

iC-HE

TRIPLE DIFFERENTIAL LINE DRIVER



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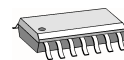
FEATURES

- ◆ Complementary short-circuit-proof push-pull driver stages for RS422 and 24 V applications up to 2 MHz
- ◆ SO14N package pin-compatible to ET9600
- ◆ Integrated line adaptation for high signal quality at 24 V
- ◆ Moderate slew rate reduces EMI
- ◆ High driving capability of typically 200 mA at 24 V
- ◆ Output saturation of just 0.3 V at 40 mAdc
- ◆ Tristate function with excessive temperature
- ◆ TTL-/CMOS-compatible Schmitt trigger inputs, voltage-proof to 40 V
- ◆ 4.5 to 35 V single supply operation with low static power dissipation
- ◆ Operating temperature from -25 to 125 °C (-40 °C is optional)
- ◆ 50 mA LED driver with ISET input for current control

APPLICATIONS

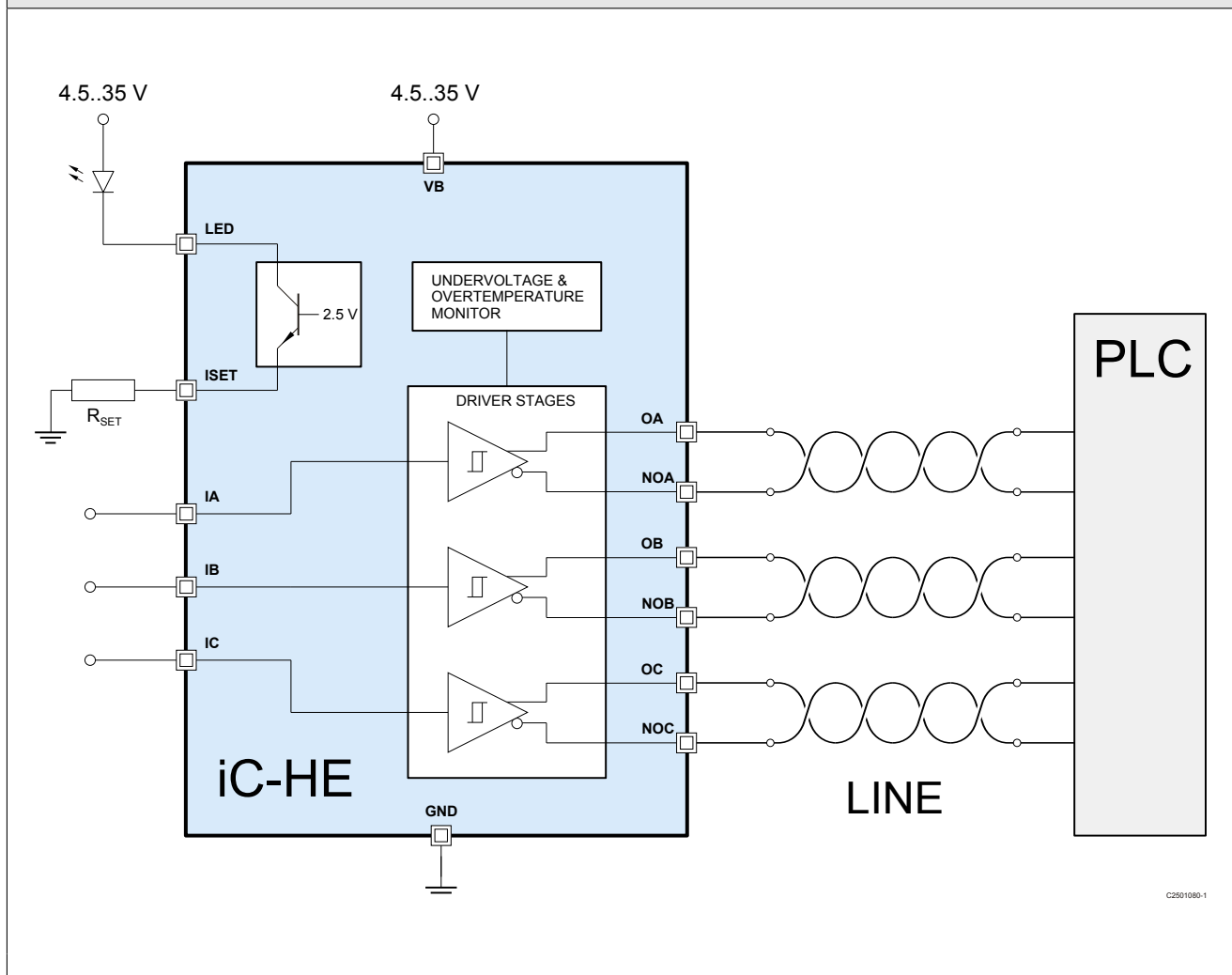
- ◆ Line drivers for 24 V control engineering
- ◆ Linear scales and encoders
- ◆ Sensor systems

PACKAGES



SO14N

BLOCK DIAGRAM



C2501080-1

iC-HE

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DESCRIPTION

The iC-HE is a three channel line driver with complementary outputs optimized for line impedances in the range of 75 Ω.

The push-pull output stages can deliver at least 200 mA from 24 V supply and are short-circuit-proof and current-limited, shutting down with excessive temperature or undervoltage condition.

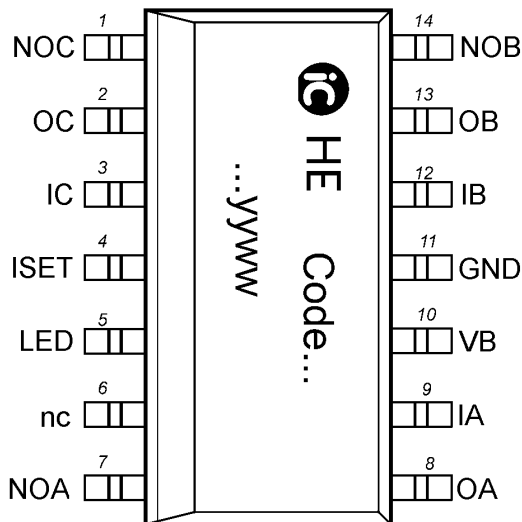
All inputs are compatible with CMOS and TTL levels.

The emitter and collector outputs of an on-chip NPN transistor is available for driving an external light emitting diode. The base of the transistor is connected to an internal reference voltage of 2.5 V. Collector current at pin LED can be controlled by the value of the resistor connected between ISET and ground.

The device is protected against ESD.

PACKAGING INFORMATION

PIN CONFIGURATION SO14N



PIN FUNCTIONS

No. Name Function

1	NOC	Inverted Output Driver C
2	OC	Output Driver C
3	IC	Input Driver C
4	ISET	LED Current Setting
5	LED	LED Current Output
6	n.c.	
7	NOA	Inverted Output Driver A
8	OA	Output Driver A
9	IA	Input Driver A
10	VB	Supply Voltage
11	GND	Ground
12	IB	Input Driver B
13	OB	Output Driver B
14	NOB	Inverted Output Driver B

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ABSOLUTE MAXIMUM RATINGS

Beyond these values damage may occur; device operation is not guaranteed. Absolute Maximum Ratings are no Operating Conditions. Integrated circuits with system interfaces, e.g. via cable accessible pins (I/O pins, line drivers) are per principle endangered by injected interferences, which may compromise the function or durability. The robustness of the devices has to be verified by the user during system development with regards to applying standards and ensured where necessary by additional protective circuitry. By the manufacturer suggested protective circuitry is for information only and given without responsibility and has to be verified within the actual system with respect to actual interferences.

Item No.	Symbol	Parameter	Conditions			Unit
				Min.	Max.	
G001	VB	Supply Voltage		0	40	V
G002	Vin()	Voltage at Inputs IA, IB, IC		0	VB	V
G003	V()	Voltage at Outputs OA..OC, NOA..NOC		0	VB	V
G004	I()	Current in Outputs OA..OC, NOA..NOC		-500	500	mA
G005	V(LED)	Voltage at LED		0	40	V
G006	I(LED)	Current in LED		-300	300	mA
G007	V(ISET)	Voltage at ISET		0	6	V
G008	I(ISET)	Current in ISET		-300	15	mA
G009	Vd()	ESD Susceptibility	HBM, 100 pF discharged through 1.5 kΩ		2	kV
G010	Tj	Junction Temperature		-40	150	°C
G011	Ts	Storage Temperature		-40	150	°C

THERMAL DATA

Item No.	Symbol	Parameter	Conditions				Unit
				Min.	Typ.	Max.	
T01	Ta	Operating Ambient Temperature (extended range to -40°C on request)		-25		125	°C
T02	Rthja	Thermal Resistance SO14N	surface mounted, no special heat sink		160		K/W

All voltages are referenced to ground unless otherwise stated.

All currents flowing into the device pins are positive; all currents flowing out of the device pins are negative.

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ELECTRICAL CHARACTERISTICS

Operating Conditions: $V_B = 4.5...35\text{ V}$, $T_j = -40...125\text{ °C}$, unless otherwise noted

Item No.	Symbol	Parameter	Conditions				Unit
				Min.	Typ.	Max.	
Total Device							
001	V_B	Permissible Supply Voltage		4.5		35	V
002	$V(\text{LED})$	Permissible Voltage at LED	no clamp diode to V_B	4.5		35	V
003	$I(V_B)$	Supply Current in VCC	no loads on outputs, ISET open		2.6	4	mA
004	$V_c(\text{lo})$	Clamp Voltage low at Ix inputs	$I() = -1\text{ mA}$	-1.2		-0.4	V
005	$V_c(\text{hi})$	Clamp Voltage high at Ix inputs	$I() = 1\text{ mA}$	$V_B + 0.4$		$V_B + 1.2$	V
006	$V_c(\text{lo})$	Clamp Voltage lo at OA, OB, OC, NOA, NOB, NOC	$V_B = 0\text{ V}$, $I() = -10\text{ mA}$	-1.2		-0.4	V
007	$V_c(\text{hi})$	Clamp Voltage hi at OA, OB, OC, NOA, NOB, NOC	$V_B = 0\text{ V}$, $I() = 10\text{ mA}$	$V_B + 0.4$		$V_B + 1.2$	V
008	$V_c(\text{LED})\text{lo}$	Clamp Voltage low at LED	$I() = -10\text{ mA}$	-1.2		-0.4	V
009	$V_c(\text{LED})\text{hi}$	Clamp Voltage high at LED	$I() = 10\text{ mA}$	41		58	V
010	$V_c(\text{ISET})\text{lo}$	Clamp Voltage low at ISET	$V_B = 0\text{ V}$, $I() = -10\text{ mA}$	-1.2		-0.4	V
011	$V_c(\text{ISET})\text{hi}$	Clamp Voltage high at ISET	$V_B = 0\text{ V}$	0.8		2.4	V
Driver Outputs Ox, NOx (x = A...C)							
101	$V_s(\text{lo})$	Saturation voltage low	$I(A) = 40\text{ mA}$		0.2	0.5	V
102	$V_s(\text{hi})$	Saturation voltage high	$I(A) = -40\text{ mA}$		0.3	0.7	V
103	$I_{\text{out}}(\text{hi})$	Output current lo	$V_B = 30\text{ V}$, $V(\text{Ox}, \text{NOx}) = 3\text{ V}$	40	60	90	mA
104	$I_{\text{out}}(\text{hi})$	Output current hi	$V_B = 30\text{ V}$, $V(\text{Ox}, \text{NOx}) = V_B - 3\text{ V}$	-90	-60	-40	mA
105	$I_{\text{sc}}(\text{lo})$	Short-Circuit Current lo	$V_B = 30\text{ V}$, $V(\text{Ox}, \text{NOx}) = V_B$		200	500	mA
106	$I_{\text{sc}}(\text{hi})$	Short-Circuit Current hi	$V(\text{Ox}, \text{NOx}) = 0\text{ V}$	-500	-200		mA
107	$R_{\text{out}}()$	Output Resistance	$V_B = 10...30\text{ V}$, $V(\text{Ox}) = 0.5 * V_B$	50	75	110	Ω
108	$SR(\text{lo}, \text{hi})$	Slew-Rate lo, hi	$V_B = 24\text{ V}$, $CL = 100\text{ pF}$		400		V/ μs
109	$t_p(\text{lo}, \text{hi})$	Delay Time lo,hi	not tested, guaranteed by design		75	200	ns
110	$dtp()$	Delay Time Difference	not tested, guaranteed by design	-35		35	ns
111	$I_{\text{lk}}()$	Output Leakage Current	at overtemperature shutdown	-100		100	μA
Driver Inputs Ix (x=A...C)							
201	$V_t(\text{lo})$	Threshold Voltage lo		0.8			V
202	$V_t(\text{hi})$	Threshold Voltage hi				2.4	V
203	$V_t(\text{hys})$	Input Hysteresis		0.1	0.2		V
204	$I()$	Input Leakage Current in Ix	$0\text{ V} < V(I_x) < 5\text{ V}$	-5		5	μA
Undervoltage Detection							
501	V_{off}	Undervoltage Threshold lo		2	3.4		V
502	V_{on}	Undervoltage Threshold hi			3.5	4.1	V
503	V_{hys}	Hysteresis		35	100		mV
504	$t_p(\text{shut})$	Reset Delay Time			20		μs
Thermal Shutdown							
601	T_{off}	Shutdown Temperature		130	150	170	$^{\circ}\text{C}$
602	ΔT_{off}	Hysteresis			8		$^{\circ}\text{C}$
LED driver							
701	$TC(\text{ISET})$	Temp.- Koeffizient at ISET	$I(\text{ISET}) = 10\text{ mA}$		2.0		mV/ $^{\circ}\text{K}$
702	$V(\text{ISET})$	Voltage at ISET	$T_j = 27\text{ }^{\circ}\text{C}$; $I(\text{ISET}) = 1\text{ mA}$	1.7	1.93	2.2	V
703	$V(\text{ISET})$	Voltage at LED	$T_j = 27\text{ }^{\circ}\text{C}$; $I(\text{ISET}) = 10\text{ mA}$	1.5	1.82	2.1	V
704	$V(\text{ISET})$	Voltage at ISET	$T_j = 27\text{ }^{\circ}\text{C}$; $I(\text{ISET}) = 50\text{ mA}$	1.3	1.64	2	V
705	CR	Current Ratio $I(\text{LED})/I(\text{ISET})$	$I(\text{ISET}) = 1..50\text{ mA}$	0.97		1	
706	$I_{\text{sc}}(\text{LED})$	Short-Circuit Current in LED	$V(\text{ISET}) = 0\text{ V}$	65	125	250	mA
707	$V_s(\text{LED})$	Saturation Voltage NPN	$V_s(\text{LED}) = V(\text{LED}) - V(\text{ISET})$; $I(\text{LED}) = 1\text{ mA}$		0.15	0.4	V
708	$V_s(\text{LED})$	Saturation Voltage NPN	$V_s(\text{LED}) = V(\text{LED}) - V(\text{ISET})$; $I(\text{LED}) = 50\text{ mA}$		0.55	1.2	V
709	$I_{\text{lk}}(\text{LED})$	Leakage Current in LED	ISET open, $V(\text{LED}) = 35\text{ V}$			100	μA

ELECTRICAL CHARACTERISTICS

Operating Conditions: $V_B = 4.5...35\text{ V}$, $T_j = -40...125\text{ }^\circ\text{C}$, unless otherwise noted

Item No.	Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
710	$I_{lk}(\text{LED})$	Leakage Current in LED	over temperature condition, $V(\text{LED}) = 35\text{ V}$			200	μA

ELECTRICAL CHARACTERISTICS: Diagrams

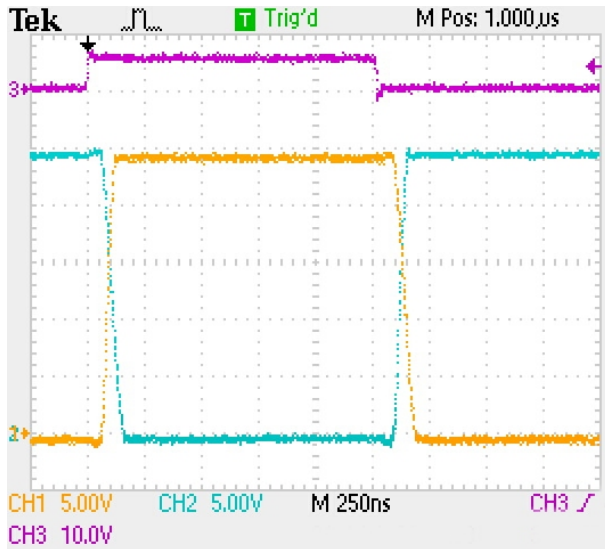


Figure 1: Example of moderate slew rate with un-loaded Ox and NOx outputs ($V_B = 24\text{ V}$)

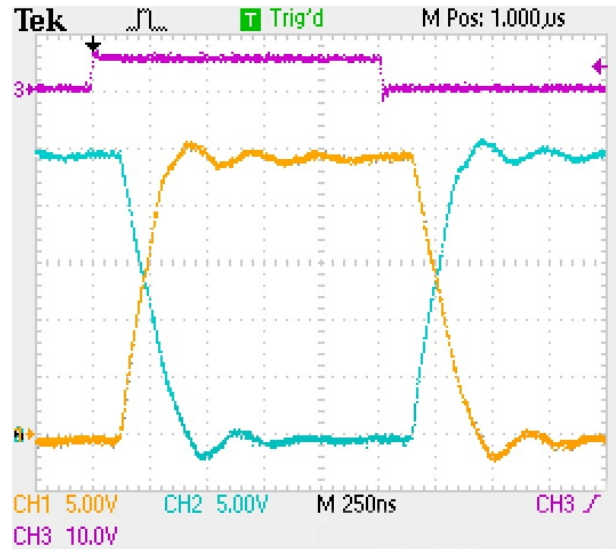


Figure 2: Example of typical line end signal without termination ($V_B = 24\text{ V}$, length of cable 10 m)

DESIGN REVIEW: Notes on Chip Functions

iC-HE X		
No.	Function, Parameter/Code	Description and Application Hints
		No further notes at time of printing.

Table 4: Notes on chip functions regarding iC-HE chip revision X

REVISION HISTORY

Rel.	Rel. Date*	Chapter	Modification	Page
A1	2009-11-30	ALL	First Release	all pages

Rel.	Rel. Date*	Chapter	Modification	Page
A2	2020-07-29	All	Label "preliminary" removed	all pages
		BLOCK DIAGRAM	Color of block diagram changed to blue	2
		DESIGN REVIEW: Notes on Chip Functions	Section DESIGN REVIEW introduced for completeness	6
		Revision History	introduced and updated	6
		Disclaimer	current version at time of printing	6
		ORDERING INFORMATION	order handling team contact information added	last page

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* Release Date format: YYYY-MM-DD

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ORDERING INFORMATION

Type	Package	Order Designation
iC-HE	SO14N	iC-HE SO14N

Please send your purchase orders to our order handling team:

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