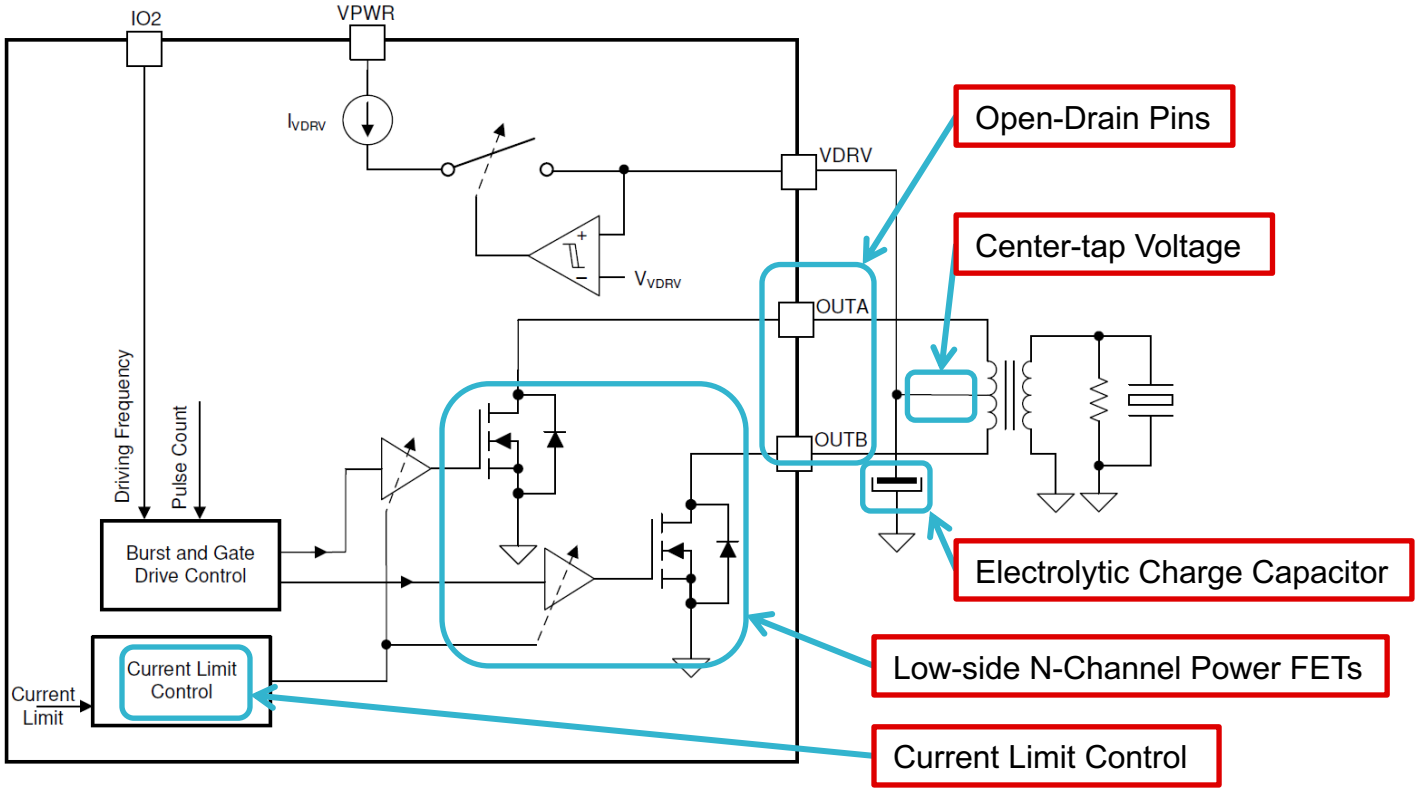


Push-Pull Transformer

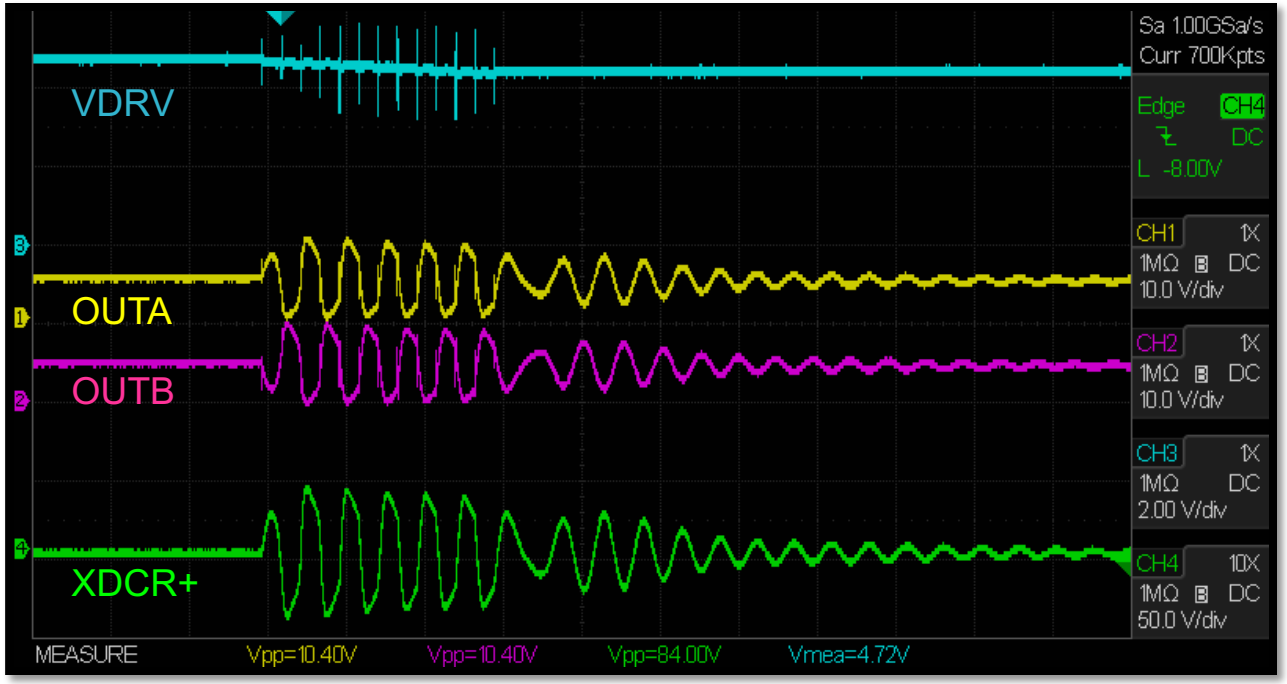


Single-Ended Transformer

Transformer Driver Structure



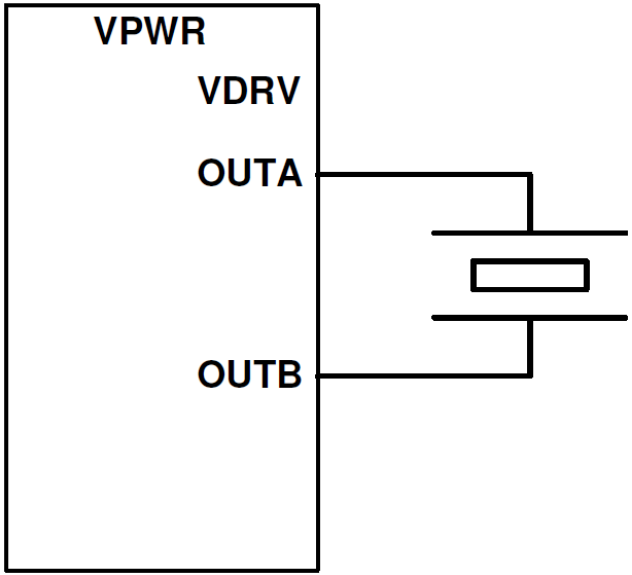
Transformer Driver Example



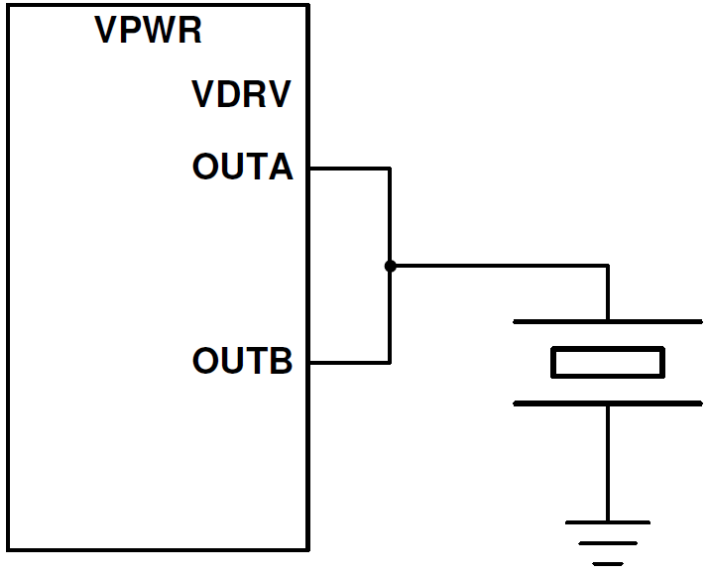
Test conditions:

- 5V center-tap (VDRV)
- Push-pull transformer
- 40 kHz driver frequency
- Closed-top transducer
- 6 burst pulses
- 400 mA driver current limit

Direct-Driver Configurations

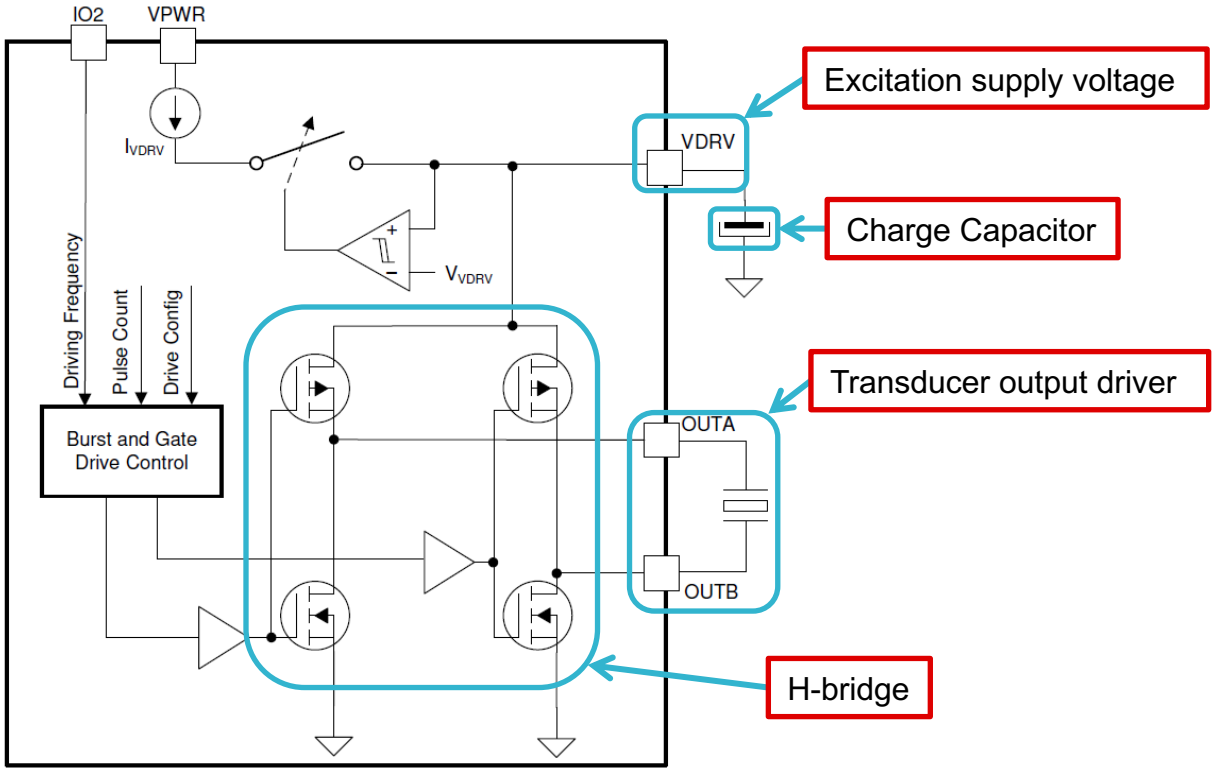


Full-Bridge Direct Driver

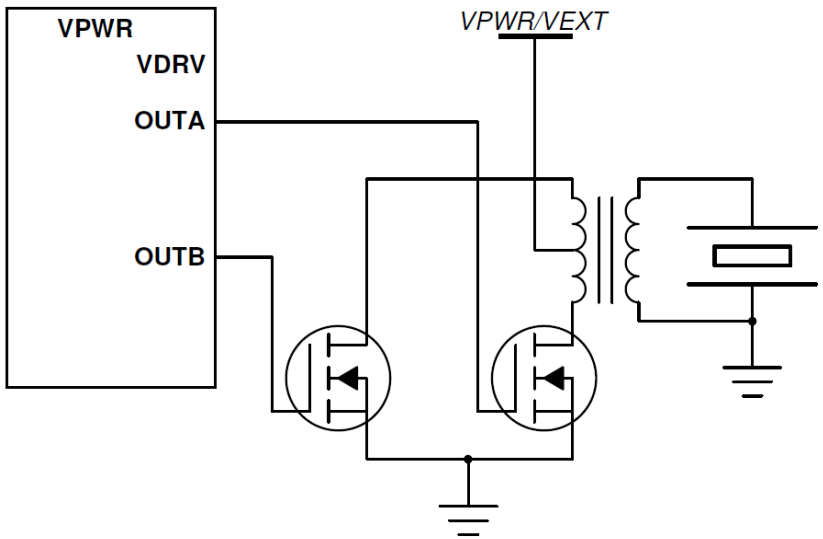


Half-Bridge Direct Driver

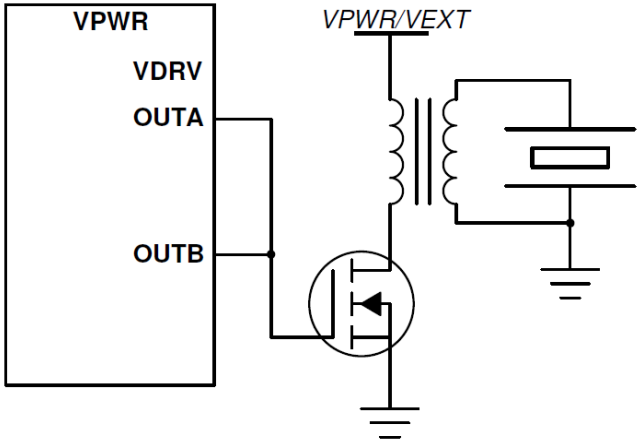
Direct-Driver Structure



Pre-Driver Configurations

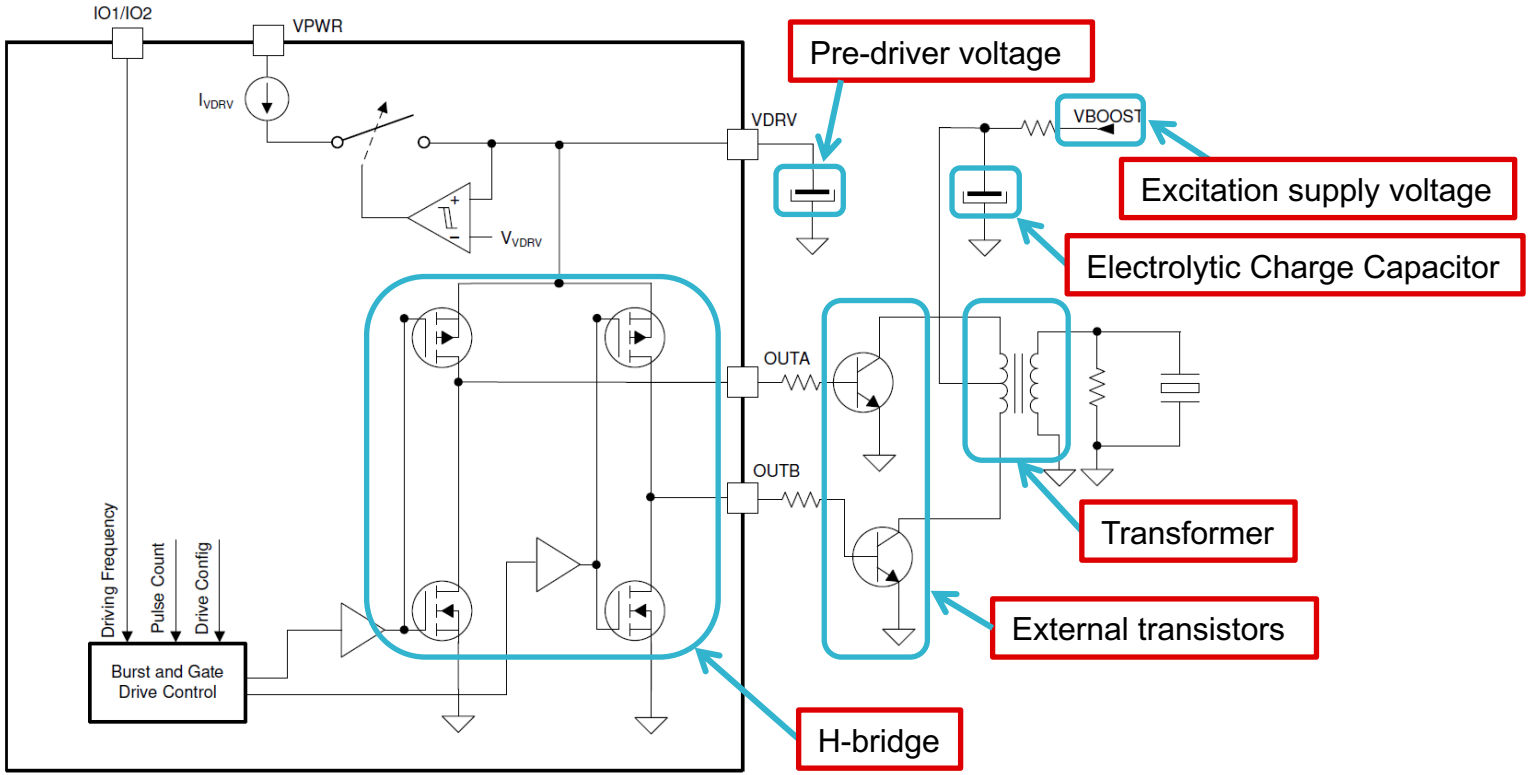


Pre-Driver for Push-Pull



Pre-Driver for Single-Ended

Pre-Driver Structure

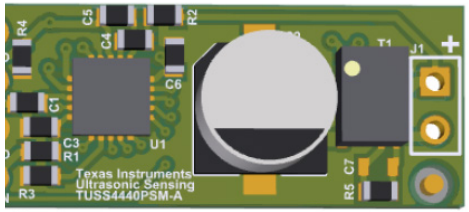


Select Driver Based on Transducer

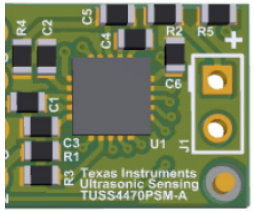
Transducer Parameter	 *Closed-top* MA58MF14-7N	 *Open-top* MA40H1S-R
Operating Temperature Range	-40℃ to 85℃	-20℃ to 60℃
Construction	Closed type	Open type
Center Frequency	58kHz	40kHz
Overall Sensitivity	More than 1 Vop	-65dB min. (0dB=1V/Pa)
Directivity	80° x 35°(typ.)	80° (typ.)
Capacitance	1400pF	4500pF
Capacitance Tolerance	±20%	±20%
Max. Input Voltage	120Vp-p Pulse number: 20 pulses or less Interval: 20ms or more. Do not apply D.C. voltage.	7.2Vp-p (at 40kHz,Square wave)
Recommended Driver	Transformer Driver	Direct Driver

Which Driver to Use?

System Requirement	Transformer Driver	Direct Driver
Performance	Superior short and long range performance due to large excitation voltage and matching component compatibility	Longer ring-decay time hinders minimum range capability
PCB Size	Larger size due to transformer component and 100uF charge capacitor	Smaller size due to small charge 1uF capacitor
PCB Cost	Higher cost due to costly transformer and charge capacitor, and larger PCB size	Lower cost due to smaller PCB size
Frequency Support	Optimized for low driver frequencies up to 500kHz	Supports all driver frequencies up to 1MHz



TUSS4440
transformer drive



TUSS4470
direct drive

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