

CGS2535V/CGS2535TV Commercial Quad 1 to 4 Clock Drivers/Industrial Quad 1 to 4 Clock Drivers

Check for Samples: [CGS2535TV](#), [CGS2535V](#)

FEATURES

- **Guaranteed:**
 - 1.0 ns rise and fall times while driving 12 inches of 50Ω microstrip terminated with 25 pF
 - 350 ps pin-to-pin skew (t_{OSLH} and t_{OSHL})
- 650 ps part-to-part variation on positive or negative transition @ 5V V_{CC}
- Operates with either 3.3V or 5.0V supply
- Inputs 5V tolerant with V_{CC} in 3.3V range
- Symmetric output current drive: 24 mA I_{OH}/I_{OL}
- Industrial temperature range -40°C to $+85^{\circ}\text{C}$
- Symmetric package orientation
- Large fanout for memory driving applications
- Guaranteed 2 kV ESD protection
- Implemented on National's ABT family process
- 28-pin PLCC for optimum skew performance

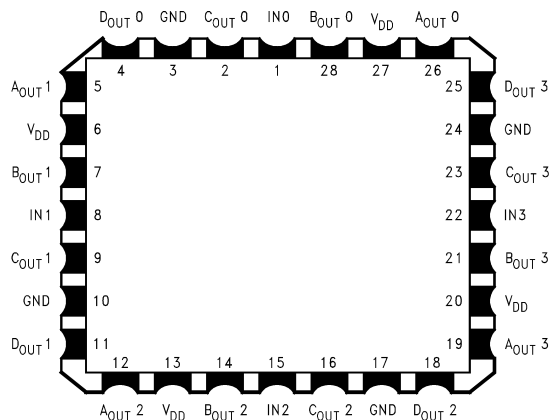
DESCRIPTION

These Clock Generation and Support clock drivers are specifically designed for driving memory arrays requiring large fanouts while operating at high speeds.

The CGS2535 is a non-inverting 4 to 16 driver with CMOS I/O structures. The CGS2535 specification guarantees part-to-part skew variation.

Connection Diagram

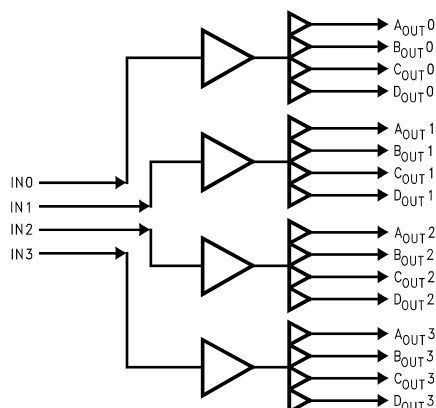
Figure 1. Pin Assignment for 28-Pin PLCC



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

All trademarks are the property of their respective owners.

Figure 2. CGS2535



Truth Table

Input	Output
In (0–3)	ABCD Out (0–3)



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings ⁽¹⁾

Supply Voltage (V_{CC})	7.0V
Input Voltage (V_I)	7.0V
Input Current	-30 mA
Current Applied to Output	
(High/Low)	Twice the Rated I_{OH}/I_{OL}
Operating Temp. Industrial grade	-40°C to +85°C
Comm. grade	0°C to +70°C
Storage Temperature Range	-65°C to +150°C
Airflow	Typical θ_{JA}
0 LFM	62°C/W
225 LFM	43°C/W
500 LFM	34°C/W
900 LFM	27°C/W

(1) The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the DC and AC Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The Recommended Operating Conditions will define the conditions for actual device operation.

Recommended Operating Conditions

Supply Voltage	V_{CC} 4.75V to 5.25V
	V_{CC} 3.0V to 3.6V
Maximum Input Rise/Fall Time	
(0.8V to 2.0V)	5 ns
Free Air Operating Temperature	
Commercial	0°C to + 70°C
Industrial	-40°C to + 85°C

DC Electrical Characteristics

Over recommended operating free air temperature range. All typical values are measured at $V_{CC} = 5V$, $T_A = 25^\circ C$.

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Typ	Max	Units		
V_{IH}	Input High Level Voltage		3.0	2.1			V		
			4.5	3.15					
			5.5	3.85					
V_{IL}	Input Low Level Voltage		3.0			0.9	V		
			4.5			1.35			
			5.5			1.65			
V_{IK}	Input Clamp Voltage	$I_I = -18$ mA	4.5			-1.2	V		
V_{OH}	High Level Output Voltage	$I_{OH} = -50$ μA	3.0	2.9			V		
			4.5	4.4					
			5.5	5.4					
			3.0	2.46					
V_{OL}	Low Level Output Voltage	$I_{OL} = 50$ μA	3.0			0.1	V		
			4.5			0.1			
			5.5			0.1			
			3.0	0.44					
									4.5
5.5	0.44								
I_I	Input Current @ Max Input Voltage	$V_{IH} = 7V$	5.5			7	μA		
			$V_{IH} = V_{CC}$	3.6				1	
I_{IH}	High Level Input Current	$V_{IH} = V_{CC}$	5.5			5	μA		
I_{IL}	Low Level Input Current	$V_{IL} = 0V$	5.5	-5			μA		
I_{OLD}	Minimum Dynamic Output Current (1)	$V_{OLD} = 1.65V$ (max)	5.5	75			mA		
			$V_{OLD} = 0.9V$ (max)	3.0 (2)	36				
I_{OHD}	Minimum Dynamic Output Current (1)	$V_{OHD} = 3.85V$ (min)	5.5	-75			mA		
			$V_{OHD} = 2.1V$ (min)	3.0 (2)	-25				
I_{CC}	Supply Current		3.6			75	μA		
			5.5			235			
C_{IN}	Input Capacitance		5.0		5		pF		

(1) Maximum test duration 2.0 ms, one output loaded at a time.

(2) At $V_{CC} = 3.3V$, $I_{OLD} = 55$ mA min; @ $V_{CC} = 3.6V$, $I_{OLD} = 64$ mA min At $V_{CC} = 3.3V$, $I_{OHD} = -58$ mA min; @ $V_{CC} = 3.6V$, $I_{OHD} = -66$ mA min

AC Electrical Characteristics (1) (2) (3)

Over recommended operating free air temperature specified. All typical values are measured at $V_{CC} = 5V$, $T_A = 25^\circ C$.

Symbol	Parameter	V_{CC} (V) (5)	CGS2535						Units
			$T_A = +25^\circ C$			$T_A = -40^\circ C$ to $+85^\circ C$			
			$C_L = 50\text{ pF}$, $R_L = 500\Omega$			(4)			
			Min	Typ	Max	Min	Typ	Max	
f_{max}	Frequency Maximum	3.0					100		MHz
		5.0					125		
t_{PLH}	Low-to-High Propagation Delay	3.3			4.5	2.5		4.5	ns
	CK to O_n @ 1 MHz (6)	5.0			3.5	2.0		3.5	
t_{PHL}	High-to-Low Propagation Delay	3.3			4.5	2.5		4.5	ns
	CK to O_n @ 1 MHz (6)	5.0			3.5	2.0		3.5	
t_{PLH}	Low-to-High Propagation Delay	3.3			5.0	2.5		5.0	ns
	CK to O_n @ 66.67 MHz (6) (7)	5.0			4.5	2.0		4.5	
t_{PHL}	High-to-Low Propagation Delay	3.3			5.0	2.5		5.0	ns
	CK to O_n @ 66.67 MHz (6) (7)	5.0			4.5	2.0		4.5	
t_{OSLH}	Maximum Skew Common Edge	3.3		150	350		300	350	ps
	Output-to-Output Variation	5.0		150	350		300	350	
	(1) (3)								
t_{OSHL}	Maximum Skew Common Edge	3.3		150	350		300	350	ps
	Output-to-Output Variation	5.0		150	350		300	350	
	(1) (3)								
t_{rise}	Rise/Fall Time	3.3			3.5			3.5	ns
t_{fall}	(from 0.8V/2.0V to 2.0V/0.8V) (8)	5.0			3.0			3.0	
t_{rise}	Rise/Fall Time	3.3			0.8			1.0	ns
t_{fall}	(from 0.8V/2.0V to 2.0V/0.8V) (9) (7)	5.0			0.4			0.6	
t_{rise}	Rise/Fall Time	3.3			1.0			1.0	ns
t_{fall}	(from 0.8V/2.0V to 2.0V/0.8V) (10) (7)	5.0			0.7			0.9	
t_{High}	Pulse Width Duration High	3.3	4.0			4.0			ns
	(2) (3) (7)	5.0	4.0			4.0			
t_{Low}	Pulse Width Duration Low	3.3	4.0			4.0			
	(2) (3) (7)	5.0	4.0			4.0			
t_{PVLH}	Part-to-Part Variation of	3.3			650			1.0	ns
	Low-to-High Transitions	5.0			650			650	ps
	@ 1 MHz (6)								
t_{PVHL}	Part-to-Part Variation of	3.3			650			1.0	ns
	High-to-Low Transitions	5.0			650			650	ps
	@ 1 MHz (6)								

- (1) Output-to-Output Skew is defined as the absolute value of the difference between the actual propagation delay for any outputs within the same packaged device and output bank. The specifications apply to any outputs switching in the same direction either LOW to HIGH (t_{OSLH}) or HIGH to LOW (t_{OSHL}).
- (2) Time high is measured with outputs at 2.0V or above. Time low is measured with outputs at 0.8V or below. Input waveform characteristics for t_{High} , t_{Low} measurement: $f = 66.67\text{ MHz}$, duty cycle = 50%.
- (3) The input waveform has a rise and fall time transition time of 2.5 ns (10% to 90%).
- (4) Industrial range ($-40^\circ C$ to $+85^\circ C$) limits apply to the commercial temperature range ($0^\circ C$ to $+70^\circ C$).
- (5) Voltage Range 5.0 is $5.0V \pm 0.25V$, 3.3 is $3.3V \pm 0.3V$.
- (6) All 16 outputs switching simultaneously.
- (7) Guaranteed by design.
- (8) These Rise and Fall times are measured with $C_L = 50\text{ pF}$, $R_L = 500\Omega$ (see Figure 3).
- (9) These Rise and Fall times are measured with $C_L = 25\text{ pF}$, $R_L = 500\Omega$ (see Figure 3), and are guaranteed by design.
- (10) These Rise and Fall times are measured driving 12 inches of 50Ω microstrip terminated with equivalent $C_L = 25\text{ pF}$ (see Figure 4), and are guaranteed by design.

AC Electrical Characteristics (1) (2) (3) (continued)

Over recommended operating free air temperature specified. All typical values are measured at $V_{CC} = 5V$, $T_A = 25^\circ C$.

Symbol	Parameter	CGS2535							Units
		V_{CC} (V) (5)	$T_A = +25^\circ C$			$T_A = -40^\circ C$ to $+85^\circ C$			
			$C_L = 50\text{ pF}$, $R_L = 500\Omega$						
			Min	Typ	Max	Min	Typ	Max	
t_{PVLH}	Part-to-Part Variation of Low-to-High Transitions @ 66.67 MHz (6) (7)	3.3			1.0			1.0	ns
t_{PVHL}	Part-to-Part Variation of High-to-Low Transitions @ 66.67 MHz (6) (7)	3.3			1.0			1.0	

Timing Information

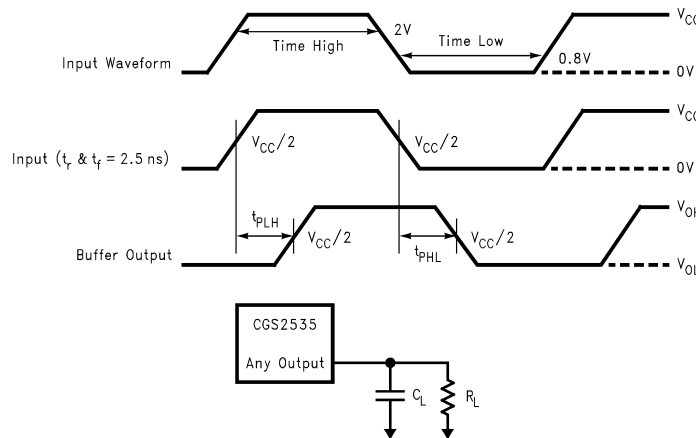


Figure 3. A.C. Load (11) (12)
 $C_L = \text{Total Load Including Probes}$

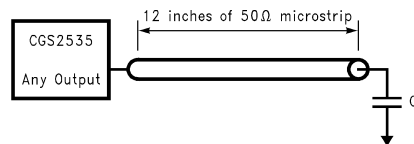


Figure 4. A.C. Load (13)
 $C_L = \text{Total Load Including Probes}$

CGS2534/35/36/37

MEMORY ARRAY DRIVING

In order to minimize the total load on the address bus, quite often memory arrays are driven by buffers while having the inputs of the buffers tied together. Although this practice was feasible in the conventional memory designs, in today's high speed, large buswidth designs which require address fetching at higher speeds, this technique produces many undesired results such as cross-talk and over/undershoot.

(11) These Rise and Fall times are measured with $C_L = 50\text{ pF}$, $R_L = 500\Omega$ (see Figure 3).
 (12) These Rise and Fall times are measured with $C_L = 25\text{ pF}$, $R_L = 500\Omega$ (see Figure 3), and are guaranteed by design.
 (13) These Rise and Fall times are measured driving 12 inches of 50Ω microstrip terminated with equivalent $C_L = 25\text{ pF}$ (see Figure 4), and are guaranteed by design.

CGS2534/35/36/37 Quad 1 to 4 clock drivers were designed specifically to address these application issues on high speed, large memory arrays systems.

These drivers are optimized to drive large loads, with 3.5 ns propagation delays. These drivers produce less noise while reducing the total capacitive loading on the address bus by having only four inputs tied together (see the diagram below, point A). This helps to minimize the overshoot and undershoot by having only four outputs being switched simultaneously.

Also this larger fan-out helps to save board space since for every one of these drivers, two conventional buffers were typically being used.

Another feature associated with these clock drivers is a 350 ps pin-to-pin skew specification. The minimum skew specification allows high speed memory system designers to optimize the performance of their memory subsystem by operating at higher frequencies without having concerns about output-to-output (bank-to-bank) synchronization problems which are associated with driving high capacitive loads (Point B).

The diagram below depicts a “2534/35/36/37” a memory subsystem operating at high speed with large memory capacity. The address bus is common to both the memory and the CPU and I/Os.

These drivers can operate beyond 125 MHz, and are also available in 3V–5V TTL/CMOS versions with large current drive .

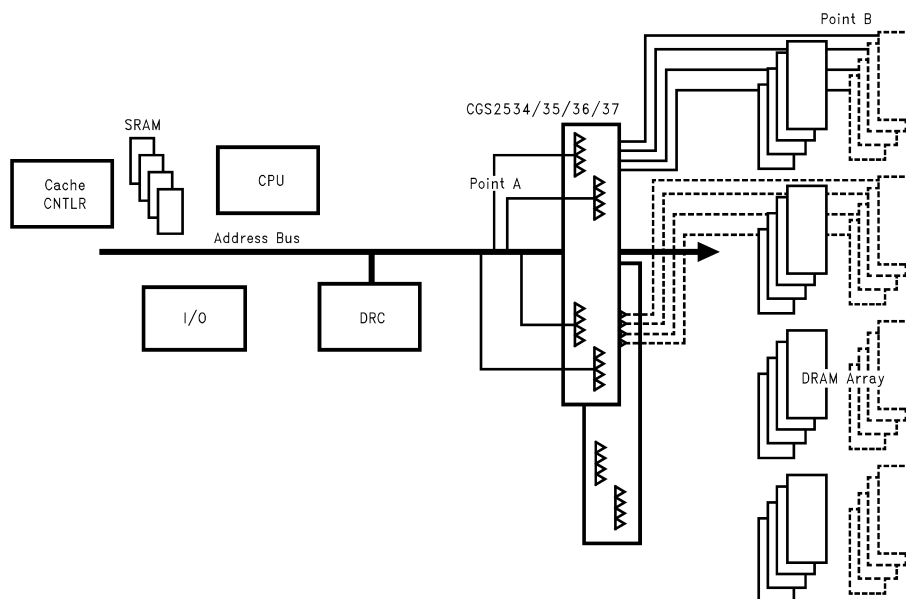
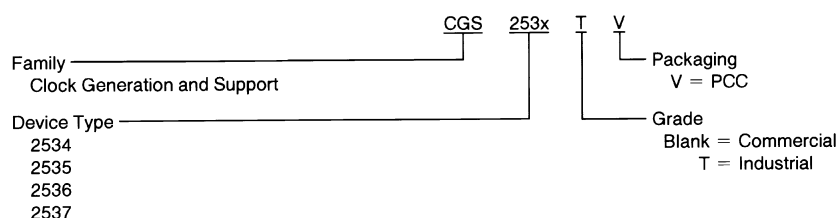


Figure 5. “2534/35/36/37”

Device	V _{CC}	I/O	Output Configuration
2534	5	TTL	Inverting quad 1–4
2535	3 or 5	CMOS	Non-inverting quad 1–4
2536	3 or 5	CMOS	Inverting, Non-inverting, ± 2
2537	5	TTL	Inverting quad 1–4 with series 8 Ω output resistors

Part Numbering Information



IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com