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# Application Note

## Key Difference Between GDDR2 and GDDR3

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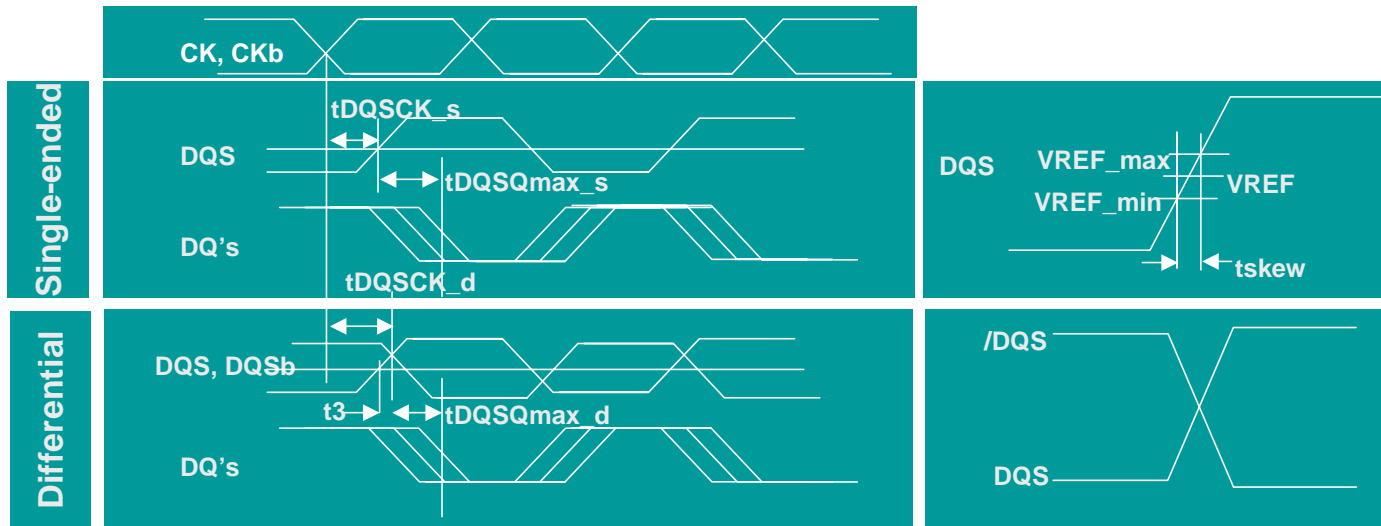
# GDDR2/3 Key Feature Differences

Key Features of GDDR3 are almost same as GDDR2 except 2 things

	GDDR2	GDDR3
Strobe	Bi-directional & Differential (DQS, /DQS)	Uni Directional & Single-ended (RDQS,WDQS)
Receiver Type	Push Pull	Pseudo Open-Drain

# Strobe Type Comparison (I)

## ❖ Single-ended DQS Vs. Differential DQS

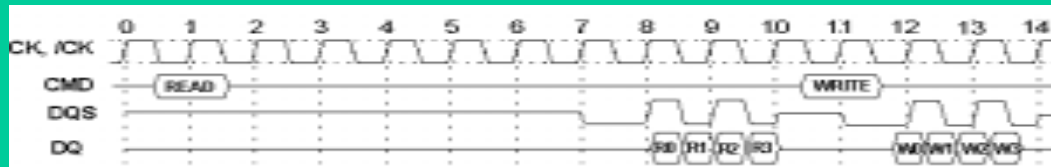


- In case of differential strobe,  $t_{DQSQmax}$  can be improved a lot by reducing skews resulted from SSO noise and DQS buffer's high/low transition noise.  
 $t_{DQSQmax\_d} = t_{DQSQmax\_s} - t_3$ , whereas  $t_3$  is nearly a half value of SSO noise.
- On consideration of  $V_{ref}$  noise,  $t_{DS}/t_{DH}$  of differential strobe scheme is better than that of single-end strobe scheme.

# Strobe Type Comparison (II)

## ❖ Single-ended DQS Vs. Differential DQS

### GDDR1/2: Bi-directional DQS (CL7, BL4, WL1)



DQS should be in hi-z state at least one clock prior to write command

### GDDR3 : Unidirectional separate read & write DQS (CL7, BL4, WL1)

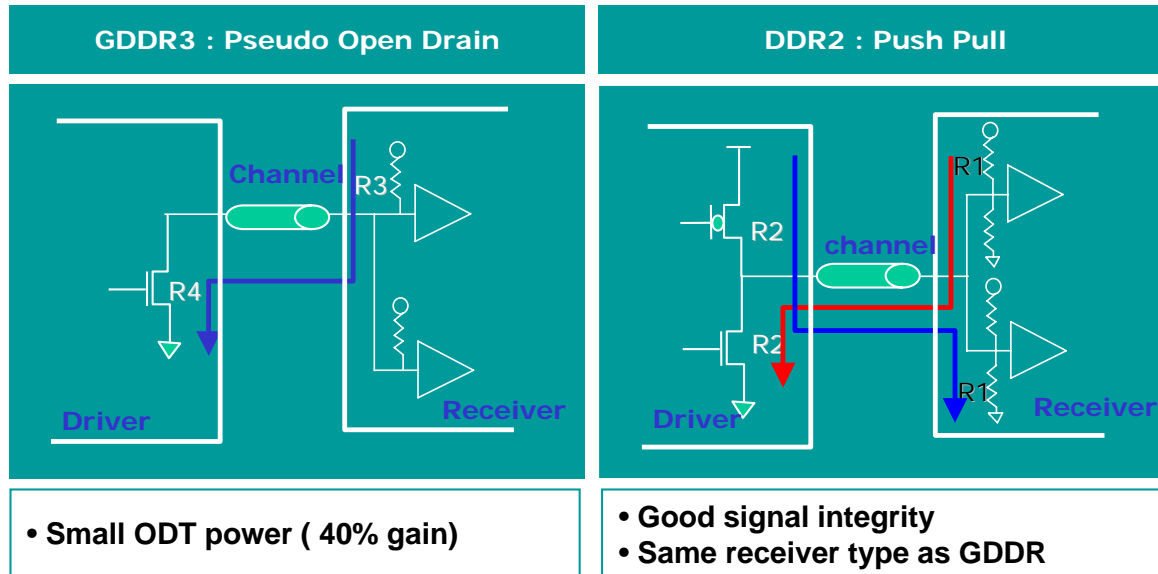


No read to write data strobe turn-around time required

- By implementing separate read and write data strobe, Read to Write turn around time can be saved by  $1t_{CK}$ .

# Receiver Type Comparison

## ❖ Pseudo Open Drain (GDDR3) Vs. Push Pull (GDDR2)

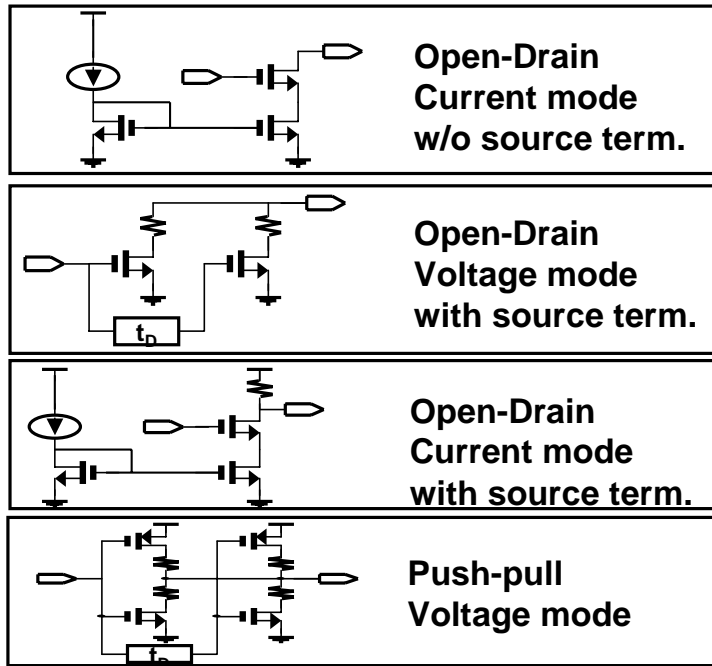
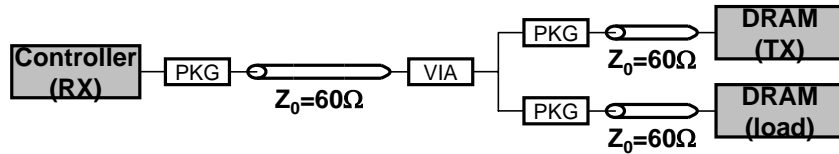


Assumption : Same channel condition for both cases.

It doesn't represent absolute number of ODT power difference between pseudo open drain case and push-pull case.

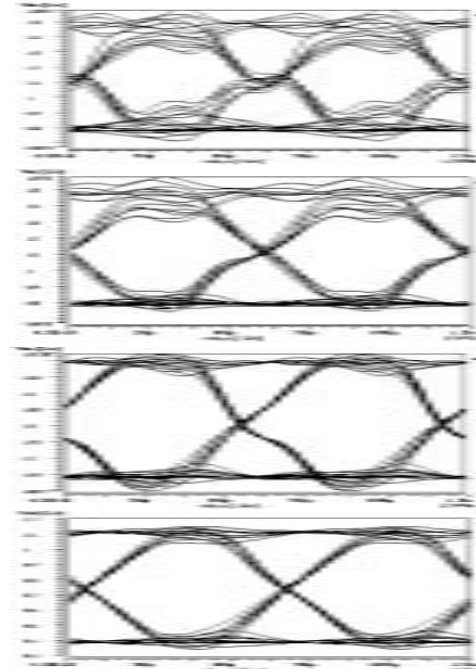
# Receiver Type Comparison (Simulation)

◆ Channel - P2P



Poor

Good



# GDDR2/3 144FBGA Ballout

	2	3	4	5	6	7	8	9	10	11	12	13
B	DQS0	/DQS0	VSSQ	DQ3	DQ2	DQ0	DQ31	DQ29	DQ28	VSSQ	/DQS3	DQS3
C	DQ4	DM0	VDDQ	VDDQ	DQ1	VDDQ	VDDQ	DQ30	VDDQ	VDDQ	DM3	DQ27
D	DQ6	DQ5	VSSQ	VSSQ	VSSQ	VDD	VDD	VSSQ	VSSQ	VSSQ	DQ26	DQ25
E	DQ7	VDDQ	VDD	VSS	VSSQ	VSS	VSS	VSSQ	VSS	VDD	VDDQ	DQ24
F	DQ17	DQ16	VDDQ	VSSQ	THERMAL	THERMAL	THERMAL	THERMAL	VSSQ	VDDQ	DQ15	DQ14
G	DQ19	DQ18	VDDQ	VSSQ	THERMAL	THERMAL	THERMAL	THERMAL	VSSQ	VDDQ	DQ13	DQ12
H	DQS2	/DQS2	NC	VSSQ	THERMAL	THERMAL	THERMAL	THERMAL	VSSQ	NC	/DQS1	DQS1
J	DQ20	DM2	VDDQ	VSSQ	THERMAL	THERMAL	THERMAL	THERMAL	VSSQ	VDDQ	DM1	DQ11
K	DQ21	DQ22	VDDQ	VSSQ	VSS	VSS	VSS	VSS	VSSQ	VDDQ	DQ9	DQ10
L	DQ23	A3	VDD	VSS	RFU2	VDD	VDD	RFU1	VSS	VDD	A4	DQ8
M	VREF	A2	A10	/RAS	NC	CKE	NC	ZQ	/CS	A9	A5	VREF
N	A0	A1	A11	BA0	/CAS	CK	/CK	/WE	BA1	A8/AP	A6	A7

**GDDR2 Ballout**

	2	3	4	5	6	7	8	9	10	11	12	13
B	WDQS0	RDQS0	VSSQ	DQ3	DQ2	DQ0	DQ31	DQ29	DQ28	VSSQ	RDQS3	WDQS3
C	DQ4	DM0	VDDQ	VDDQ	DQ1	VDDQ	VDDQ	DQ30	VDDQ	VDDQ	DM3	DQ27
D	DQ6	DQ5	VSSQ	VSSQ	VSSQ	VDD	VDD	VSSQ	VSSQ	VSSQ	DQ26	DQ25
E	DQ7	NC	VDD	VSS	VSSQ	VSS	VSS	VSSQ	VSS	VDD	NC	DQ24
F	DQ17	DQ16	VDDQ	VSSQ	THERMAL	THERMAL	THERMAL	THERMAL	VSSQ	VDDQ	DQ15	DQ14
G	DQ19	DQ18	VDDQ	VSSQ	THERMAL	THERMAL	THERMAL	THERMAL	VSSQ	VDDQ	DQ13	DQ12
H	WDQS2	RDQS2	VDDQ	VSSQ	THERMAL	THERMAL	THERMAL	THERMAL	VSSQ	VDDQ	RDQS1	WDQS1
J	DQ20	DM2	VDDQ	VSSQ	THERMAL	THERMAL	THERMAL	THERMAL	VSSQ	VDDQ	DM1	DQ11
K	DQ21	DQ22	VDDQ	VSSQ	VSS	VSS	VSS	VSS	VSSQ	VDDQ	DQ9	DQ10
L	DQ23	A3	VDD	VSS	RFU2	VDD	VDD	RFU1	VSS	VDD	A4	DQ8
M	VREF	A2	A10	/RAS	RESET	CKE	NC	ZQ	/CS	A9	A5	VREF
N	A0	A1	A11	BA0	/CAS	CK	/CK	/WE	BA1	A8/AP	A6	A7

**GDDR3 Ballout**