iC-OF
3-BIT OPTO ENCODER

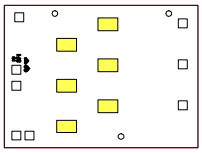
FEATURES

- Monolithic construction with integrated photodiodes ensures excellent matching and technical reliability
- Short track spacing of 600 µm
- Elimination of dark current effects through differential scanning
- Photocurrent amplifier with high cut-off frequency
- Comparators with precise signal-related hysteresis
- Current-limited push-pull outputs
- Analog outputs as current source/sink additionally
- Low power consumption from 5V supply voltage
- Low board space requirements
- Options: extended temperature range to -40 °C, customized packages, COB and reticle assembly

APPLICATIONS

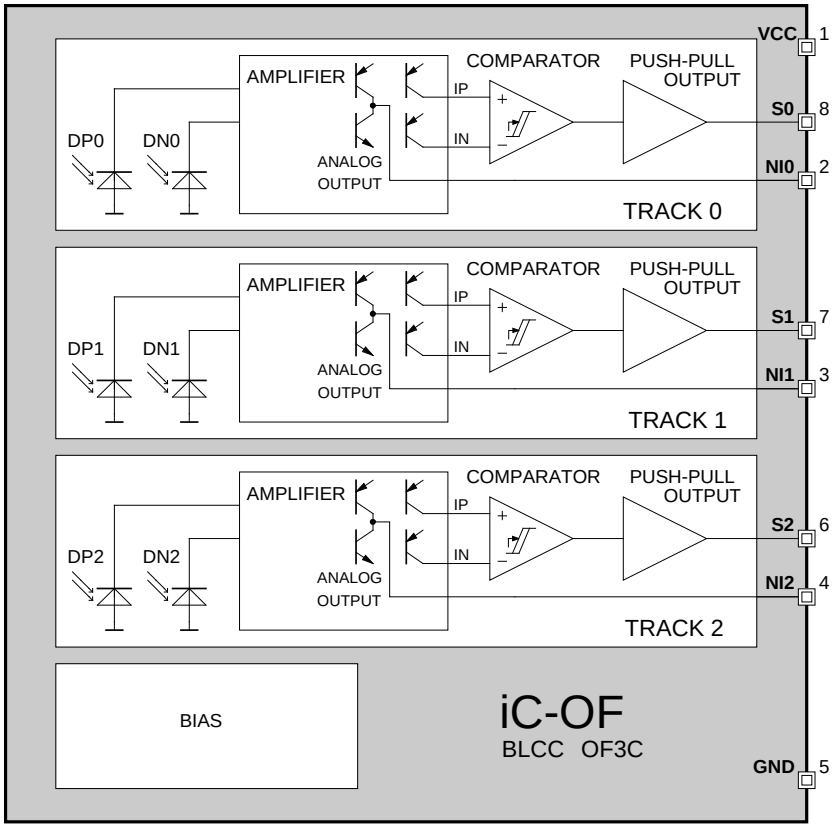
- Optical position decoding for incremental encoders using the principle of differential scanning

CHIP



2.8mm × 2.08mm

BLOCK DIAGRAM



DESCRIPTION

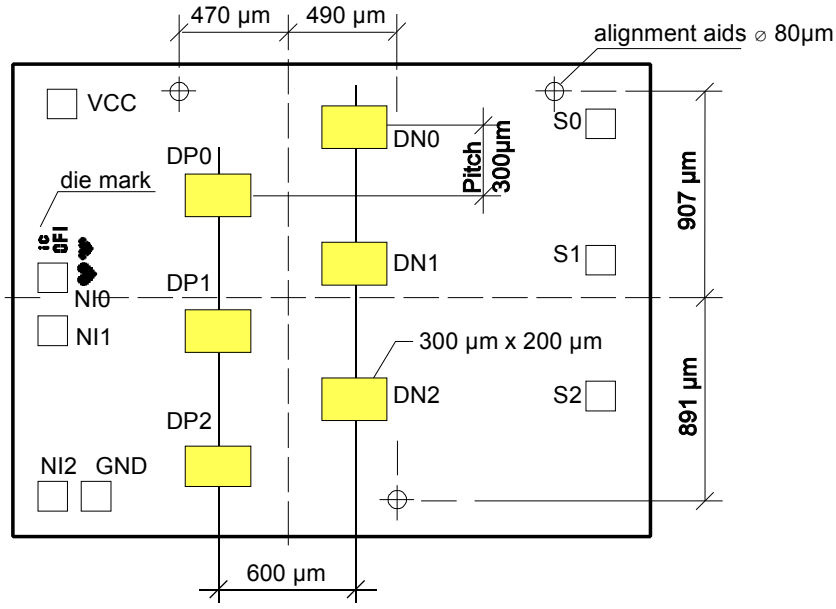
The iC-OF device is an optoelectronic detector IC for linear and angle measuring systems, such as shaft encoders, for example.

Photodiodes, amplifiers, comparators and TTL-compatible push-pull output drivers are integrated monolithically. Each of the 3 tracks is evaluated differentially; there are also analog outputs available.

The outputs are protected against ESD and short-circuit damage.

CHIP LAYOUT

dimensions in µm; chip size 2.8mm × 2.08mm



PAD DESCRIPTION

Name	Function
VCC	+5V Supply Voltage
NI0	Track 0 Analog Current Output
NI1	Track 1 Analog Current Output
NI2	Track 2 Analog Current Output
S0	Track 0 Push-Pull Output
S1	Track 1 Push-Pull Output
S2	Track 2 Push-Pull Output
GND	Ground

ABSOLUTE MAXIMUM RATINGS

Values beyond which damage may occur; device operation is not guaranteed.

Item	Symbol	Parameter	Conditions	Fig.	Min.	Max.	Unit
G001	VCC	Supply Voltage			-0.3	6	V
G301	V(S)	Voltage at Outputs S0..2			-0.3	VCC+0.3	V
G302	I(S)	Current in Outputs S0..2	V(S)< 0V or V(S)> VCC		-3	3	mA
G501	V(NI)	Voltage at Analog Outputs NI0..2			-0.3	VCC+0.3	V
G502	I(NI)	Current in Analog Outputs NI0..2			-3	3	mA
E001	Vd()	ESD-Susceptibility at all pins	HBM, 100 pF discharged through 1.5 kΩ			2	kV
TG1	Tj	Chip Temperature			-40	125	°C
TG2	Ts	Storage Temperature	see package specification				

THERMAL DATA

Operating Conditions: VCC= 5V ±10%

Item	Symbol	Parameter	Conditions	Fig.	Min.	Typ.	Max.	Unit
T1	Ta	Operating Ambient Temperature Range	see package specification					

All voltages are referenced to ground unless otherwise noted.
All currents into the device pins are positive; all currents out of the device pins are negative.

ELECTRICAL CHARACTERISTICS

Operating Conditions: VCC= 5V ±10%; Tj= -40..125 °C, unless otherwise noted.

Item	Symbol	Parameter	Conditions	Tj °C	Fig.	Min.	Typ.	Max.	Unit
Total Device									
001	VCC	Permissible Supply Voltage				4.5		5.5	V
002	I(VCC)	Supply Current in VCC, Outputs S0..2 hi	I(DP0..7)= 30nA, I(DN0..7)= 3nA, I(S0..7)= 0	27			2.3		mA
003	I(VCC)	Supply Current in VCC, Outputs S0..2 lo	I(DP0..7)= 3nA, I(DN0..7)= 30nA, I(S0..7)= 0	27			2.3		mA
004	fo	Cut-off Frequency, tracks 0..2	sinusoidal waveform, I(DP0..7)= 3..30nA, I(DN0..7)= 30..3nA			100			kHz
005	tp(D-S)	Propagation Delay	see No. 4					2.5	µs
006	fo	Propagation Delay, tracks 0..2	sinusoidal waveform, I(DP0..7)= 6..60nA I(DN0..7)= 60..6nA			200			kHz
007	tp(D-S)	Propagation Delay	see No. 6					1.5	µs
Photodiodes and Amplifiers, tracks 0..2									
101	Aph(D)	Radiant Sensitive Area					0.2 × 0.3		mm²
102	S(λ)max	Spectral Sensitivity	λ= 850nm				0.5		A/W
103	λar	Range of Spectral Sensitivity	Se(λar)= 0.1×S(λ)max			500		1050	nm
104	I(D)	Permissible Photocurrent						90	nA
105	CM()	Common Mode DPi to DNi				0.85	1	1.15	
Difference Comparators, tracks 0..2									
201	Hys	Hysteresis refered to [I(DPi) + I(DNi)] /2	I(DPi, DNi)= 3..90nA			8	11	16	%
Push-Pull Outputs S0..2									
301	Vs()hi	Saturation Voltage hi	Vs()hi= VCC-V(); I()= -40µA	-40 27 70 125			 0.81 0.69 0.58 0.51	0.9	V V V V V
302	Vs()hi	Saturation Voltage hi	Vs()hi= VCC-V(); I()= -400µA	-40 27 70 125			 0.92 0.83 0.74 0.68	1.0	V V V V V
303	Vs()lo	Saturation Voltage lo	I()= 1.6mA	-40 27 70 125			 0.20 0.22 0.25 0.27	0.4	V V V V V
304	Isc()hi	Short-Circuit Current hi	V()= 0V..VCC-1.2V			-7	-4.6	-1.5	mA
305	Isc()lo	Short-Circuit Current lo	V()= 0.4V..VCC			1.8	7.3	13	mA
306	SRhi	Slew-Rate hi	CL()= 30pF	 27		24	 61	130	V/µs V/µs
307	SRlo	Slew-Rate lo	CL()= 30pF	 27		50	 115	330	V/µs V/µs
308	Vc()hi	Clamp Voltage hi	Vc()hi= V()-VCC; S= hi, I()= 3mA			0.4		1.5	V
309	Vc()lo	Clamp Voltage lo	S= lo, I()= -3mA			-1.5		-0.4	V

ELECTRICAL CHARACTERISTICS

Operating Conditions: VCC= 5V ±10%; Tj= -40..125 °C, unless otherwise noted.

Item	Symbol	Parameter	Conditions	Tj °C	Fig.	Min.	Typ.	Max.	Unit
Analog Outputs NI0..2									
501	CR()	Current Ratio I(NIi) / (I(DPi)-I(DNi))	V(NIi)= 0.3V..VCC-1.2V, I(DPi)= 3..90nA, I(DNi)= 90..3nA	27		550	720	850	
502	I0()	Leakage Current	V(NI)= 0.3V..VCC-1.2V, I(DPi,DNi)= 0			-1.5		1.5	µA
503	fo()	Cut-off Frequency	V(NIi)= constant, sinussoidal waveform, I(DPi)= 3..30nA, I(DNi)= 30..3nA			100			kHz
504	fo()	Cut-off Frequency	V(NIi)= constant, sinussoidal waveform, I(DPi)= 6..60nA, I(DNi)= 60..6nA			200			kHz
505	fo()	Cut-off Frequency	R(VCC/NIi)= 50kΩ, R(NIi/GND)= 50kΩ, CL()= 30pF			50	80		kHz
506	Vc(S)hi	Clamp Voltage hi	Vc()hi= V()-VCC; I()= 3mA			0.4		1.5	V
507	Vc(S)lo	Clamp Voltage lo	I()= -3mA			-1.5		-0.4	V

APPLICATIONS INFORMATION

Wiring of the analog outputs NI0..2

The analog outputs each consist of two current sources in a push-pull configuration. One of these works towards GND as a sink, the other works as a source coming from VCC. The voltage swing at the output pins NI0..2 is determined by the external wiring - the saturation voltage of the current sources must be taken into account.

The simplest configuration is to connect the outputs to a voltage divider consisting of two resistors, wired from VCC against GND (with 50kΩ respectively, for example). Any resulting load capacities can reduce the cutoff frequency of the analog signals.

In view of the suppression of the supply voltage, however it may be preferable to use an op-amp as a current-voltage converter (transconductance amplifier) if the reference potential is suitably stable.

ORDERING INFORMATION

Type	Package	Order designation
iC-OF	-	iC-OF Chip
iC-OF	BLCC OF3C	iC-OF-BLCC OF3C
iC-OF	BLCC OF3C-ET	iC-OF BLCC OF3C-ET

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