Project Code: APM_ICT_2017

ADI ICT/FCT EQUIPMENT SOLUTIONS

Application Introduction

In circuit tests (ICTs) and function circuit tests (FCTs) are necessary steps and processes during PCBA mass production to guarantee the yield.

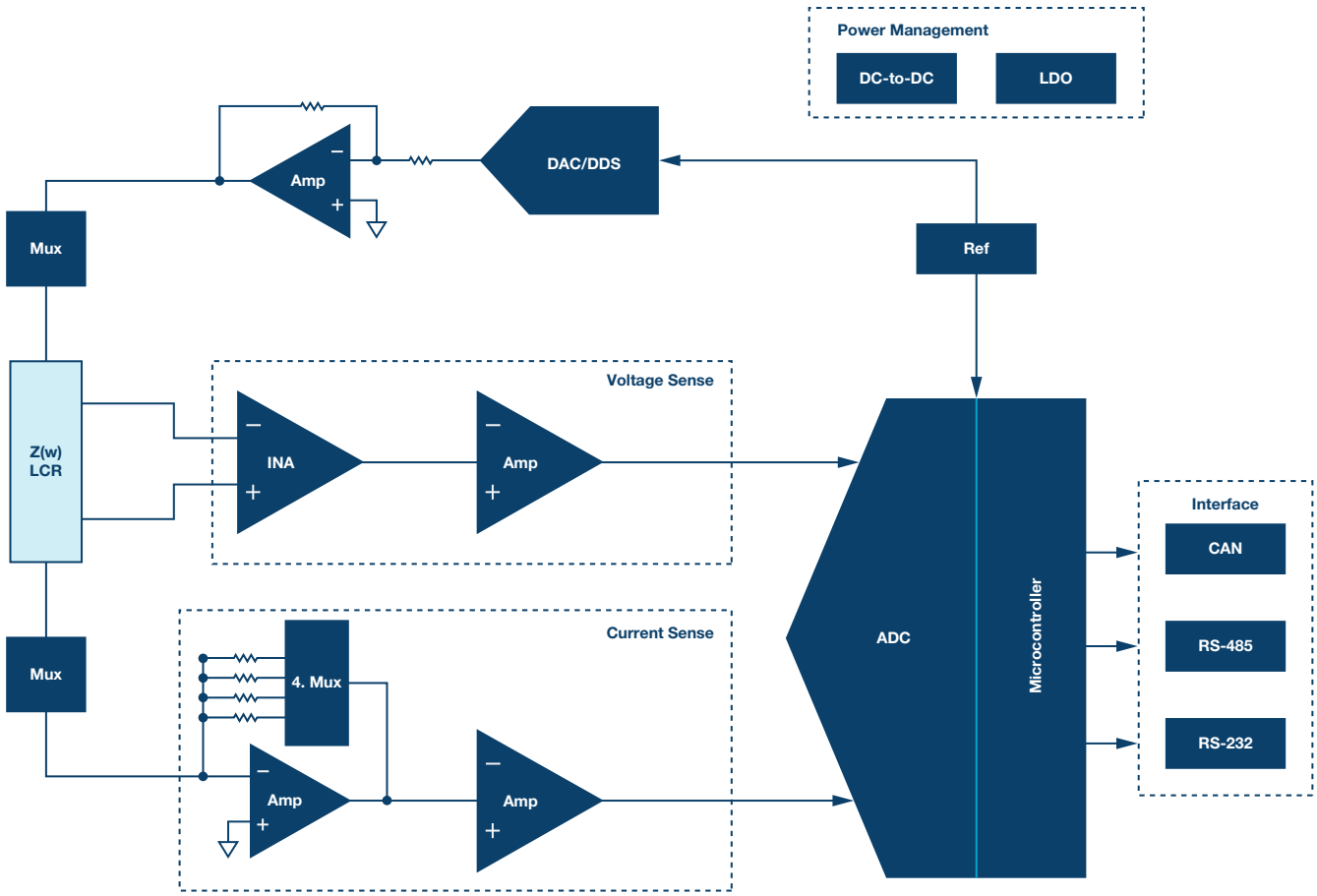
An ICT performs schematic verification by testing individual components of a printed circuit board (PCBA). It's very effective at finding manufacturing defects, such as solder shorts, missing components, wrong components, and open connections.

An FCT verifies that a PCB assembly functions properly by providing stimulus to an assembly and verifying the response. Functional tests are designed to ensure that circuitry functions within specifications. FCTs are good at uncovering problems that ICT can't find, such as analog signal distortion, amplifier issues, and communications problems.

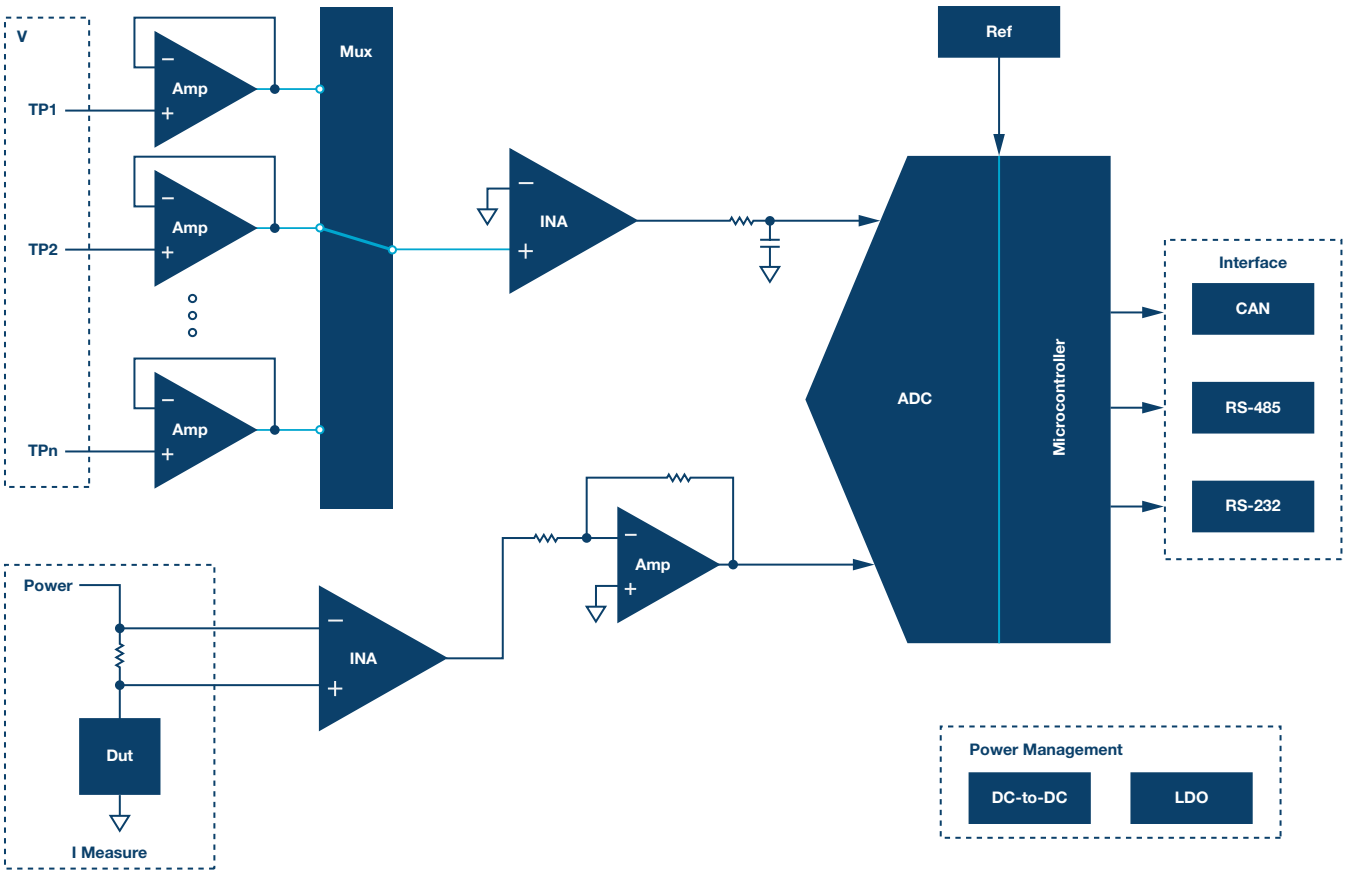
Solutions from ADI

System Block Diagram

An ICT measures the impedance of components under test without a power up PCBA, which mainly includes resistance, capacitance, and inductance measurement.



An FCT's purpose is to verify if the functionality of a PCBA is correct or not. The most common way of testing functionality is by stimulating potential and measuring the responding current.



Amplifiers	INAs	ADCs	DACs/DDSs
ADA4522-1/AD8638/ADA4528-1/ AD8626/ADA4897-1/AD8021	AD8221/AD8421/AD8237/AD8228/ AD8422/AD8220	AD7173-8/AD7175-2/AD7177/AD7685/ AD7980/AD7988-5/AD7960/AD7626/ AD4000/AD4003	AD5676R/AD5686R/AD5689R/ AD9833/AD9834

Muxes	References	Microcontrollers	Power Management	Interface
ADG1608/ADG1408/ADG1208/ ADG5408/ADG5412F/ADG1212	ADR4550/ADR3450	ADuCM361/ADuC7061	ADP2503/ADP2370/ADP160/ ADP7102/ADP7182/ADM8828/ ADP2301/ADP2441	ADM2483/ADM2484E/ ADM3251E/AduM1250/ ADM3202/ADM3053/ADM3260/ ADM2587E

Main Products

Part Number	Description	Benefits
Amplifiers		
ADA4522-1	Single 55 V, EMI enhanced, zero-drift, 22 nV/°C maximum ultralow noise, 117 nV p-p typical from 0.1 Hz to 10 Hz, rail-to-rail output operational amplifiers	The dual-channel/quad-channel ADA4522-2/ADA4522-4 are available
AD8626	0.25 pA bias current @ typ room temperature, less than 2 pA bias current @ typ 50°C, low offset drift 2 µV/°C, up to ±13 V power supply, high bandwidth 5 MHz, rail-to-rail output	Wider power supply range, low bias current @ 0°C to 50°C, low offset drift
AD8638	16 V auto-zero, rail-to-rail output operational amplifier, offset drift 40 nV/°C maximum	High voltage, low drift, dual-channel AD8639 is available
ADA4528-1	5 V, zero-drift 15 nV/°C @ max, ultralow noise 97 nV p-p @ 0.1 Hz to 10 Hz	Extreme low drift and extreme low noise, dual-channel ADA4528-2 is available
ADA4897-1	1 nV/$\sqrt{\text{Hz}}$, low power, rail-to-rail output amplifiers high speed 230 MHz, −3 dB bandwidth (G = +1) 120 V/µs slew rate, 10 V power rail	High speed op amp, ADC driver
AD8021	2 nV/$\sqrt{\text{Hz}}$, low power, rail-to-rail output amplifiers high speed 200 MHz, −3 dB bandwidth 24 V power rail	Low noise, high speed amplifier for 16-bit systems, ADC driver

Part Number	Description	Benefits
Instrumentation Amplifiers		
AD8221	36 V, 80 dB CMRR @ 10 kHz, gain range 1 to 1000	Classic precision instrumentation amplifier
AD8422	36 V, 80 dB CMRR @ 10 kHz, gain range 1 to 1000, 2.2 MHz bandwidth, 8 nV/√Hz maximum input voltage noise	High performance, low power, rail-to-rail precision instrumentation amplifier
AD8228	36 V, low gain drift 1 ppm/°C, low noise 15 nV/√Hz	Fixed gain 10/100 with internal resistor save cost and improve gain accuracy
AD8421	Low bias current 0.1 nA, low noise 3 nV/√Hz, high bandwidth 10 MHz @ G = 1, low offset drift 0.2 µV/°C, slew rate 35 V/µs	High speed instrumentation amplifier, low noise and low bias current
AD8220	JFET input, low bias current 10 pA @ typ, high bandwidth 1.5 MHz @ G = 1, gain range 1 to 1000	Low bias current, enough bandwidth, suitable for conductivity meter
AD8237	5 V, maximum offset voltage drift: 0.3 µV/°C, minimum CMRR: 106 dB	Micropower, zero-drift, true rail-to-rail instrumentation amplifier
ADCs		
AD7173-8	31.25 kSPS, 24-bit, low power, 8 full differential/16 single-ended channel multiplexed Σ-Δ analog-to-digital converter	High speed, high resolution; precision 2.5 V reference 3.5 ppm/°C; precsion analog buffer
AD7175-2	250 kSPS, 24-bit, 2 full differential/4 single-ended channel multiplexed Σ-Δ analog-to-digital converter	High speed, high resolution; precision 2.5 V reference; true rail-to-rail analog buffer
AD7177-2	10 kSPS, 32-bit, Σ-Δ ADC with 100 µs settling and true rail-to-rail buffers	High speed, high resolution; precision 2.5 V reference; true rail-to-rail analog buffer
AD7685	16-bit, 250 kSPS, INL: ±0.6 LSB typical	Precision SAR ADC
AD7988-5	16-bit, 500 kSPS, INL: ±0.6 LSB typical	Precision SAR ADC ultralow power
AD7980	16-bit, 1 MSPS, INL: ±0.6 LSB typical	Precision SAR ADC
AD4000	16-bit, 2 MSPS precision pseudo differential SAR ADC	Precision SAR ADC
AD4003	18-bit, 2 MSPS precision SAR differential ADC, INL: ±1 LSB typical	Precision SAR ADC, high speed
AD7960	18-bit, 5 MSPS, INL: ±0.8 LSB typical	Precision SAR ADC, high speed
AD7626	16-bit, 10 MSPS, INL: ±0.45 LSB typical	Precision SAR ADC, high speed
DACs		
AD5676R	16-bit, 8-channel DAC; ±3 LSB INL (max); 50 M SPI interface; 2 ppm/°C reference	High resolution, high linearity, intense integrated; 20-lead TSSOP package; 2 ppm/°C reference
AD5686R	16-bit, 4-channel DAC; ±2 LSB INL (max); 50 M SPI interface; 2 ppm/°C reference	High resolution, high linearity; precision 2.5 V reference 2 ppm/°C
AD5689R	16-bit, 2-channel DAC; ±2 LSB INL (max); selectable gain of 1 and 2; 50 M SPI interface	High resolution, high linearity; precision 2.5 V reference 2 ppm/°C
AD9833	5 V DDS digitally programmable frequency and phase, 28-bit resolution, 25 MHz reference clock	25 MHz complete DDS
AD9834	5 V DDS digitally programmable frequency and phase, 28-bit resolution, 75 MHz reference clock	75 MHz complete DDS
Muxes		
ADG1608	8-channel multiplexer, ±8 V power supply, low on resistance 4.5 Ω @ typ, low leakage current 20 pA @ typ, low power consumption 1 µA	Wider power supply range, low leakage and low on resistance help to build high accurate system
ADG1408	8-channel multiplexer, ±15 V power supply, low on resistance 4.7 Ω @ typ, low leakage current 20 pA @ typ	Wider power supply range, low leakage and low on resistance help to build high accurate system
ADG1208	8-channel multiplexer, ±15 V power supply, <1 pC charge injection over full signal range, 1 pF off capacitance, low leakage current 20 pA @ typ	Wider power supply range, low leakage and low capacitance/charge injection help to build high accurate system
ADG5408	8-channel multiplexer, ±22 V power supply, low on resistance 13.5 Ω @ typ, low leakage current 50 pA @ typ	High voltage latch-up proof 8-channel multiplexer
ADG5412F	10 Ω quad SPST, ±22 V power supply 100 pA leakage current @ typ	High voltage latch-up; overvoltage protection up to –55 V and +55 V; power-off protection up to –55 V and +55 V
ADG1212	Quad SPST, ±15 V power supply, 2.6 pF on capacitance <1 pC charge injection, 20 pA leakage current @ typ	Low capacitance, low charge injection, ±15 V/+12 V *i*CMOS quad SPST switch
References		
ADR4550	5 V reference, very low drift: 2 ppm/°C (max), low noise: 2.8 µV p-p @ 0.1 Hz to 10 Hz, long time stability: 25 ppm/√1000 hr	Low drift, very good stability and low noise reference, many other choices for output voltage in ADR45xx family
ADR3450	5 V reference, very low drift: 8 ppm/°C (max), 2.5 ppm/°C (typ), low noise: 35 µV p-p @ 0.1 Hz to 10 Hz, long time stability: 30 ppm/√1000 hr	Low drift, good stability, low cost reference; many other choices for output voltage in ADR34xx family
Microcontrollers		
ADuCM361	Precision analog microcontrollers, ARM® Cortex®-M3 32-bit processor, 6 differential channels, single (24-bit) ADCs, single 12-bit DAC, power consumption 1.0 mA, 290 µA/MHz, 19-pin GPIO, 128 kB Flash®/EE memory, 8 kB SRAM; small package, low drift internal reference 5 ppm typical, integrated programmable current source	Low power consumption, high precision 24-bit Σ-Δ ADC, 4 mA to 20 mA loop applications, small package
ADuC7061	A precision analog microcontroller based on a 10 MHz ARM7 and a highly precise dual Σ-Δ ADC front end, 24-bit resolution and 16-bit ENOB and sub-100 Hz output rates; memory footprint includes a 32 kB flash and 4 kB SRAM; other key specs includes sub-3 mA operation (with MCU core at 1 MHz) making the part suitable for 4 mA to 20 mA loop applications, a 12-bit DAC and small package—5 mm × 5 mm, 32-lead LFCSP	Low power consumption, low cost 24-bit Σ-Δ ADC, 4 mA to 20 mA loop applications, small package

Part Number	Description	Benefits
Power Management		
ADP2503	38 µA quiescent current; 2.5 MHz buck-boost dc-to-dc converter, has ability to operate at input voltages greater than, less than, or equal to the regulated output voltage	Low power consumption to achieve long battery life, small package, and few external parts around cost small PCB space
ADM8828	Voltage inverter without inductor, two 1 µF external capacitor	Small package and few external parts around cost small PCB space
ADP2301	3.0 V to 20 V input , 1.2 A, 1.4 MHz frequency, high efficiency up to 91%, current-mode control architecture	Small 6-lead SOT-23 package, few peripheral components, and small solution size
ADP160	2.2 V to 5.5 V input, 150 mA maximum output current, 1% initial accuracy, up to 15 fixed-output voltage options available from 1.2 V to 4.2 V; low quiescent current: 42 µA	Low power consumption, integrated output discharge resistor, small package with only two 1 µF external capacitor
ADP7102	20 V input LDO, 300 mA output current, low noise 15 µV rms, 7 fixed output voltage options and adjustable output	High input voltage, low noise LDO
ADP7182	–28 V input LDO, 200 mA output current, low noise 18 µV rms	High input voltage, low noise negative LDO
ADP2441	4.5 V to 36 V input buck regulator, 1 A output current, high efficiency larger than 90%, adjustable switching frequency: 300 KHz to 1 MHz, current limit protection, external soft start, thermal shutdown	Small 3 mm × 3 mm LFCSP package, high efficiency
ADP2370	3.0 V to 15 V input buck regulator, 800 mA output current, 1.2 MHz or 600 kHz PWM frequency, low quiescent current 14 µA, high efficiency >90%, current-mode control architecture	Small 3 mm × 3 mm LFCSP package, few peripheral components, and small solution size
Interface		
ADM2483	Half-duplex, 500 kbps data rate, 5 V or 3 V operations, low power operation: 2.5 mA max, 2.5 kV isolation	Low power operation and competitive price
ADM2484E	5 kV signal isolated, ESD protected, 500 kbps, full-/half-duplex RS-485 transceiver	Full-/half-duplex RS-485 transceiver
ADM3251E	2.5 kV fully isolated (power and data) RS-232 transceiver, *iso*Power® integrated, isolated dc-to-dc converter, 460 kbps data rate	Isolated single channel RS-232 line driver/receiver
ADUM1250	Bidirectional I²C communication open-drain interfaces, suitable for hot swap applications	Hot swappable dual I²C isolator
ADM3202	460 kbps data rate DIP, SO, SOIC, SSOP and TSSOP	High speed, 2-channel RS-232/V.28 interface devices
ADM3053	Signal and power isolated CAN transceiver with integrated isolated dc-to-dc converter, 5 V operation on V_{CC}, 5 V or 3.3 V operation on VIO	2.5 kV rms signal and power isolated CAN transceiver
ADM3260	Bidirectional I²C communication, 3.0 V to 5.5 V supply/logic levels suitable for hot swap applications	Hot swappable, dual I²C isolators with integrated dc-to-dc converter
ADM2587E	2.5 kV signal and power isolated, ±15 kV ESD protected, full-/half-duplex RS-485 transceiver (500 kbps)	Isolated RS-485/RS-422 transceiver, integrated isolated dc-to-dc converter

Design Resources

Circuits from the Lab®

- CN-0292: Completely Isolated, Robust, 4-Channel, Multiplexed Data Acquisition System for Industrial Level Signals—*www.analog.com/en/cn-0292*
- CN-0277: 18-Bit, 5 MSPS, Data Acquisition System Optimized for AC Performance—*www.analog.com/en/cn-0277*

Design Tools/Forums

- ADIsimPower™: ADI Voltage Regulator Design Tool—*www.analog.com/adisimpower*
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cic.asia@analog.com

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Technical Hotline

1-800-419-0108 (India)

1-800-225-5234 (Singapore)

0800-055-085 (Taiwan)

82-31-786-2500 (Korea)

Analog Devices, Inc.
Worldwide Headquarters

Analog Devices, Inc.
One Technology Way
P.O. Box 9106
Norwood, MA 02062-9106
U.S.A.
Tel: 781.329.4700
(800.262.5643, U.S.A. only)
Fax: 781.461.3113

Analog Devices, Inc.
Europe Headquarters

Analog Devices GmbH
Otl-Aicher-Str. 60-64
80807 Munich
Germany
Tel: 49.89.76903.0
Fax: 49.89.76903.157

Analog Devices, Inc.
Japan Headquarters

Analog Devices, KK
New Pier Takeshiba
South Tower Building
1-16-1 Kaigan, Minato-ku,
Tokyo, 105-6891
Japan
Tel: 813.5402.8200
Fax: 813.5402.1064

Analog Devices, Inc.
Asia Pacific Headquarters

Analog Devices
5F, Sandhill Plaza
2290 Zuchongzhi Road
Zhangjiang Hi-Tech Park
Pudong New District
Shanghai, China 201203
Tel: 86.21.2320.8000
Fax: 86.21.2320.8222

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