



APPLICATION NOTE 351

T1/E1 and T3/E3 Transformer Selection Guide

Abstract: This application note lists vendor transformers that meet the specifications required for use with Maxim Single-Chip Transceivers (SCTs) and Line Interface Units (LIUs). Recommended transformers are made based on the following transformer specifications: turns ratio, primary inductance, leakage inductance, interwinding capacitance, and DC resistance for both 5V and 3.3V operation. Actual results are dependant on the integrity of the PCB design and other termination circuitry and should be verified by the customer.

Introduction

This application note applies to the following products:

T1/E1 LIUs	T1 SCTs	E1 SCTs	T1/E1 SCTs	T1/E1 Ethernet/Serial TDM	T3/E3 LIUs	T3/E3 SCTs
DS2148	DS2151	DS2153	DS2156	DS33R11	DS3150	DS3170
DS21348	DS2152	DS2154	DS2155	DS33R41	DS3151	DS3171
DS21Q48	DS21352	DS21354	DS21Q55		DS3152	DS3172
DS21Q348	DS21552	DS21554	DS21455		DS3153	DS3173
DS21448	DS21Q552	DS21Q554	DS21458		DS3154	DS3174
DS2149	DS21Q352	DS21Q354	DS26502		DS3251	DS3181
DS21349	DS2196	DS21Q59	DS26503		DS3252	DS3182
DS26303		DS21Q58	DS26504		DS3253	DS3183
DS26324		DS21Q50	DS26518		DS3254	DS3184
DS26334			DS26519		DS32504	
			DS26521		DS32506	
			DS26522		DS32508	
			DS26524		DS32512	
			DS26528			

Table 1 shows the specifications for our 5V devices and **Table 2** shows the specifications for our 3.3V devices. The specifications for selecting an appropriate transformer are given in the data sheets for each device and repeated below for simplicity. **Table 3** lists the transformer part numbers from multiple vendors and matches them with the parts listed above.

Table 1. Transformer Specifications for 5V Operation

Specification	Recommended Value
Turns Ratio, 5V Applications	1:1 (RX) and 1:15 or 1:1.36 (TX) $\pm 5\%$
Primary Inductance	600 μ H minimum
Leakage Inductance	1.0 μ H maximum
Interwinding Capacitance	40pF maximum
Transmit Transformer DC Resistance	
Primary (Device Side)	1.2 maximum
Secondary	1.2 maximum
Receive Transformer DC Resistance	
Primary (Device Side)	1.2 maximum
Secondary	1.2 maximum

Table 2. Transformer Specifications for 3.3V Operation

Specification	Recommended Value
Turns Ratio, 3.3V Applications	1:1 (RX) and 1:2 (TX) $\pm 2\%$
Primary Inductance	600 μ H minimum
Leakage Inductance	1.0 μ H maximum
Interwinding Capacitance	40pF maximum
Transmit Transformer DC Resistance	
Primary (Device Side)	1.0 maximum
Secondary	2.0 maximum
Receive Transformer DC Resistance	
Primary (Device Side)	1.5 maximum
Secondary	1.2 maximum

Table 3. Transformer Part Information

Vendor	Part	Turns Ratio	No. of Ports	Package Type	No. of Pins	Temp Range	Hierarchy	Maxim Device
Pulse	PE-65388	1:1.15CT	TX only	Through Hole	6	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
	PE-65586	1:1.36CT	TX only	Through Hole	6	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS21Q552, DS21554, DS21Q554

PE-65351	1:2CT	TX only	Through Hole	6	0°C to +70°C	T1/E1	DS2196, DS21348, DS21Q348, DS21448, DS21352, DS21Q352, DS21354, DS21Q354
PE-64936	1CT:1	RX only	Through Hole	6	0°C to +70°C	T1/E1	DS2196, DS2151, DS2152, DS2153, DS2154, DS21348, DS21Q348, DS21448, DS2148, DS21Q48, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS2121Q552, DS21554, DS21Q554
PE-65565	1:1.15CT and 1:2CT	1	Through Hole	6	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
TX1315	1CT:1CT	RX only	Surface Mount	6	-40°C to +85°C	T1/E1	DS2196, DS2151, DS2152, DS2153, DS2154, DS21348, DS21Q348, DS21448, DS2148, DS21Q48, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS21Q552, DS21554, DS21Q554
TX1320	1CT:1.36CT	TX Only	Surface Mount	6	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS21Q552, DS21554, DS21Q554

TX1277	1CT:1CT and 1CT:2CT	1	Surface Mount	14	-40°C to +85°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59, DS33R11, DS33R41
PE-68882	1CT:1.15CT and 1CT:1CT	1	Surface Mount	14	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
PE-64952	1:2CT and 1:1.36	1	Through Hole	14	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS2148, DS21Q48, DS21552, DS21Q552, DS21554, DS21Q554
PE-64953	1:2CT and 1:2CT	1	Through Hole	14	0°C to +70°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59
PE-65865	1:1.15CT and 1CT:2CT	1	Surface Mount	16	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
T1076	1:1.15CT and 1CT:2CT	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
T1136	1CT:1CT and 1CT:1.36CT	1	Surface Mount	16	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS2148, DS21Q48, DS21552, DS21Q552, DS21554, DS21Q554
PE-68678	1CT:1CT and 1CT:2CT	1	Surface Mount	16	0°C to +70°C	T1/E1	DS2196, DS21348, DS21Q348, DS21448, DS21352, DS21Q352, DS21354, DS21Q354

PE-68877	1CT:1CT and 1CT:2CT	1	Surface Mount	12	-40°C to +85°C	T1/E1	DS33R11, DS33R41
T1094	1CT:1CT and 1CT:2CT	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59
TX1099	1CT:1:0.8 and 1CT:1:0.8	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21348, DS21Q348, DS21448, DS26502, DS26503, DS26504, DS26521, DS26522, DS33R11
TX1467	1CT:1:1 and 1CT:1:1	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59
TX1473	1:2 and 1:1	4	Surface Mount	32	-40°C to +85°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59
T1068	1:2CT and 1:1CT	4	Surface Mount	40	0°C to +70°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59
TX1475	1CT:1CT and 1CT:2CT	4	Surface Mount	32	-40°C to +85°C	T1/E1	DS26324, DS26334, DS26518, DS26519, DS26524, DS26528
T1114	1CT:1CT and 1CT:2CT	4	Surface Mount	40	-40°C to +85°C	T1/E1	DS26303
T1108	1:2CT and 1:1CT	4	Surface Mount	40	-40°C to +85°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59

	TX1292	1:1.36 and 1:1	4	Surface Mount	40	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS2148, DS21Q48, DS21552, DS21Q552, DS21554, DS21Q554
	PE-65968	1:2CT	RX or TX	Surface Mount	6	0°C to +70°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154, DS3181, DS3182, DS3183, DS3184, DS3251, DS3252, DS3253, DS3254
	PE-65969	1:2CT	RX or TX	Through Hole	6	0°C to +70°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154, DS3170, DS3171, DS3172, DS3173, DS3174, DS3181, DS3182, DS3183, DS3184
	T3002	1:2CT	RX or TX	Surface Mount	6	-40°C to +85°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154, DS3181, DS3182, DS3183, DS3184
	T3012	1:2CT	RX or TX	Surface Mount	6	-40°C to +85°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154, DS3181, DS3182, DS3183, DS3184
	T3021	1:2CT and 1:2CT	1	Surface Mount	16	-40°C to +85°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154, DS3181, DS3182, DS3183, DS3184
	T3047	1:1	4	Surface Mount	32	-40°C to +85°C	T3/E3	DS32501, DS32502, DS32503, DS32504, DS32512
	T3049	1:2	4	Surface Mount	32	-40°C to +85°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154, DS3170, DS3171, DS3172, DS3173, DS3174, DS3181, DS3182, DS3183, DS3184
HALO Electronics	TG38-1505A	1:1.15CT	TX only	Through Hole	6	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554

TD70-1205A	1:1.36CT	TX only	Through Hole	6	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
TD15-1205A	1:2CT	TX only	Through Hole	6	0°C to +70°C	T1/E1	DS2196, DS21348, DS21Q348, DS21448, DS21352, DS21Q352, DS21354, DS21Q354
TD02-1205A	1CT:1	RX only	Through Hole	6	0°C to +70°C	T1/E1	DS2196, DS2151, DS2152, DS2153, DS2154, DS21348, DS21Q348, DS21448, DS2148, DS21Q48, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS2121Q552, DS21554, DS21Q554
TG04-1505NS	1CT:1CT	RX only	Surface Mount	6	-40°C to +85°C	T1/E1	DS2196, DS2151, DS2152, DS2153, DS2154, DS21348, DS21Q348, DS21448, DS2148, DS21Q48, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS2121Q552, DS21554, DS21Q554
TG15-1505NS	1CT:2CT	TX only	Surface Mount	6	-40°C to +85°C	T1/E1	DS2196, DS21348, DS21Q348, DS21448, DS21352, DS21Q352, DS21354, DS21Q354
TG38-1505NS	1:1.15CT	TX only	Surface Mount	6	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554

TG70-1505NS	1:1.36CT	TX only	Surface Mount	6	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
TD63-1505D	1:1.15CT and 1:2CT	1	Through Hole	14	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
TG63-1505N1	1:1.15CT and 1CT:2CT	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
TG35-1505N1	1CT:1.15CT and 1CT:1CT	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
TGSP-1467N1	1CT:1:1 and 1CT:1:1	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59
TG28-1505N1	1CT:1CT and 1CT:1.36C	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS21Q552, DS21554, DS21Q554
TG74-1205N1	1CT:1CT and 1CT:2CT	1	Surface Mount	16	0°C to +70°C	T1/E1	DS2196, DS21348, DS21Q348, DS21448, DS21352, DS21Q352, DS21354, DS21Q354
TG83-S006NU	1:2 and 1:1	4	Surface Mount	32	-40°C to +85°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59

	TG74-1205N1	1CT:1CT and 1CT:2CT	1	Surface Mount	16	0°C to +70°C	T1/E1	DS2196, DS21348, DS21Q348, DS21448, DS21352, DS21Q352, DS21354, DS21Q354
	TG07-0206NS	1:2CT	TX or RX only	Surface Mount	6	0°C to +70°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154
	TD07-0206NE	1:2CT	TX or RX only	Through Hole	6	0°C to +70°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154
	TG07-0356NS	1:2CT	TX or RX only	Surface Mount	6	0°C to +70°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154
	TG07-0406N1	1:2CT and 1:2CT	1	Surface Mount	16	-40°C to +85°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154
	TG05-0206NU	1:2	4	Surface Mount	32	-40°C to +85°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154
Bel	S553-3855-02	1:1.15CT and 1CT:2CT	1	Surface Mount	16	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
	S553-0013-02	1:2CT and 1:1.36	1	Surface Mount	16	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS2148, DS21Q48, DS21552, DS21Q552, DS21554, DS21Q554
	S553-0013-01	1CT:2CT and 1:1	1	Surface Mount	16	0°C to +70°C	T1/E1	DS21352, DS21354, DS2148, DS2155, DS2196, DS21Q352, DS21Q354, DS21Q48
	S554-3184-01	1:2CT	1	Surface Mount	6	0°C to +70°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154, DS3181, DS3182, DS3183, DS3184
	0554-3184-01	1:2CT	1	Through Hole	6	0°C to +70°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154, DS3181, DS3182, DS3183, DS3184

S553-6500-H5	1CT:1:1 and 1CT:1:1	4	Surface Mount	32	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21554, DS21Q552, DS21Q554
S554-6500-21	1:2	4	Surface Mount	32	-40°C to +85°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154, DS3181, DS3182, DS3183, DS3184
S553-6500-C8	1:2 and 1:1	4	Surface Mount	32	-40°C to +85°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59
0553-0013-RC	1:1.15CT	TX only	Through Hole	6	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
0553-0013-BC	1CT:1	RX only	Through Hole	6	0°C to +70°C	T1/E1	DS2196, DS2151, DS2152, DS2153, DS2154, DS21348, DS21Q348, DS21448, DS2148, DS21Q48, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS2121Q552, DS21554, DS21Q554
0553-0013-1J	1:2CT and 1:2CT	1	Through Hole	14	0°C to +70°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59
0553-0013-2J	1:2CT and 1:1.36	1	Through Hole	14	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS2148, DS21Q48, DS21552, DS21Q552, DS21554, DS21Q554

T2099S	1CT:1CT and 1CT:1.36CT	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS2148, DS21Q48, DS21552, DS21Q552, DS21554, DS21Q554
T2006	1:1.15CT	TX only	Through Hole	6	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
T2007	1:1.36CT	TX only	Through Hole	6	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS21Q552, DS21554, DS21Q554
T2028S	1:1.15CT and 1CT:2CT	1	Surface Mount	16	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
T0034	1:2CT	TX only	Through Hole	6	0°C to +70°C	T1/E1	DS2196, DS21348, DS21Q348, DS21448, DS21352, DS21Q352, DS21354, DS21Q354
S553-6500- 76	1CT:1CT and 1CT:2CT	1	Surface Mount	16	0°C to +70°C	T1/E1	DS2196, DS21348, DS21Q348, DS21448, DS21352, DS21Q352, DS21354, DS21Q354
S553-6500- E6	1CT:1CT and 1CT:2CT	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS21348, DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59
S553-6500- H6	1CT:1:0.8 and 1CT:1:0.8	1	Surface Mount	32	-40°C to +85°C	T1/E1	DS21348, DS21Q348, DS21448, DS2155, DS2156

Coev	PT-311	1:1.36CT	TX only	Through Hole	6	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS21Q552, DS21554, DS21Q554
	PT-311ET	1:1.36CT	TX only	Through Hole	6	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS21Q552, DS21554, DS21Q554
	PT-306	1:2CT	TX only	Through Hole	6	0°C to +70°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59
	PT-306ET	1:2CT	TX only	Through Hole	6	-40°C to +85°C	T1/E1	DS2155, DS2156, DS21Q55, DS21455, DS21458, DS21Q50, DS21Q58, DS21Q59
	PT-312	1CT:1	RX only	Through Hole	6	0°C to +70°C	T1/E1	DS2196, DS2151, DS2152, DS2153, DS2154, DS21348, DS21Q348, DS21448, DS2148, DS21Q48, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS2121Q552, DS21554, DS21Q554

PT-312ET	1CT: 1	RX only	Through Hole	6	-40°C to +85°C	T1/E1	DS2196, DS2151, DS2152, DS2153, DS2154, DS21348, DS21Q348, DS21448, DS2148, DS21Q48, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS2121Q552, DS21554, DS21Q554
PT-323	1: 1	RX only	Through Hole	6	0°C to +70°C	T1/E1	DS2196, DS2151, DS2152, DS2153, DS2154, DS21348, DS21Q348, DS21448, DS2148, DS21Q48, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS2121Q552, DS21554, DS21Q554
PT-323ET	1: 1	RX only	Through Hole	6	-40°C to +85°C	T1/E1	DS2196, DS2151, DS2152, DS2153, DS2154, DS21348, DS21Q348, DS21448, DS2148, DS21Q48, DS21352, DS21Q352, DS21354, DS21Q354, DS21552, DS2121Q552, DS21554, DS21Q554
SMD601-05	1: 1.15CT and 1CT: 2CT	1	Surface Mount	16	0°C to +70°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554
SMD601-05ET	1: 1.15CT and 1CT: 2CT	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS2151, DS2152, DS2153, DS2154, DS21552, DS21Q552, DS21554, DS21Q554

SMD606-05	1CT:1CT and 1CT:2CT	1	Surface Mount	16	0°C to +70°C	T1/E1	DS21352, DS21354
SMD606-05ET	1CT:1CT and 1CT:2CT	1	Surface Mount	16	-40°C to +85°C	T1/E1	DS21352, DS21354
SM01-T304M	1:2CT	1	Surface Mount	6	-40°C to +85°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154, DS3181, DS3182, DS3183, DS3184
MGBBT-00019	1:2	4	Surface Mount	32	-40°C to +85°C	T3/E3	DS3150, DS3151, DS3152, DS3153, DS3154, DS3181, DS3182, DS3183, DS3184

T1/E1 and T3/E3 Transformer Selection Information

If you have further questions on T1/E1 or T3/E3 transformer selection for our devices, please contact the Telecommunication Applications support team by email at telecom.support@dalsemi.com, or call 01-972-371-6555. For more information about specific transformers, please consult the manufacturers using the information listed below.

Vendor List

Address	Phone	Fax	Website
Pulse Engineering Inc. 12220 World Trade Drive San Diego, CA 92128	858-674-8100	858-674-8262	www.pulseeng.com
HALO Electronics Inc. 1861 Landings Drive Mountain View, CA 94043	650-903-3800	650-903-9300	www.haloelectronics.com
Bel Fuse Inc. 206 Van Vorst Street Jersey City, NJ 07302	201-432-0463	201-432-9542	www.belfuse.com
Coev Magnetics (Tyco) 3003 9th Avenue SW Watertown, SD 57201	605-886-3326	605-884-3640	www.coev.net

Application Note 351: www.maxim-ic.com/an351

More Information

For technical support: www.maxim-ic.com/support

For samples: www.maxim-ic.com/samples

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