

**YAMAHA® LSI**

# **YTD427**

**APPLICATION MANUAL**

**IAFE**

**ISDN DSU Analog Front End**

**YAMAHA**

YTD427 APPLICATION MANUAL
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# Chapter 1

## INTRODUCTION

### 1.1 General Description

YTD427 is a communication LSI which provides the ISDN subscriber interface (two-wire metallic time compression multiplexing operation). It is capable of providing the electric characteristics conforming to TTC Standard JT-G961.

A DSU (Digital Service Unit) can easily be constructed by combining with YTD426B.

### 1.2 Features

1. Automatic Gain Control (AGC) function
2. Filter function
3. Peak hold function
4. ADC (Analog Digital Converter) function
5. Low Power Consumption  
Operation mode 72mW(typ.)
6. CMOS technology
7. 64-pin QFP
8. Single +5 volt supply



## Chapter 2

# BLOCK DIAGRAM

YTD 427 internal block diagram is shown in Figure2.1.

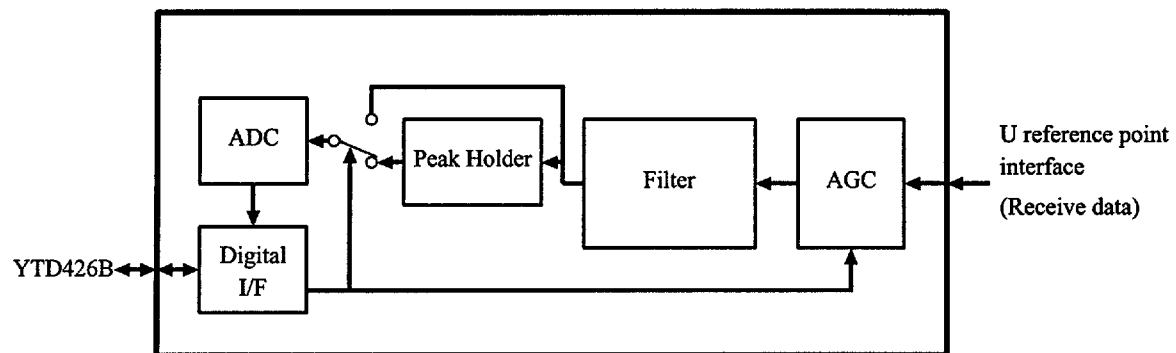


Figure 2.1: Internal Block Diagram





## Chapter 3

# PIN DESCRIPTIONS

### 3.1 Pin Assignments

The pin assignments of YTD427 are shown in Figure 3.1.

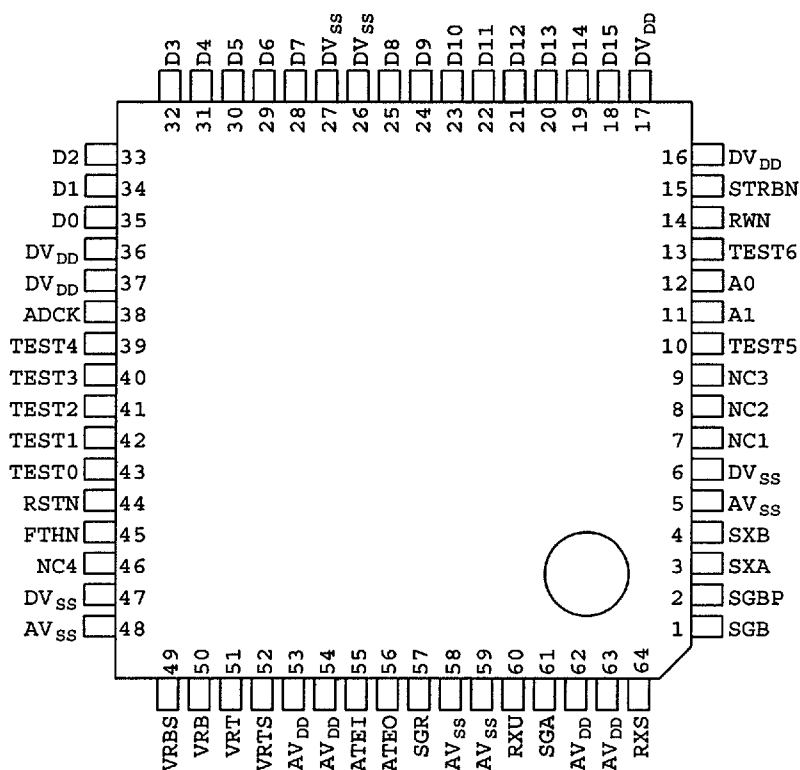


Figure 3.1: YTD427-F (64-pin QFP) Pin Assignments [Top View]

### 3.2 Pin Functions

Pin No.	Pin Name	I/O	Function	Remarks
1	SGB	–	Connect a 0.015 $\mu$ F capacitor across the SGB and SGR pins.	
2	SGBP	–	Connect a 0.015 $\mu$ F capacitor across the SGBP and SGR pins.	
3	SXA	–	Connected to SXB.	
4	SXB	–	Connected to SXA.	
5, 48, 58, 59	AV <sub>SS</sub>	GND	Analog ground	All pins must be joined together.
6, 26, 27, 47	DV <sub>SS</sub>	GND	Digital ground	All pins must be joined together.
7	NC1	IN	Unused Connected to DV <sub>SS</sub>	
8	NC2	IN	Unused Connected to DV <sub>SS</sub>	
9	NC3	IN	Unused Connected to DV <sub>SS</sub>	
10	TEST5	IN	Test input 5 Connected to DV <sub>SS</sub>	
11	A1	IN	Address bus bit 1 Connected to ADDRESS1 of YTD426B	
12	A0	IN	Address bus bit 0 Connected to ADDRESS0 of YTD426B	
13	TEST6	IN	Test input 6 Connected to DV <sub>SS</sub>	
14	RWN	IN	Read/write signal “H” : Read “L” : Write Connected to RWN of YTD426B	
15	STRBN	IN	Strobe signal “H” : Inactive “L” : Active Connected to STRBN of YTD426B	
16, 17, 36, 37	DV <sub>DD</sub>	PWR	Digital power supply	All pins must be joined together.

Pin No.	Pin Name	I/O	Function	Remarks
18	D15	OUT	Data bus bit 15 Connected to AFEDATA15 of YTD426B.	
19	D14	OUT	Data bus bit 14 Connected to AFEDATA14 of YTD426B.	
20	D13	OUT	Data bus bit 13 Connected to AFEDATA13 of YTD426B.	
21	D12	OUT	Data bus bit 12 Connected to AFEDATA12 of YTD426B.	
22	D11	OUT	Data bus bit 11 Connected to AFEDATA11 of YTD426B.	
23	D10	OUT	Data bus bit 10 Connected to AFEDATA10 of YTD426B.	
24	D9	OUT	Data bus bit 9 Connected to AFEDATA9 of YTD426B.	
25	D8	OUT	Data bus bit 8 Connected to AFEDATA8 of YTD426B.	
28	D7	IN	Data bus bit 7 Connected to AFEDATA7 of YTD426B.	
29	D6	IN	Data bus bit 6 Connected to AFEDATA6 of YTD426B.	
30	D5	IN	Data bus bit 5 Connected to AFEDATA5 of YTD426B.	
31	D4	IN	Data bus bit 4 Connected to AFEDATA4 of YTD426B.	
32	D3	IN	Data bus bit 3 Connected to AFEDATA3 of YTD426B.	
33	D2	IN	Data bus bit 2 Connected to AFEDATA2 of YTD426B.	
34	D1	IN	Data bus bit 1 Connected to AFEDATA1 of YTD426B.	
35	D0	IN	Data bus bit 0 Connected to AFEDATA0 of YTD426B.	

Pin No.	Pin Name	I/O	Function	Remarks
38	ADCK	IN	ADC operation clock signal Connected to CLK640K of YTD426B.	
39	TEST4	IN	Test input 4 Connected to DV <sub>SS</sub> .	
40	TEST3N	I/O	Test input 3 Usually fixed to "H".	
41	TEST2	IN	Test input 2 Connected to DV <sub>SS</sub> .	
42	TEST1	IN	Test input 1 Connected to DV <sub>SS</sub> .	
43	TEST0	IN	Test input 0 Connected to DV <sub>SS</sub> .	
44	RSTN	IN	Reset input pin "L" : Reset Reset time is 2 $\mu$ s(minimum)	
45	PTHN	IN	Test input Usually fixed to "H".	
46	NC4	IN	Unused Connected to DV <sub>SS</sub> .	
49	VRBS	OUT	ADC reference power supply output (low voltage)	
50	VRB	IN	ADC reference power supply input (low voltage)	
51	VRT	IN	ADC reference power supply input (high voltage)	
52	VRTS	OUT	ADC reference power supply output (high voltage)	
53, 54, 62, 63	AV <sub>DD</sub>	PWR	Analog power supply	All pins must be joined together.
55	ATEI	IN	Test signal input Connected to AV <sub>SS</sub> .	
56	ATEO	I/O	Test signal input, output Connected to AV <sub>SS</sub> .	
57	SGR	OUT	Analog signal reference output	
60	RXU	IN	Receive signal input	
61	SGA	—	Connect a 0.0047 $\mu$ F capacitor across SGA and SGR.	
64	RXS	—	Connect a 0.0022 $\mu$ F capacitor across RXS and SGR.	

# Chapter 4

## FUNCTIONS

**Receive Interface**      Receive pin RXU has a high input impedance. An example of a reference circuit of the receive interface is shown in Figure 4.1.

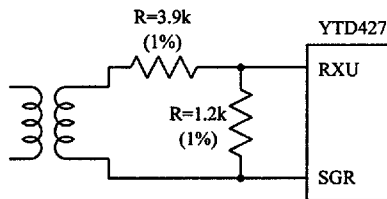


Figure 4.1: Receive Interface Connection

**AGC**      The AGC section adjusts the gain in 0.22 dB step in the range from 0.0 to 56.1 dB at the receive signal center frequency ( $f=160$  kHz) and amplifies the receive signal amplitude to the maximum dynamic range.

**Filter**      The filter section is to prevent the ADC and the peak hold section from erroneous operation caused by high-frequency noise.

**Peak Hold section**      Peak hold is performed during the initial training so that the gain of the AGC section is set to make best communication condition.

**ADC**      The ADC section makes an A/D conversion of the received signal and transfers it to YTD426B. The A/D conversion timing is synchronized to the clock (ADCK) provided by YTD426B.

**Digital Interface**      The digital section provides the interface to YTD426B.



## Chapter 5

# ELECTRICAL CHARACTERISTICS

### 5.1 Absolute Maximum Ratings

( $DV_{SS}=AV_{SS}=0.0V$   $T_a=25\text{ }^{\circ}C$ )

Parameters	Symbol	Min.	Max.	Units
Supply Voltage (Digital)	$DV_{DD}$	-0.3	+7.0	V
Supply Voltage (Analog)	$AV_{DD}$	-0.3	+7.0	V
Input Voltage (Digital)	$DV_{IN}$	$DV_{SS} - 0.3$	$DV_{DD} + 0.3$	V
Input Voltage (Analog)	$AV_{IN}$	$AV_{SS} - 0.3$	$AV_{DD} + 0.3$	V
Output Voltage (Digital)	$DV_{OUT}$	$DV_{SS} - 0.3$	$DV_{DD} + 0.3$	V
Output Voltage (Analog)	$AV_{OUT}$	$AV_{SS} - 0.3$	$AV_{DD} + 0.3$	V
Power Dissipation	$P_D$		400	mW
Operating Temperature	$T_{OP}$	-20	+70	$^{\circ}C$
Storage Temperature	$T_{ST}$	-55	+125	$^{\circ}C$

**Note 1** The values represent the minimum and maximum voltages that can be applied to the pins without causing damage. It does not guarantee the operation. Applying a voltage exceeding the absolute maximum ratings may cause permanent damage to YTD427.

**Note 2** Use digital power supply  $DV_{DD}$  and analog power supply  $AV_{DD}$  under the condition:  $DV_{DD} = AV_{DD}$ . Also, insert a  $C \geq 0.1\mu F$  across  $DV_{DD}$  and  $DV_{SS}$  and across  $AV_{DD}$  and  $AV_{SS}$  to prevent latch up.

**Note 3** Use digital ground  $DV_{SS}$  and analog ground  $AV_{SS}$  under the condition:  $DV_{SS} = AV_{SS}$ .

**Note 4** Even though digital power supply  $DV_{DD}$  and analog power supply  $AV_{DD}$  have the same pin name, they are not connected inside YTD427. Make sure to connect the pins that have the same name.

**Note 5** Even though digital ground  $DV_{SS}$  and analog ground  $AV_{SS}$  have the same pin name, they are not connected inside YTD427. Make sure to connect the pins that have the same name.

## 5.2 Recommended Operating Conditions

( $DV_{SS}=AV_{SS}=0.0V$ ,  $T_a=25\text{ }^{\circ}C$ )

Parameters	Symbol	Condition	Min.	Typ.	Max.	Units
Digital Power Supply Voltage	$DV_{DD}$		4.75	5.0	5.25	V
Analog Power Supply Voltage	$AV_{DD}$		4.75	5.0	5.25	V
Digital Input Voltage	$DV_{IN}$		$DV_{SS}$		$DV_{DD}$	V
Analog Input Voltage	$AV_{IN}$		$AV_{SS}$		$AV_{DD}$	V
Digital Output Voltage	$DV_{IN}$		$DV_{SS}$		$DV_{DD}$	V
Analog Output Voltage	$AV_{IN}$		$AV_{SS}$		$AV_{DD}$	V
Operating Temperature Range	$T_{OP}$		-20	25	70	$^{\circ}C$
External Clock Input						
Clock Frequency	$f_{CP}$	(Note1)		0.64		MHz
Clock Frequency Allowable Deviation	$\Delta f_{CP}$	(Note1)	-50		50	ppm
Clock Duty	$t_{DUTY}$	(Note1)	45	50	55	%
High Level Time	$t_{WCH}$	(Note1)	400			ns
Low Level Time	$t_{WCL}$	(Note1)	400			ns
Rise Time	$t_{TLHC}$	(Note1)			20	ns
Fall Time	$t_{THLC}$	(Note1)			20	ns
YTD426 Supply Input Signal						
High-Level Pulse Width	$t_{WDH}$	(Note2)	90			ns
Low-Level Pulse Width	$t_{WDL}$	(Note2)	90			ns
Rise Time	$t_{TLHD}$	(Note2)			10	ns
Fall Time	$t_{THLD}$	(Note2)			10	ns

**Note 1** With respect to ADCK pin.

**Note 2** With respect to A1, A0, RWN, STRBN, D15 to D0 pins.



## 5.3 DC Characteristics

( $DV_{DD}=AV_{DD}=4.75\sim 5.25V$ ,  $DV_{SS}=AV_{SS}=0.0V$ ,  $T_a=25\text{ }^{\circ}C$ )

Parameters	Symbol	Condition	Min.	Typ.	Max.	Units
High-Level Input Voltage (CMOS)	$V_{IHC}$	(Note1)	$0.7DV_{DD}$		$DV_{DD}$	V
Low-Level Input Voltage (CMOS)	$V_{ILC}$	(Note1)	0.0		$0.3DV_{DD}$	V
Input Leak Current (CMOS)	$I_{LIC}$	(Note1) (Note2)			$\pm 10$	$\mu A$
High-Level Input Voltage (TTL)	$V_{IHT}$	(Note3)	2.0		$DV_{DD}$	V
Low-Level Input Voltage (TTL)	$V_{ILT}$	(Note3)	0.0		0.8	V
Input Leak Current (TTL)	$I_{LIT}$	(Note3) (Note4)			$\pm 10$	$\mu A$
High-Level Output Voltage (TTL)	$V_{OHT}$	(Note3) (Note5)	4.4			V
Low-Level Output Voltage (TTL)	$V_{OLT}$	(Note3) (Note6)			0.4	V
Supply Current (Normal)	$I_{DD1}$	(Note7)		14.4	24.9	mA
Supply Current (at reset)	$I_{DD4}$	(Note7) (Note8)		4.4	7.6	mA
Power Consumption (Normal)	$P_{tot1}$	(Note7)		72	131	mW
Power Consumption (at reset)	$P_{tot4}$	(Note7) (Note8)		22	40	mW

**Note1** With respect to ADCK, TEST4, TEST2 to TEST0, RSTN, FTHN, NC4 to NC1 pins.

**Note2**  $V_{IC}=DV_{SS} - DV_{DD}$

**Note3** With respect to A1, A0, RWN, STRBN, D15 to D0, TEST3, TEST5, TEST6 pins.

**Note4**  $V_{IT}=DV_{SS} - DV_{DD}$

**Note5**  $I_{OH}=-4mA$

**Note6**  $I_{OL}=12mA$

**Note7** Neither external circuit nor parts

**Note8** ADCK pin fixed to  $DV_{SS}$

( $DV_{DD}=AV_{DD}=4.75\sim 5.25V$ ,  $DV_{SS}=AV_{SS}=0.0V$ ,  $T_a=25\text{ }^{\circ}C$ )

Parameters	Symbol	Condition	Min.	Typ.	Max.	Units
Analog Output Allowable Load Impedance	$Z_O$	(Note1)	30			$k\Omega$
Analog Receive Buffer Input Impedance	$Z_{i1}$	(Note2)	10			$M\Omega$
Analog Receive Buffer Input Impedance	$Z_{i2}$	(Note3)		100		$k\Omega$
Reference Resistance	$R_{REF}$	(Note4)	1.92	2.40	3.84	$k\Omega$
Voltage Divider Resistance	$R_{DIV}$	(Note5)	1.44	1.80	2.88	$k\Omega$
Analog Signal Reference Voltage	$V_{SG}$	(Note6)	$0.5AV_{DD}-0.05$	$0.5AV_{DD}$	$0.5AV_{DD}+0.05$	V
ADC						
High-Level Reference Voltage Level	$V_{RT}$	(Note7)	$0.7AV_{DD}$		$AV_{DD}$	V
Low-Level Reference Voltage Level	$V_{RB}$	(Note8)	0.0		$0.3AV_{DD}$	V
Self-Bias VRT	$V_{RTS}$	(Note9)	$0.7AV_{DD}-0.1$	$0.7AV_{DD}$	$0.7AV_{DD}+0.1$	V
Self-Bias VRB	$V_{RBS}$	(Note10)	$0.3AV_{DD}-0.1$	$0.3AV_{DD}$	$0.3AV_{DD}+0.1$	V

**Note1** With respect to SGR, SXA pins.

**Note2** With respect to RXU pin.

**Note3** With respect to SXB pin.

**Note4** Across VRT and VRB pins.  $VRB=1.5\text{ V}$

**Note5** Across VRT and  $AV_{DD}$  pins and across VRB and  $AV_{SS}$  pins.

**Note6** SGR pin is open.

**Note7** With respect to VRT pin.

**Note8** With respect to VRB pin.

**Note9** Short VRT pin and VRTS pin

**Note10** Short VRB pin and VRBS pin

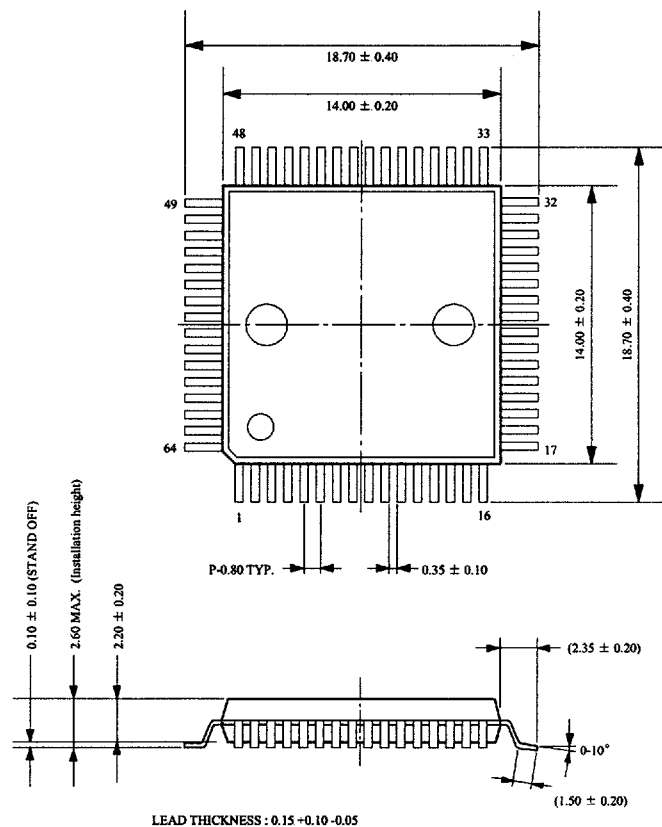
## 5.4 AC Characteristics

( $DV_{DD}=AV_{DD}=4.75\sim 5.25V$ ,  $DV_{SS}=AV_{SS}=0.0V$ ,  $T_a=25\text{ }^{\circ}C$ )

Parameters		Symbol	Condition	Min.	Typ.	Max.	Units
Total Harmonic Distortion		THD				1.0	%
AGC	Gain	$G_A$		43.76	45.76	47.76	dB
	Noise	$N_{oag}$				6	$mV_{rms}$
	DC Offset Voltage	$V_{agoff}$				$\pm 50$	mV
Filter	Cut Off Frequency	$f_c$		213	320	427	kHz
	Flatness	$A_p$		-1.0	0.0	1.0	dB
PH	Max. Conversion Time	$F_{PH}$			160	200	kHz
	Refresh Time	$t_{phr}$			60	100	ns
	Peak Hold Error	$V_{phe}$				$\pm 50$	mV
ADC	Resolution	$R_{es}$				8	Bit
	Linearity Error	EL			$\pm 1.0$	$\pm 2.0$	LSB
	Quantization Error	$E_e$		-1.0		1.0	LSB
	Max. Conversion Time	$F_{AD}$				1.28	MSPS
	Clock Frequency	$F_{ADCK}$			640		kHz



# PACKAGE OUTLINE



(UNIT) : mm (millimeters)

The shape of the molded corner may be slightly different from the shape in this diagram.

The figure in the parenthesis ( ) should be used as a reference.

Plastic body dimensions do not include burr of resin.

**Note :** The LSIs for surface mount need special consideration on storage and soldering conditions.  
For detailed information, please contact your nearest Yamaha agent.



# Appendix A

## EXMAPLE OF APPLICATIONS

### A.1 Example of Application Circuits

An example of an application circuit using YTD427 is shown in Figure A.1.

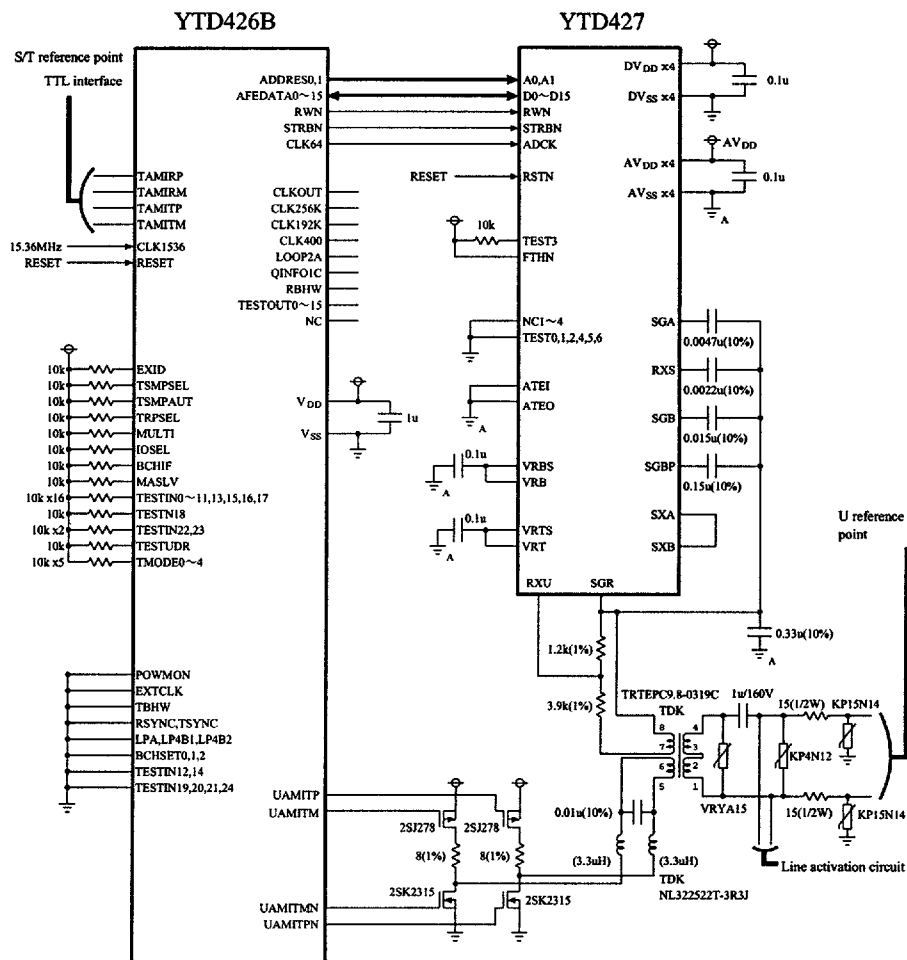


Figure A.1: Pin Connection Example