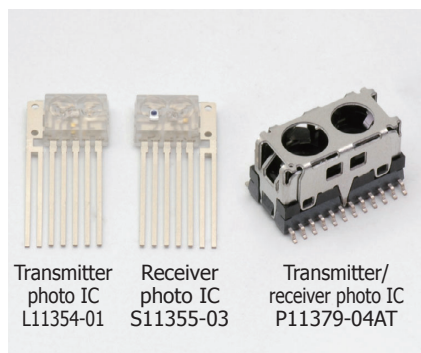


Photo IC for optical link



L11354-01

S11355-03

P11379-04AT

For 150 Mbps optical link

This photo IC is capable of data communication at a data rate of 150 Mbps through a plastic optical fiber (POF). Its 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 emitted from 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.

This product features high quality and high reliability, allowing it to be installed even in automobiles for in-vehicle networking. It is already used as an optical fiber transceiver (FOT) for a MOST network, which is a type of in-vehicle multimedia network. POFs with ferrule are also available.

Features

- Communication speed up to 150 Mbps
- Sidelooker type and SMD type are available.
- 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	L11354-01 P11379-04AT (Transmitter)	Vcc_TX	-0.5 to +7.0	V
	S11355-03 P11379-04AT (Receiver)	Vcc_RX	-0.5 to +4.6	
Input voltage	Vi	Ta=-40 to +95 °C	-0.5 to Vcc+0.5	V
Power dissipation	L11354-01	Ta=-40 to +95 °C	350	mW
	S11355-03		320	
	P11379-04AT		1250	
Operating temperature	Topr		-40 to +95	°C
Storage temperature	Tstg		-40 to +110	°C
Reflow soldering conditions*1	Tsol		Peak temperature 260 °C max., 3 times (see page 12)	-

*1: JEDEC level 2a

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

L11354-01, P11379-04AT (Transmitter)

Electrical and optical characteristics*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	I _{cc}	*4	-	-	40	mA
Peak emission wavelength	λ _{C2}		635	650	675	nm
Spectral width (RMS)	σ _{λ2}		-	-	17	nm
Fiber coupled optical output 1	Po1	CTRL_TX=Low, *5 *6	-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)	J _{tr2}	*4 *5	-	-	112	ps
Overshoot	r _{pos}	*5	See "■ Overshoot" table.			-
Undershoot	r _{nos}	*5	See "■ Undershoot" table.			-
Input voltage level "/RST"	V _{inRL}	*7	-	-	0.8	V
	V _{inRH}	*7	2	-	-	
Input voltage level "CTRL_TX"	V _{inCL}		-	-	0.8	V
	V _{inCH}		2	-	-	
Input current "/RST"	I _{inRL}	/RST=Low	-	-	-0.1	μA
	I _{inRH}	/RST=High	-	-	50	
Input current "CTRL_TX"	I _{inCL}	CTRL_TX=Low	-	-	-0.1	μA
	I _{inCH}	CTRL_TX=High	-	-	50	
Input current "TXN" "TXP"	I _{inTXL}	TXN, TXP=Low	-	-	-0.1	μA
	I _{inTXH}	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	t _{ON2}	*8 *9	-	-	100	μs
	t _{OFF2}	*8 *10	-	-	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.

L11354-01: 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	V _{id}	200	-	1272	mV
Common mode input voltage	V _{CM}	0.05	-	V _{cc} - 1.2	V
Total jitter	t _{TJtp1}	-	-	0.15	UI
Transfer jitter (RMS)	J _{tr1}	-	-	50	ps

*6: Average value, fiber core diameter φ1 mm, POF, NA=0.5, 1 m (made by Mitsubishi Rayon)

*7: /RST signal

Parameter	Symbol	Min.	Max.	Unit
Valid supply voltage range	V _{VALID}	1	3.465	V
Logic switching threshold	V _T	2.97	-	V
Logic delay time	0→1	t _{D+}	-	ms
	1→0	t _{D-}	100	μs

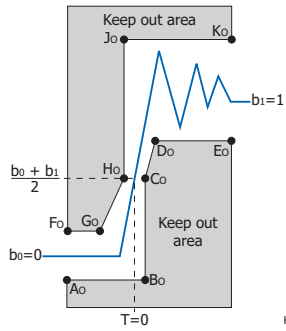
Note: See "■ Timing chart" for the /RST signal timing chart.

*8: See "■ Timing chart".

*9: Delay time for light output to turn on

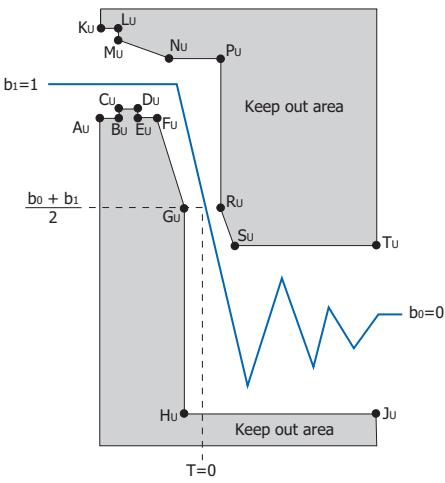
*10: Delay time for light output to turn off

■ Overshoot

Parameter	Amplitude* ¹¹	Time (UI)	Overshoot
Ao	-0.200	-0.630	 <p>The diagram shows a signal waveform starting at $b_0=0$ and rising to $b_1=1$. Key points are labeled: Ao, Bo, Co, Do, Eo, Fo, Go, Ho, Jo, Ko. A dashed line indicates the level $\frac{b_0 + b_1}{2}$. A vertical dashed line marks $T=0$. Two shaded regions are labeled 'Keep out area'.</p>
Bo	-0.200	0.100	
Co	0.500	0.100	
Do	0.800	0.350	
Eo	0.800	1.370	
Fo	0.200	-0.630	
Go	0.200	-0.350	
Ho	0.500	-0.100	
Jo	1.400	-0.100	
Ko	1.400	1.370	

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

■ Undershoot

Parameter	Amplitude* ¹²	Time (UI)* ¹³	Undershoot
Au	0.800	-0.630 - x	 <p>The diagram shows a signal waveform starting at $b_1=1$ and falling to $b_0=0$. Key points are labeled: Au, Bu, Cu, Du, Eu, Fu, Gu, Hu, Ju, Ku, Lu, Mu, Nu, Pu, Ru, Su, Tu. A dashed line indicates the level $\frac{b_0 + b_1}{2}$. A vertical dashed line marks $T=0$. Two shaded regions are labeled 'Keep out area'.</p>
Bu	0.800	-0.530 - x	
Cu	0.850	-0.530 - x	
Du	0.850	-0.430	
Eu	0.800	-0.430	
Fu	0.800	-0.350	
Gu	0.500	-0.100	
Hu	-0.200	-0.100	
Ju	-0.200	1.370	
Ku	1.400	-0.630 - x	
Lu	1.400	-0.530 - x	
Mu	1.340	-0.530 - x	
Nu	1.150	-0.220 - x	
Pu	1.150	0.100	
Ru	0.500	0.100	
Su	0.200	0.350	
Tu	0.200	1.370	

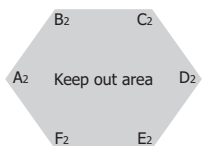
*12: On the basis of $b_0=0$ and $b_1=1$

*13: 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
A2	$0.5 \times (b_1 + b_0)$	0.150	 <p>The diagram shows an eye mask with points A2, B2, C2, D2, E2, F2. A shaded region is labeled 'Keep out area'.</p>
B2	$0.8 \times (b_1 - b_0) + b_0$	0.400	
C2	$0.8 \times (b_1 - b_0) + b_0$	0.600	
D2	$0.5 \times (b_1 + b_0)$	0.850	
E2	$0.2 \times (b_1 - b_0) + b_0$	0.600	
F2	$0.2 \times (b_1 - b_0) + b_0$	0.400	

S11355-03, P11379-04AT (Receiver)

■ Electrical and optical characteristics^{*14} (Ta=-40 to +95 °C, Vcc=3.135 to 3.465, unless otherwise noted^{*15})

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Peak sensitivity wavelength	λ_p		-	800	-	nm
Current consumption (operation mode)	Icco	^{*16}	-	-	40	mA
Current consumption (sleeping mode)	Iccs	Dark state	-	-	30	μ A
STATUS	High level output voltage	Vmh=20 μ A, ^{*17}	2.5	-	-	V
	Low level output voltage	Vml=0.2 mA, ^{*17}	-	-	0.5	V
Operation to sleeping mode transition receivable level	POFF3	^{*16} ^{*18} ^{*19}	-	-	-35	dBm
Transfer jitter (RMS)	Jtr4		-	-	230	ps
Error rate	Pe	^{*16} ^{*19} ^{*20} ^{*21} ^{*22}	-	-	10 ⁻⁹	-
Valid MOST data (input signal) frequency	FON3		12	-	73.743	MHz
Invalid MOST data frequency	FOFF3		0	-	10	kHz
Time from input signal start to operation mode	tON4	^{*23}	-	-	10	ms
Time from input signal start to STATUS ON	tSTATF	^{*23}	200	-	1000	μ s
Time from STATUS ON to LVDS output stabilization	tLVDSV4	^{*23}	-	-	100	μ s
Time from input signal stop to sleeping mode	tOFF4	^{*23}	-	-	1	ms
LVDS output hold time	tLVDSH4	^{*23}	1	-	-	μ s
Time from input signal stop to STATUS OFF	tSTATR	^{*23}	-	-	2	μ s
Eye mask	A4 to F4	See "■ Eye mask" table.				-

^{*14}: Electrical interface conforms to LVDS standards except differential output amplitude level

^{*15}: Connect a bypass capacitor (0.1 μ F) between Vcc and GND at a position within 3 mm from the leads. Also connect a 10 μ F capacitor near the photo IC.

^{*16}: Input signal

Parameter	Symbol	Min.	Typ.	Max.	Unit
Optical data that allows Valid MOST data (SP4) to be obtained	S11355-01	-23.5	-	-2	dBm
	P11379-04AT	-21.5	-	-2	
Rise time	trtp3	-	-	2	ns
Fall time	tftp3	-	-	2	ns
Total jitter	tTJtp3	-	-	600	ps
Extinction ratio	re	10	-	-	dB

^{*17}: 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.

^{*18}: Input light is specified as the average power at the fiber end. The optical fiber used is a POF (NA=0.5).

^{*19}: 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.

^{*20}: RL=100 k Ω , CL=3 pF (including parasitic capacitance such as probe, connector and circuit board)

^{*21}: A standard transmitter specified by HAMAMATSU is used to input light.

^{*22}: Optical input signal rate=150 Mbps (DCA coding)

^{*23}: See "■ Timing chart".

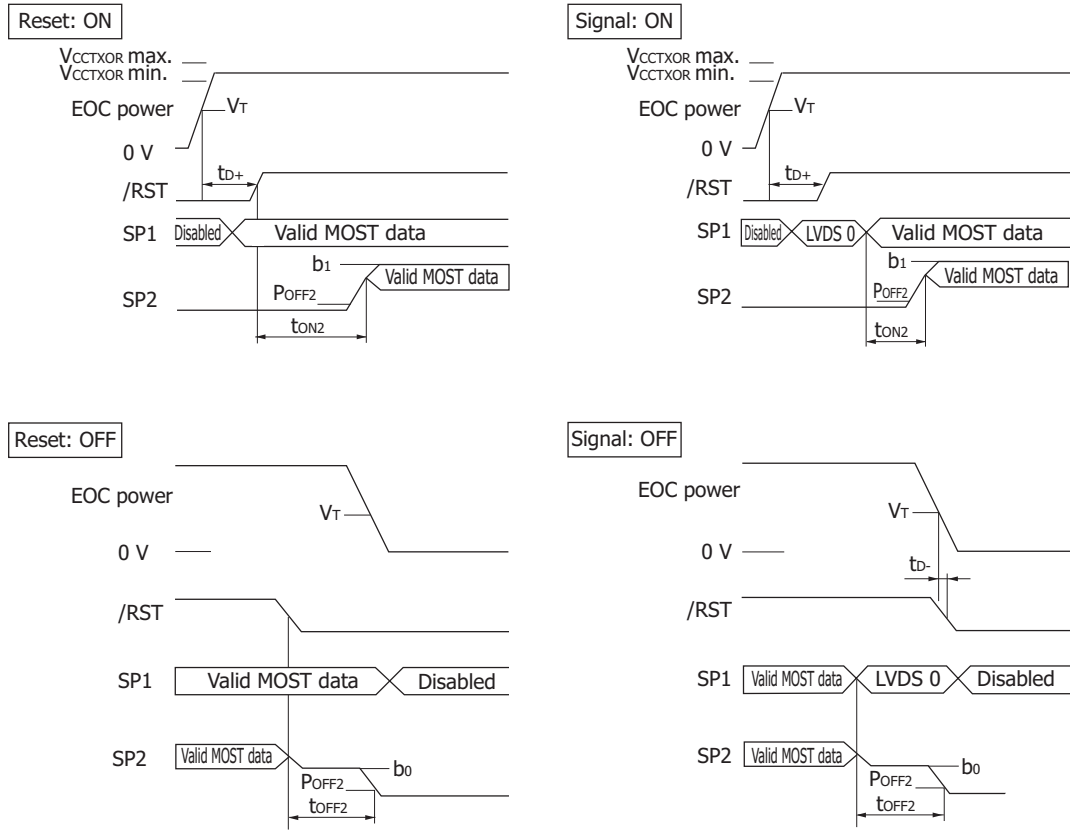
■ Eye mask

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	-	

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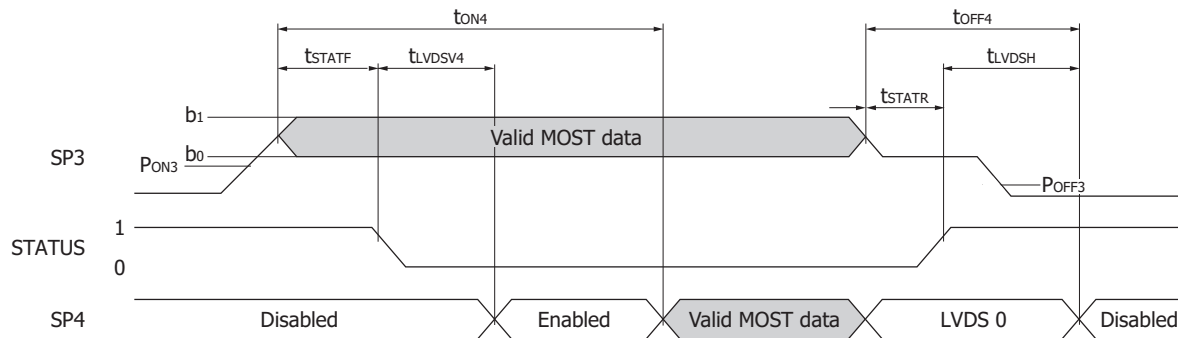
Timing chart

L11354-01, P11379-04AT (Transmitter)



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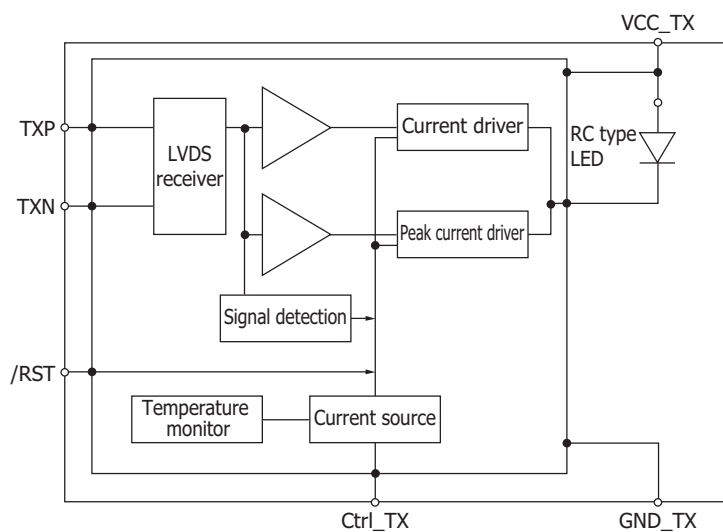
S11355-03, P11379-04AT (Receiver)



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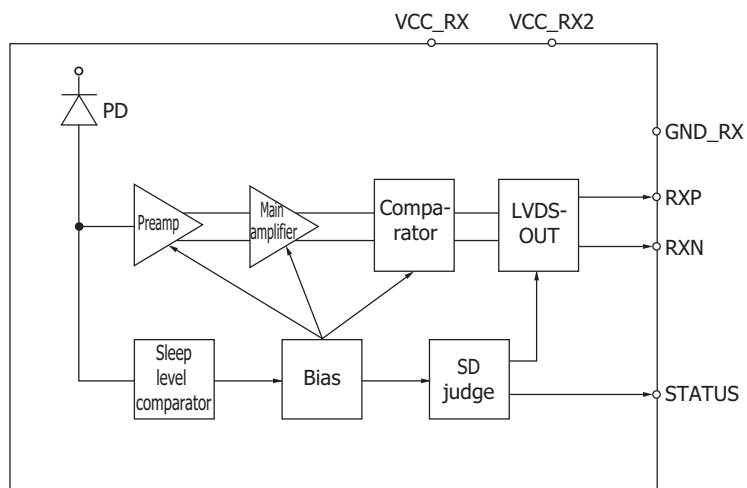
Block diagram

L11354-01, P11379-04AT (Transmitter)



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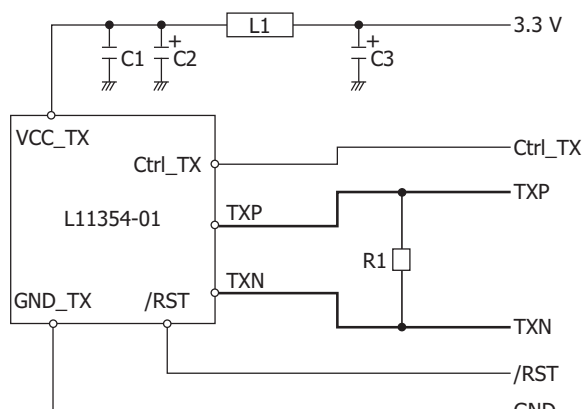
S11355-03, P11379-04AT (Receiver)



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Connection example

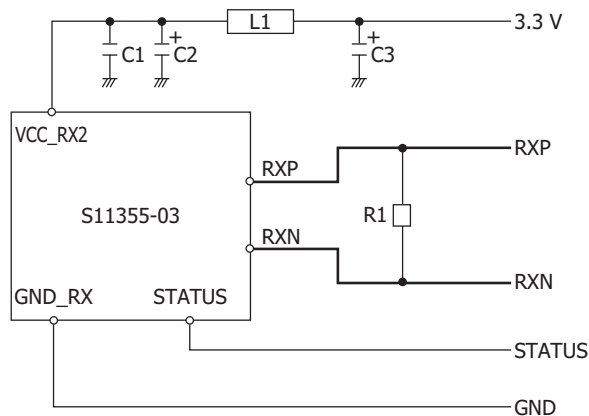
L11354-01

*Bold line: 50 Ω impedance matching

KPICC0179EA

Symbol	Part	Constant
R1	Resistor	100 Ω
L1	Inductance	0.1 μ H
C1	Capacitor	0.1 μ F
C2	Capacitor	10 μ F
C3	Capacitor	10 μ F

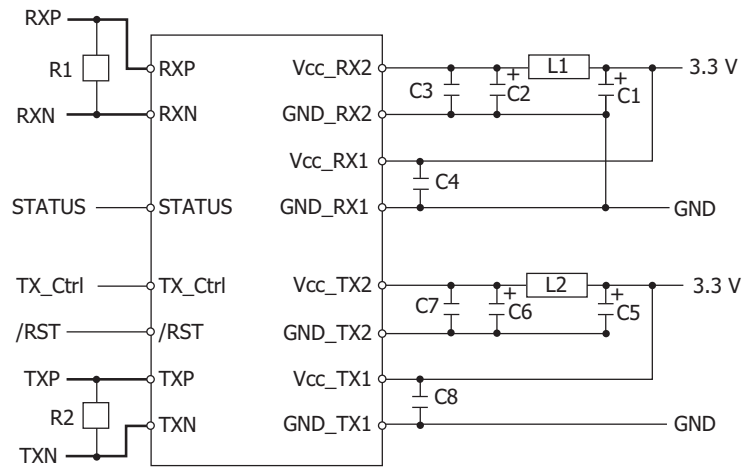
S11355-03

*Bold line: 50 Ω impedance matching

KPICC0180EC

Symbol	Part	Constant
R1	Resistor	100 Ω
L1	Inductance	0.1 μ H
C1	Capacitor	0.1 μ F
C2	Capacitor	10 μ F
C3	Capacitor	10 μ F

P11379-04AT

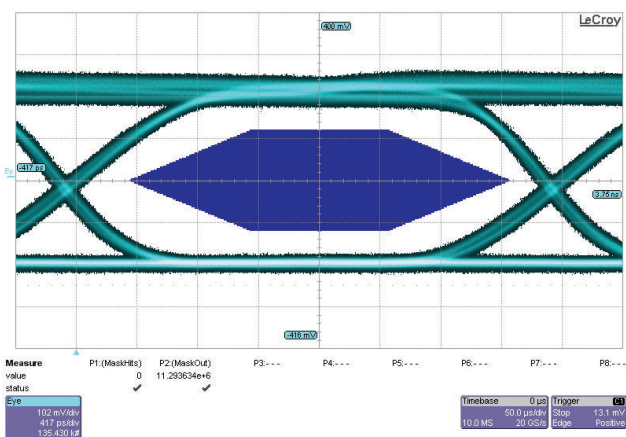
*Bold line: 50 Ω impedance matching

KPIC0187EA

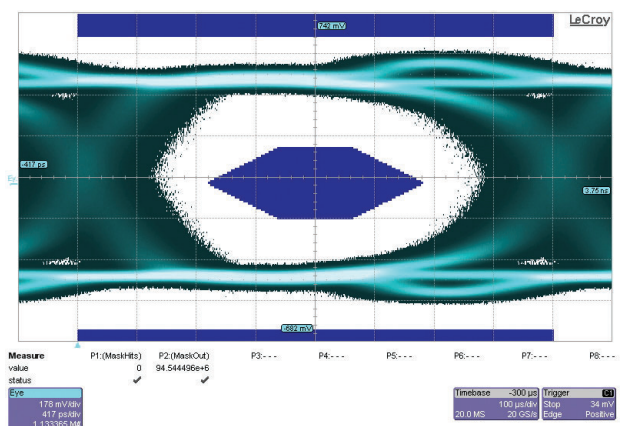
Transmitter			Receiver		
Symbol	Part	Constant	Symbol	Part	Constant
R1	Resistor	100 Ω	R2	Resistor	100 Ω
L1	Inductance	0.1 μH	L2	Inductance	0.1 μH
C1	Capacitor	10 μF	C5	Capacitor	10 μF
C2	Capacitor	10 μF	C6	Capacitor	10 μF
C3	Capacitor	0.1 μF	C7	Capacitor	0.1 μF
C4	Capacitor	0.1 μF	C8	Capacitor	0.1 μF

Eye diagram

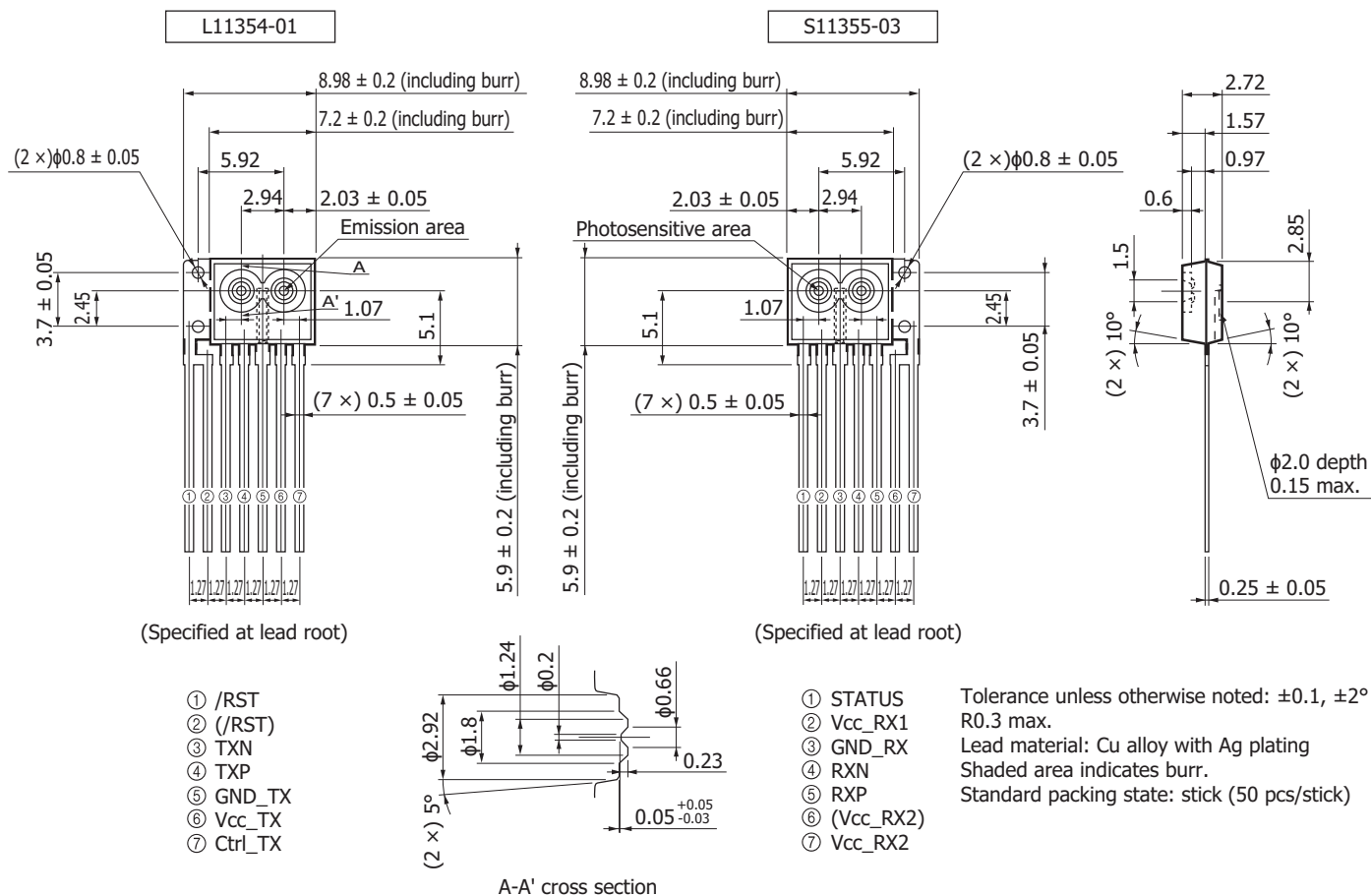
Optical output waveform of L11354-01, P11379-04AT (Transmitter)



Output waveform of S11355-03, P11379-04AT (Receiver)

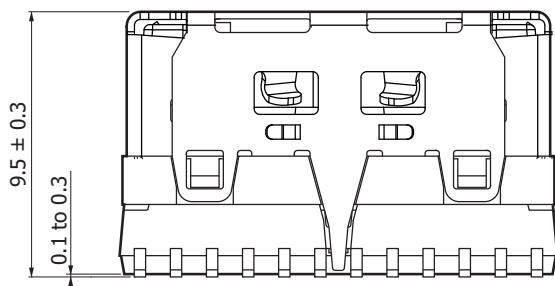
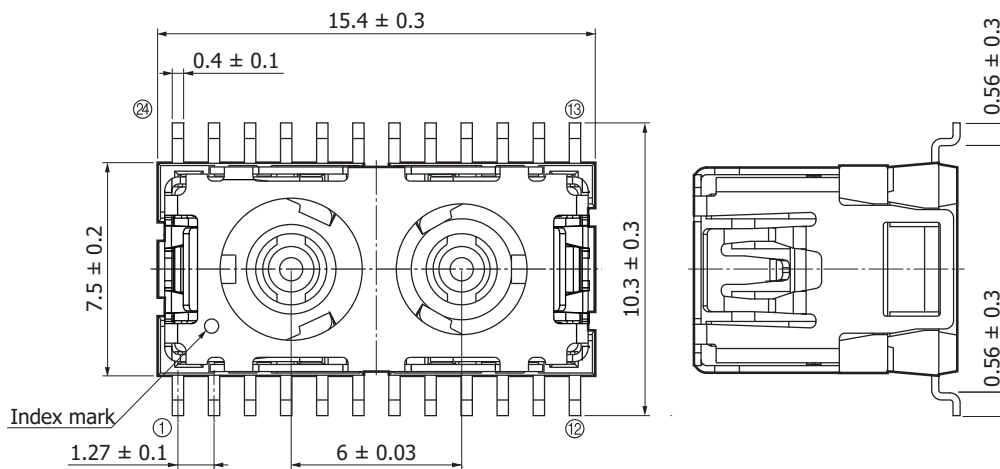


Dimensional outlines (unit: mm)



KPICA0079EC

P11379-04AT



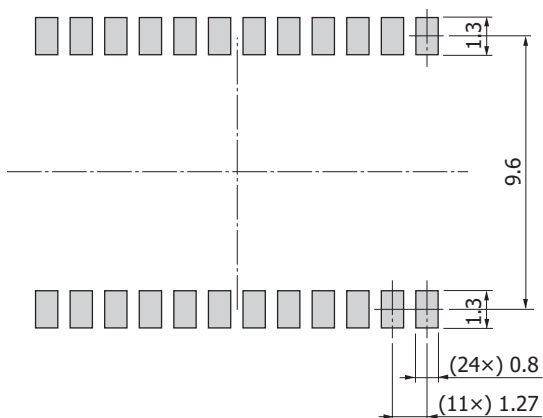
Tolerance unless otherwise noted: ± 0.1 , $\pm 2^\circ$
R0.3 max.
Lead material: Cu alloy with Ni/Pd/Au plating

Pin no.	Pin connections		Pin no.	Pin connections	
1	RXP	OEC	13	/RST	EOC
2	RXN	OEC	14	(N/C)	EOC
3	Vcc_RX1	OEC	15	GND_TX2	EOC
4	GND_RX1	OEC	16	Vcc_TX2	EOC
5	STATUS	OEC	17	GP2 (not used)	EOC
6	SHIELD	-	18	SHIELD	-
7	SHIELD	-	19	SHIELD	-
8	TX_Ctrl	EOC	20	(Vcc_RX2)	OEC
9	Vcc_TX1	EOC	21	GND_RX2	OEC
10	GND_TX1	EOC	22	Vcc_RX2	OEC
11	TXP	EOC	23	(N/C)	OEC
12	TXN	EOC	24	(GND_RX2)	OEC

OEC: receiver, EOC: transmitter

KPIC0086EC

Recommended land pattern (unit: mm, P11379-04AT)



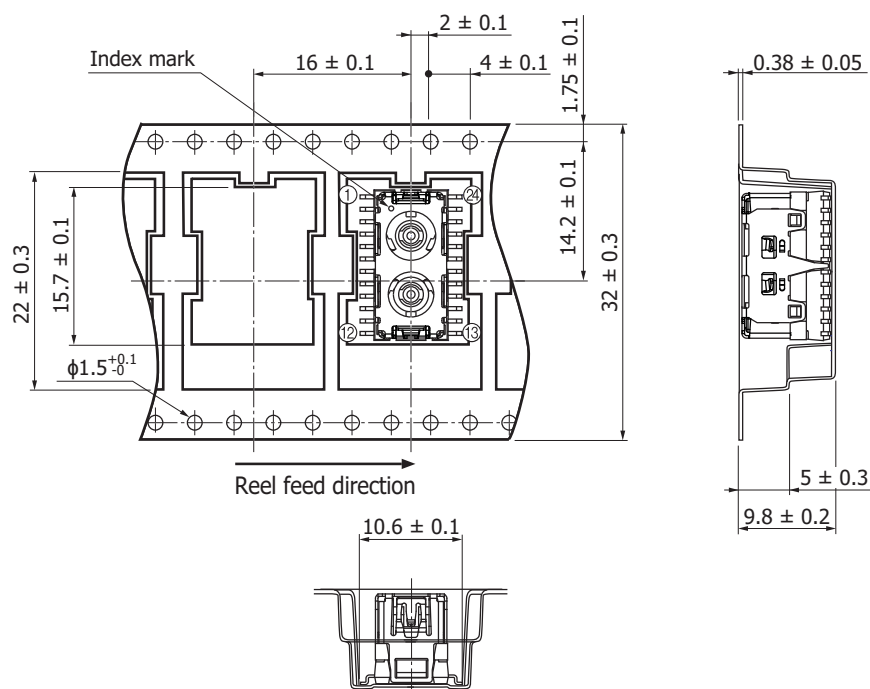
KPIC00189EB

Standard packing specifications

■ Reel (conforms to JEITA ET-7200)

Dimensions	Hab diameter	Tape width	Material	Electrostatic characteristics
380 mm	80 mm	32 mm	PS	Conductive

■ Embossed tape (unit: mm, material: PET)



KPINC0212EA

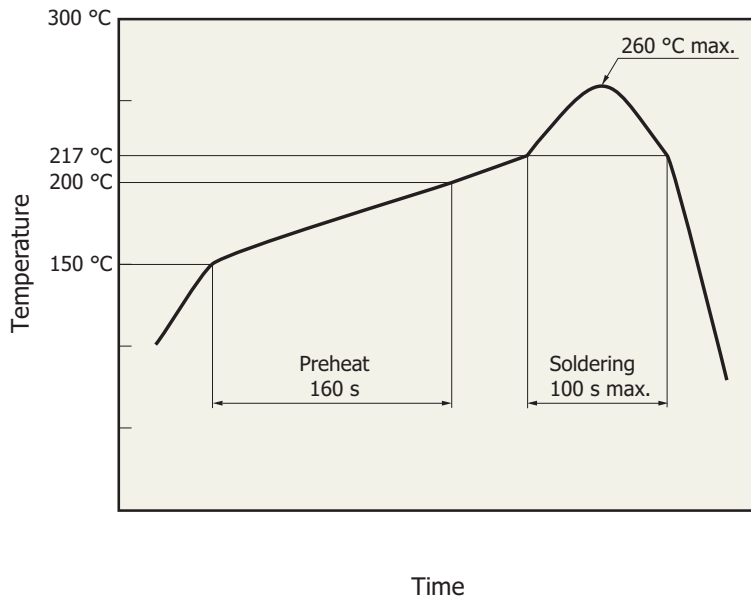
■ Packing quantity

500 pcs/reel

■ Packing type

Reel and desiccant in moisture-proof packing (vacuum-sealed)

Measured example of temperature profile with our hot-air reflow oven for product testing



KPICB0168EB

- 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 testing out the reflow soldering methods in advance.

Related information

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

■ Precautions

- Notice
- Metal, Ceramic, Plastic products
- Surface mount type products

Information described in this material is current as of September, 2014.

Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use.

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