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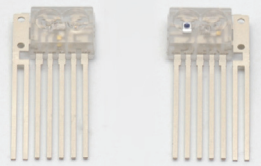
Photo IC for optical link

L11354-02 S11355-04



Transmitter photo IC L11354-02

Receiver photo IC S11355-04

For 150 Mbps optical link

These photo ICs is capable of data communication at a transmission speed of 150 Mbps through a plastic optical fiber (POF). The transmitter is composed of a 650 nm RC (resonant cavity) type LED, which is suitable for POF communications, and a driver circuit that supports an LVDS interface. The transmitter has a built-in temperature compensation function that adjusts for the reduction in the light emission power caused by the high temperature of the RC type LED. This function makes light emission with stable power possible over a wide temperature range. The receiver is composed of a PIN photodiode and signal processing circuit. The adoption of a full differential structure using a dummy photodiode eliminates the effects of external noise, achieving high sensitivity. In addition, the photo IC has a sleep function that suppresses power consumption by switching to standby mode when there is no input.
These products features high quality and high reliability, allowing it to be installed even in automobiles for in-vehicle networking. It is already used as an fiber optical transceiver (FOT) for a MOST network, which is a type of in-vehicle multimedia network.

Features

- **Communication speed up to 150 Mbps**
- **3.3 V power supply operation**
- **Wide operating temperature: -40 to +95 °C**
- **Suitable for reflow soldering**
- **Sleep mode function**

Applications

- **Data transmission in harsh, noisy environments, such as in FA and OA**
- **High-speed, short-distance data transmission**
- **Only for vehicle networks (MOST)**

MOST compliant products
Specifications of these products are subject to change without prior notice to keep up with changes in the MOST standard.

Absolute maximum ratings

Parameter		Symbol	Condition	Value	Unit
Supply voltage	L11354-02	Vcc_TX	Ta=-40 to +95 °C	-0.5 to +4.5	V
	S11355-04	Vcc_RX		-0.5 to +4.6	
Input voltage		Vi	Ta=-40 to +95 °C	-0.5 to Vcc+0.5	V
Power dissipation	L11354-02	P	Ta=-40 to +95 °C	350	mW
	S11355-04			320	
Operating temperature		Topr		-40 to +95	°C
Storage temperature		Tstg		-40 to +110	°C
Soldering temperature*1		Tsol		260 (3 times)	°C

*1: Reflow soldering, JEDEC J-STD-020 MSL 2a, see P.12

Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.

Recommended operating conditions

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	Vcc		3.135	3.3	3.465	V
Data rate	fD	DCA coding	-	-	150	Mbps

L11354-02

Electrical and optical characterisitics*2 (Ta=-40 to +95 °C, Vcc=3.135 to 3.465, unless otherwise noted*3)

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit
Current consumption		Icc	*4	-	-	40	mA
Peak emission wavelength		λC2		635	650	675	nm
Spectral width (RMS)		σλ2		-	-	17	nm
Fiber coupled optical output 1		Po1		-7	-	-1.5	dBm
Fiber coupled optical output 2		POFF2		-	-	-50	dBm
Extinction ratio		re		10	-	-	dB
Rise time		tr	20 to 80%, *4 *5	-	-	0.5	UI
Fall time		tf	80 to 20%, *4 *5	-	-	0.5	UI
Transfer jitter (RMS)		Jtr2	*4 *5	-	-	112	ps
Overshoot		rpos	*5	See "■ Overshoot" table.			-
Undershoot		rnos	*5	See "■ Undershoot" table.			-
Input voltage level "/RST"		VinRL	*6	-	-	0.8	V
		VinRH	*6	2	-	-	
Input current "/RST"		IinRL	/RST=Low	-	-	-0.1	μA
		IinRH	/RST=High	-	-	50	
Input current "TXN" "TXP"		IinTXL	TXN, TXP=Low	-	-	-0.1	μA
		IinTXH	TXN, TXP=High	-	-	0.1	
Frequency range	During transmission	FON1		12	-	73.743	MHz
	During non-transmission	FOFF1		0	-	10	kHz
Valid MOST data (SP2) time		tON2	*7 *8	-	-	100	μs
		tOFF2	*7 *9	-	-	2	μs
Eye mask		A2 to F2		See "■ Eye mask" table.			-

*2: Electrical interface conforms to LVDS standards except common mode input voltage.

*3: Connect a bypass capacitor (0.1 μF) between Vcc and GND at a position within 3 mm from the leads. Also connect a 10 μF capacitor near the photo IC.
The center of the optical fiber is aligned with the center of the package lens. The distance between the fiber end and the lens top is 0.1 mm.

*4: Input signal rate 150 Mbps (DCA coding)

*5: Input signal

Parameter	Symbol	Min.	Typ.	Max.	Unit
Differential input voltage	Vid	200	-	1272	mV
Common mode input voltage	VCM	0.05	-	Vcctx - 1.2	V
Total jitter	tTJtp1	-	-	0.15	UI
Transfer jitter (RMS)	Jtr1	-	-	50	ps

*6: /RST signal

Parameter		Symbol	Min.	Max.	Unit
Valid supply voltage range		VVALID	1	3.465	V
Logic switching threshold		VT	2.97	-	V
Logic delay time	0→1	tD+	1	-	ms
	1→0	tD-	0	100	μs

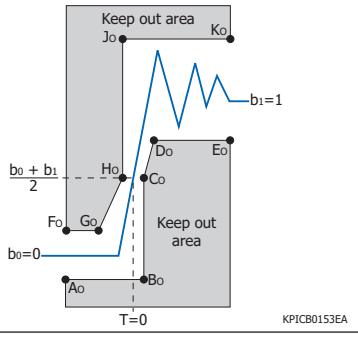
Note: See "■ Timing chart (P.5)" for the /RST signal timing chart.

*7: See "■ Timing chart (P.5)".

*8: Delay time for light output to turn on

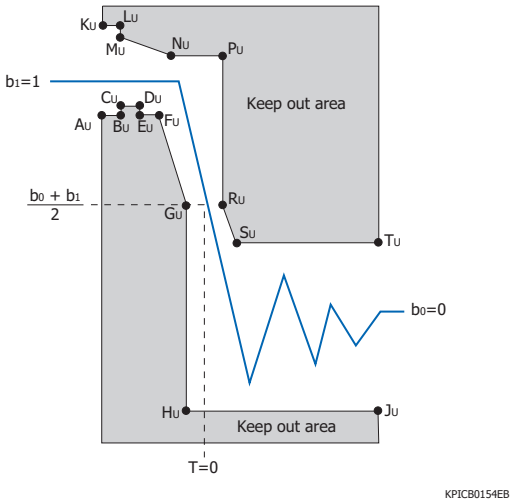
*9: Delay time for light output to turn off

■ Overshoot

Parameter	Amplitude*10	Time (UI)	Overshoot
A_O	-0.200	-0.630	
B_O	-0.200	0.100	
C_O	0.500	0.100	
D_O	0.800	0.350	
E_O	0.800	1.370	
F_O	0.200	-0.630	
G_O	0.200	-0.350	
H_O	0.500	-0.100	
J_O	1.400	-0.100	
K_O	1.400	1.370	

*10: On the basis of b_0=0 and b_1=1

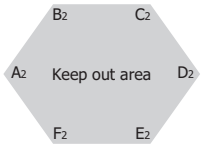
■ Undershoot

Parameter	Amplitude*11	Time (UI)*12	Undershoot
A_U	0.800	-0.630 - x	
B_U	0.800	-0.530 - x	
C_U	0.850	-0.530 - x	
D_U	0.850	-0.430	
E_U	0.800	-0.430	
F_U	0.800	-0.350	
G_U	0.500	-0.100	
H_U	-0.200	-0.100	
J_U	-0.200	1.370	
K_U	1.400	-0.630 - x	
L_U	1.400	-0.530 - x	
M_U	1.340	-0.530 - x	
N_U	1.150	-0.220 - x	
P_U	1.150	0.100	
R_U	0.500	0.100	
S_U	0.200	0.350	
T_U	0.200	1.370	

*11: On the basis of b_0=0 and b_1=1

*12: The positions of Au, Bu, Cu, Ku, Lu and Mu on the time axis depend on the MOST data pulse width (2 to 6).
x=MOST data pulse width - 2
For 2UI: x=0, For 6UI: x=4

■ Eye mask

Parameter	Amplitude	Time (UI)	Eye mask
A_2	0.5 × (b_1 + b_0)	0.150	
B_2	0.8 × (b_1 - b_0)+b0	0.400	
C_2	0.8 × (b_1 - b_0)+b0	0.600	
D_2	0.5 × (b_1 + b_0)	0.850	
E_2	0.2 × (b_1 - b_0)+b0	0.600	
F_2	0.2 × (b_1 - b_0)+b0	0.400	

S11355-04

Electrical and optical characterisitics*13 (Ta=-40 to +95 °C, Vcc=3.135 to 3.465, unless otherwise noted*14)

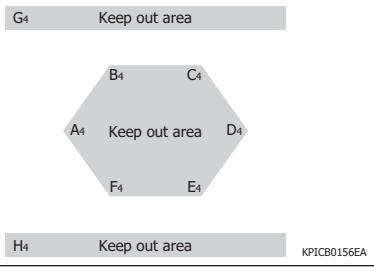
Parameter		Symbol	Condition	S11355-04			P11379-04AT			Unit
				Min.	Typ.	Max.	Min.	Typ.	Max.	
Peak sensitivity wavelength		λp		-	800	-	-	800	-	nm
Current consumption (operation mode)		Icco	*15	-	-	45	-	-	40	mA
Current consumption (sleeping mode)		Iccs	Dark state	-	-	30	-	-	30	μA
STATUS	High level output voltage	Vmh	Imh=20 μA*16	2.5	-	-	2.5	-	-	V
	Low level output voltage	Vml	Iml=0.88 mA (S11355-04)*16	-	-	0.5	-	-	0.5	V
Operation to sleeping mode transition receivable level		POFF3	*15 *17 *18	-	-	-35	-	-	-35	dBm
Transfer jitter (RMS)		Jtr4		-	-	230	-	-	230	ps
Error rate		Pe	*15 *18 *19 *20 *21	-	-	10^{-9}	-	-	10^{-9}	-
Valid MOST data (input signal) frequency		FON3		12	-	73.743	12	-	73.743	MHz
Invalid MOST data frequency		FOFF3		0	-	10	0	-	10	kHz
Time from input signal start to operation mode		tON4	*22	-	-	10	-	-	10	ms
Time from input signal start to STATUS ON		tSTATF	*22	200	-	1000	200	-	1000	μs
Time from STATUS ON to LVDS output stabilization		tLVDSV4	*22	-	-	100	-	-	100	μs
Time from input signal stop to sleeping mode		tOFF4	*22	-	-	1	-	-	1	ms
LVDS output hold time		tLVDSH4	*22	1	-	-	1	-	-	μs
Time from input signal stop to STATUS OFF		tSTATR	*22	-	-	2	-	-	2	μs
Eye mask		A4 to F4		See "■Eye mask" table.						-

*13: Electrical interface conforms to LVDS standards except differential output amplitude level
*14: Connect a bypass capacitor (0.1 μF) between Vcc and GND at a position within 3 mm from the leads. Also connect a 10 μF capacitor near the photo IC.
*15: Input signal

Parameter	Symbol	Min.	Typ.	Max.	Unit
Optical data that allows Valid MOST data (SP4) to be obtained	Popt3	-23.5	-	-2	dBm
Rise time	trtp3	-	-	2	ns
Fall time	tftp3	-	-	2	ns
Total jitter	tTJtp3	-	-	600	ps
Extinction ratio	re	10	-	-	dB

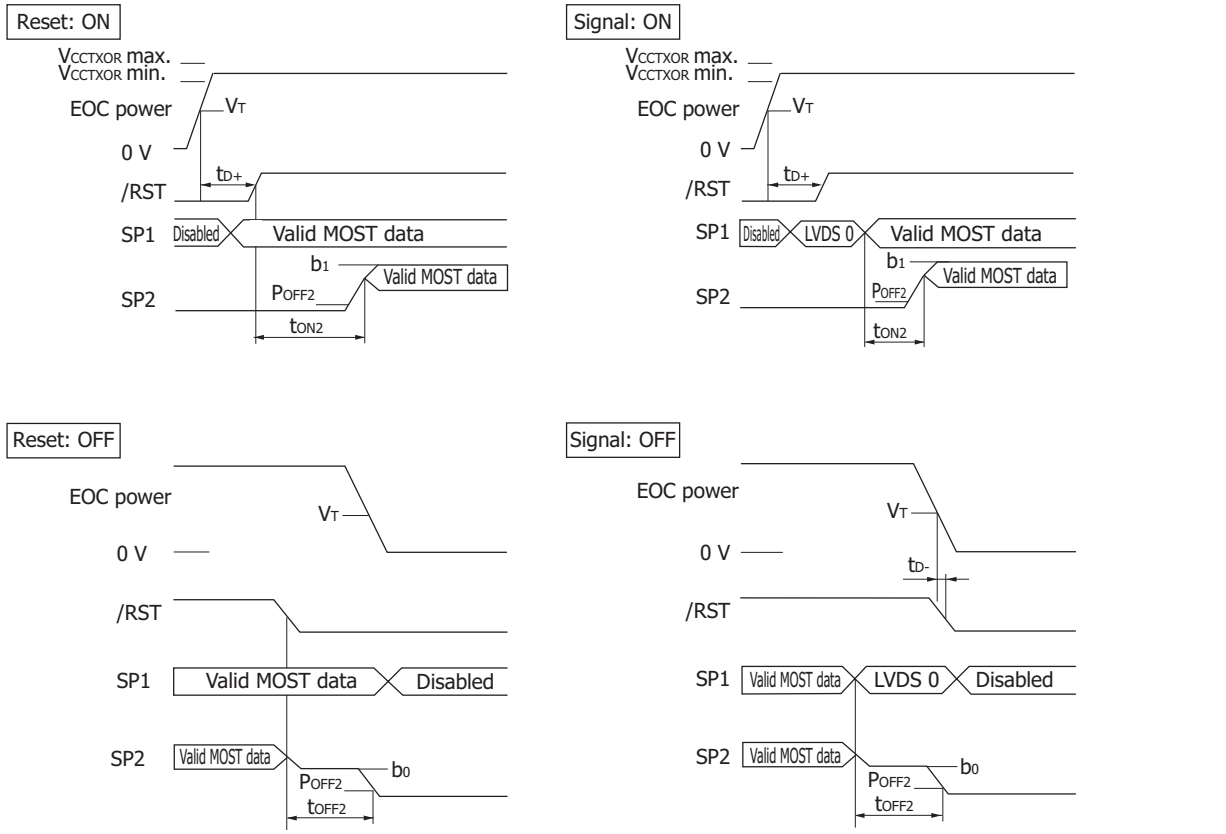
*16: Changes to operation mode when input light enters the receiver section. When STATUS output is low, the photo IC is in operation mode. When STATUS output is high, the photo IC is in sleeping mode.
*17: Input light is specified as the average power at the fiber end. The optical fiber used is a POF (NA=0.5).
*18: The center of the optical fiber is aligned with the center of the package lens. The distance between the fiber end and the lens top is 0.1 mm.
*19: RL=100 kΩ, CL=3 pF (including parasitic capacitance such as probe, connector and circuit board)
*20: A standard transmitter specified by HAMAMATSU is used to input light.
*21: Optical input signal rate=150 Mbps (DCA coding)
*22: See "Timing chart (P.5)".

■ Eye mask

Parameter	Amplitude (mV)	Time (UI)	Eye mask
A4	0	0.275	
B4	148	0.425	
C4	148	0.575	
D4	0	0.725	
E4	-148	0.575	
F4	-148	0.425	
G4	636	-	
H4	-636	-	

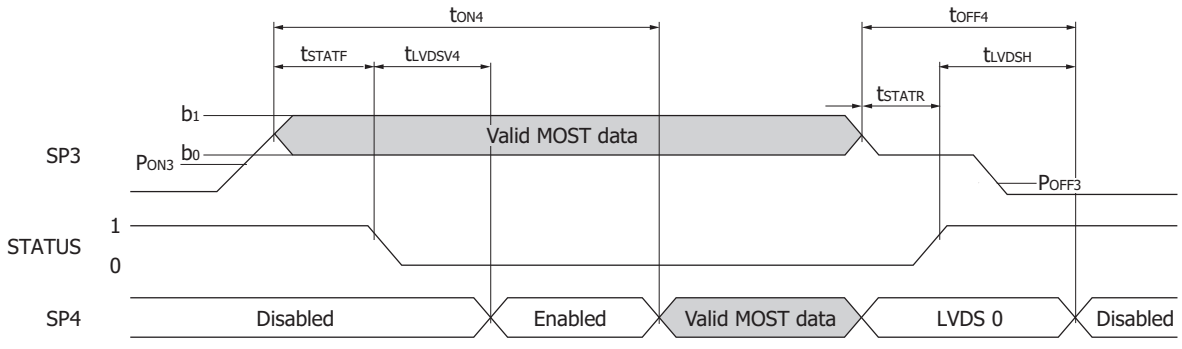
Timing chart

L11354-02



KPICC0176EA

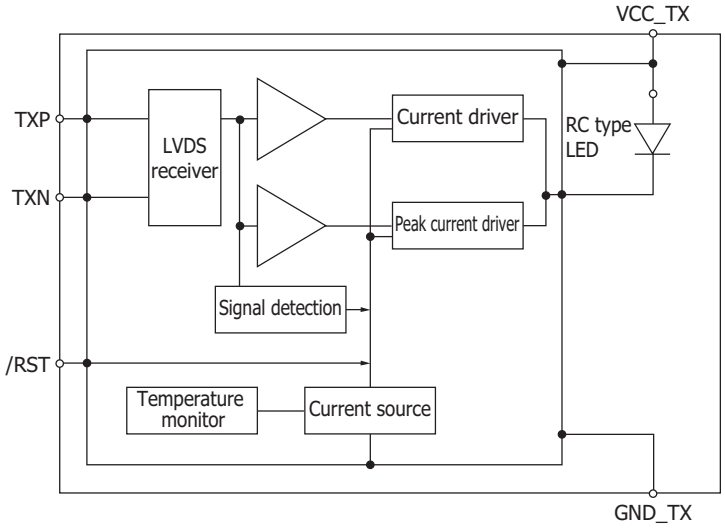
S11355-04



KPICC0181EA

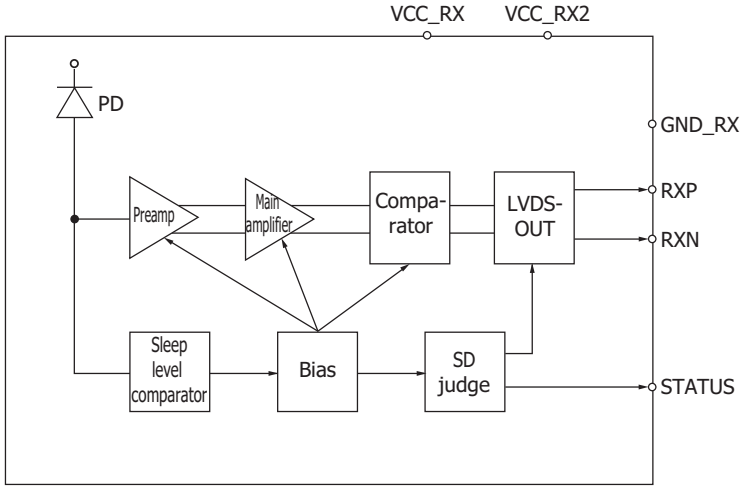
Block diagram

L11354-02



KPICC0177EC

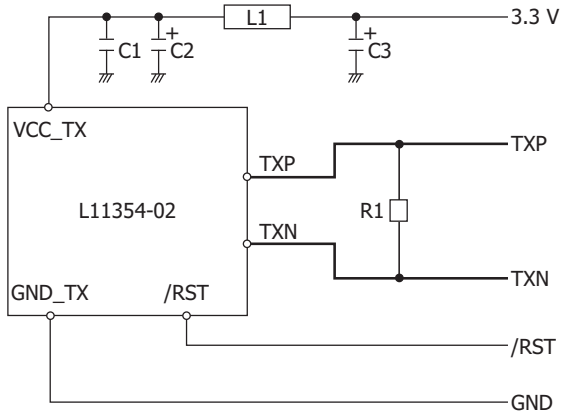
S11355-04



KPICC0178EA

Connection example

L11354-02

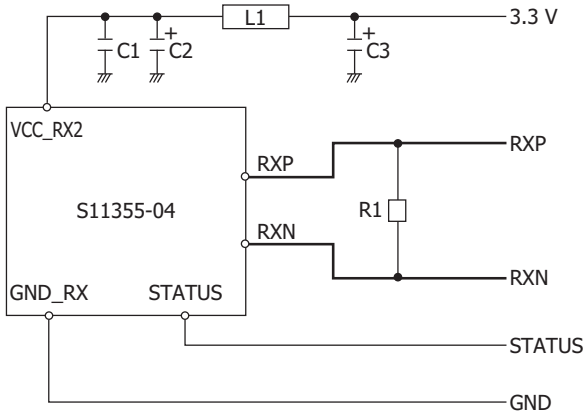


*Bold line: 50 Ω impedance matching

KPICC0179EB

Symbol	Part	Constant
R1	Resistor	100 Ω
L1	Inductance	0.1 μH
C1	Capacitor	0.1 μF
C2	Capacitor	10 μF
C3	Capacitor	10 μF

S11355-04



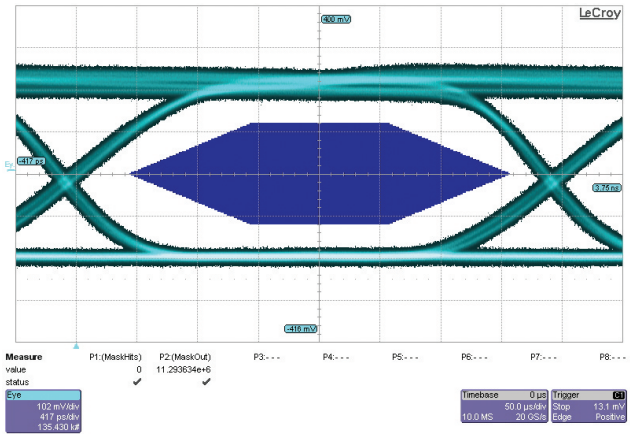
*Bold line: 50 Ω impedance matching

KPICC0180EE

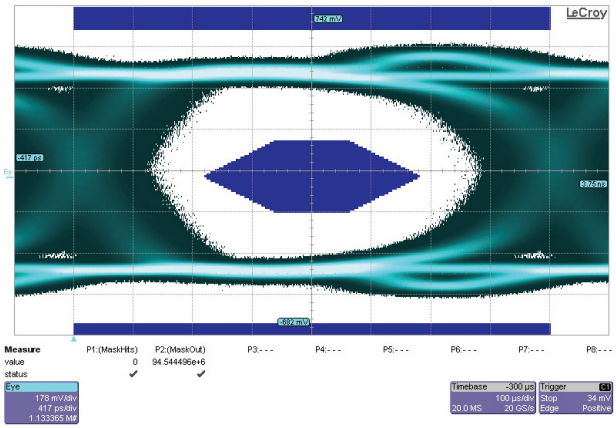
Symbol	Part	Constant
R1	Resistor	100 Ω
L1	Inductance	0.1 μH
C1	Capacitor	0.1 μF
C2	Capacitor	10 μF
C3	Capacitor	10 μF

Eye diagram

Optical output waveform of L11354-02

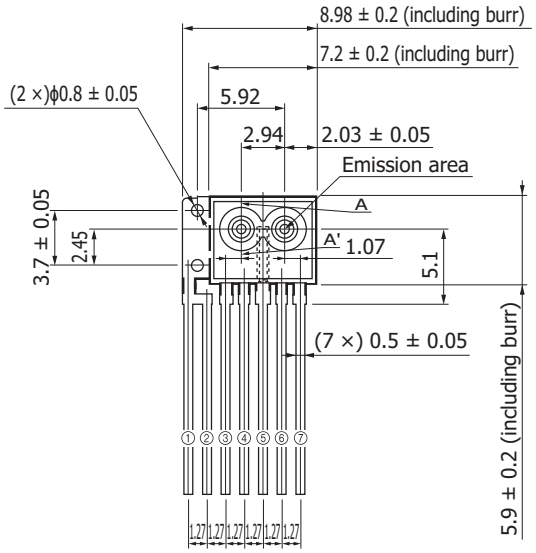


Output waveform of S11355-04



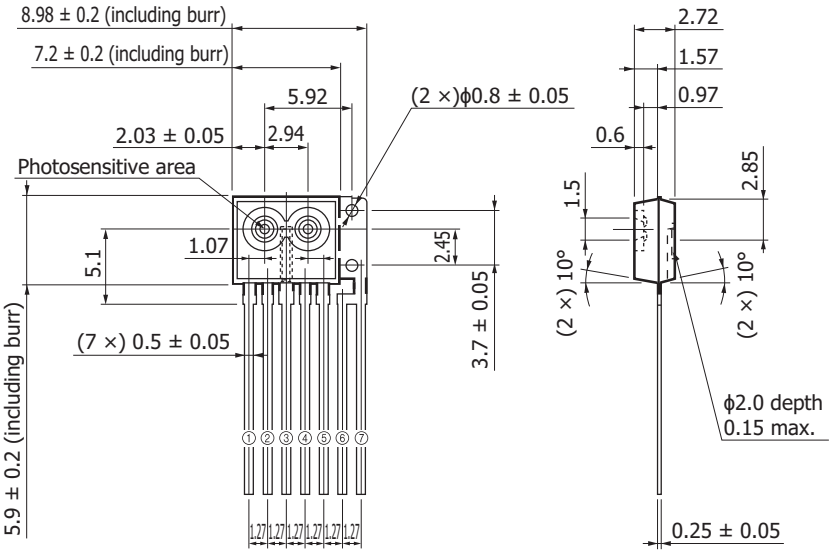
Dimensional outlines (unit: mm)

L11354-02



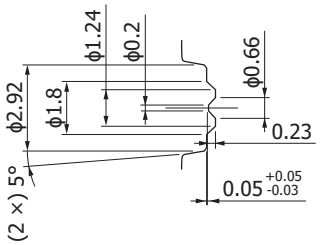
(Specified at lead root)

S11355-04



(Specified at lead root)

① /RST
② (/RST)
③ TXN
④ TXP
⑤ GND_TX
⑥ Vcc_TX
⑦ NC



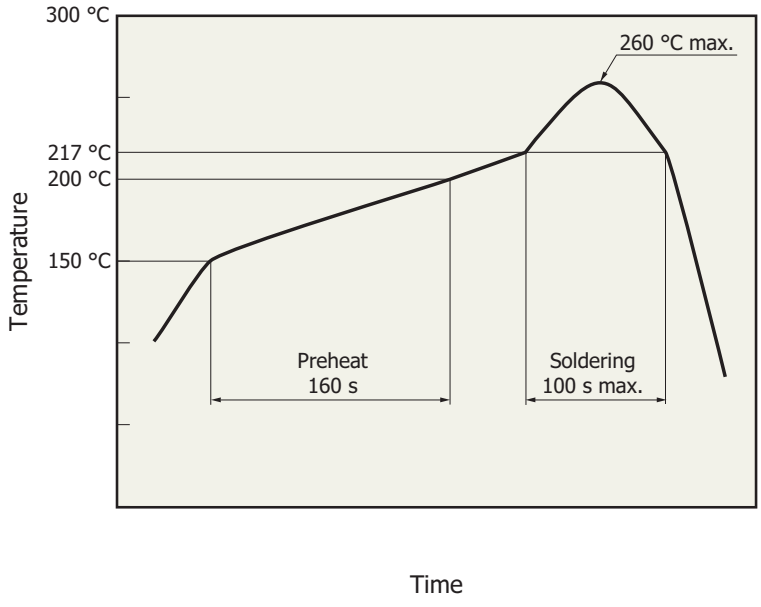
A-A' cross section

① STATUS
② Vcc_RX1
③ GND_RX
④ RXN
⑤ RXP
⑥ (Vcc_RX2)
⑦ Vcc_RX2

Tolerance unless otherwise noted: ±0.1, ±2°
R0.3 max.
Lead material: Cu alloy with Ag plating
Shaded area indicates burr.

KPICA0079ED

Recommended reflow soldering conditions



- This product supports lead-free soldering. After unpacking, store it in an environment at a temperature of 30 °C or less and a humidity of 60% or less, and perform soldering within 4 weeks.
- The effect that the product receives during reflow soldering varies depending on the circuit board and reflow oven that are used. Before actual reflow soldering, check for any problems by tesitng out the reflow soldering methods in advance.

Related information

www.hamamatsu.com/sp/ssd/doc_en.html

■ Precautions
- Disclaimer
- Metal, ceramic, plastic products

HAMAMATSU www.hamamatsu.com

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