



TMR Flight Controller V1.0 Reference Manual

CCTSAO1008

20/07/2012



Bottom View

Frame





STM32F405

Features

- Core: ARM 32-bit Cortex™-M4 CPU with FPU, Adaptive real-time accelerator (ART Accelerator™) allowing 0-wait state execution from Flash memory, frequency up to 168 MHz, memory protection unit, 210 DMIPS/1.25 DMIPS/MHz (Dhrystone 2.1), and DSP instructions
- Memories
 - Up to 1 Mbyte of Flash memory
 - Up to 192+4 Kbytes of SRAM including 64-Kbyte of CCM (core coupled memory) data RAM
 - Flexible static memory controller supporting Compact Flash, SRAM, PSRAM, NOR and NAND memories
- LCD parallel interface, 8080/6800 modes
- Clock, reset and supply management
 - 1.8 V to 3.6 V application supply and I/Os
 - POR, PDR, PVD and BOR
 - 4-to-26 MHz crystal oscillator
 - Internal 16 MHz factory-trimmed RC (1% accuracy)
 - 32 kHz oscillator for RTC with calibration
 - Internal 32 kHz RC with calibration
- Low power
 - Sleep, Stop and Standby modes
 - V_{BAT} supply for RTC, 20×32 bit backup registers + optional 4 KB backup SRAM
- 3×12-bit, 2.4 MSPS A/D converters: up to 24 channels and 7.2 MSPS in triple interleaved mode
- 2×12-bit D/A converters
- General-purpose DMA: 16-stream DMA controller with FIFOs and burst support
- Up to 17 timers: up to twelve 16-bit and two 32-bit timers up to 168 MHz, each with up to 4 IC/OC/PWM or pulse counter and quadrature (incremental) encoder input
- Debug mode
 - Serial wire debug (SWD) & JTAG interfaces
 - Cortex-M4 Embedded Trace Macrocell™
- Up to 140 I/O ports with interrupt capability
 - Up to 136 fast I/Os up to 84 MHz
 - Up to 138 5 V-tolerant I/Os
- Up to 15 communication interfaces
 - Up to 3 × I²C interfaces (SMBus/PMBus)
 - Up to 4 USARTs/2 UARTs (10.5 Mbit/s, ISO 7816 interface, LIN, IrDA, modem control)
 - Up to 3 SPIs (37.5 Mbits/s), 2 with muxed full-duplex I²S to achieve audio class accuracy via internal audio PLL or external clock
 - 2 × CAN interfaces (2.0B Active)
 - SDIO interface
- Advanced connectivity
 - USB 2.0 full-speed device/host/OTG controller with on-chip PHY
 - USB 2.0 high-speed/full-speed device/host/OTG controller with dedicated DMA, on-chip full-speed PHY and ULPI
 - 10/100 Ethernet MAC with dedicated DMA: supports IEEE 1588v2 hardware, MII/RMII
- 8- to 14-bit parallel camera interface up to 54 Mbytes/s
- True random number generator
- CRC calculation unit
- 96-bit unique ID
- RTC: subsecond accuracy, hardware calendar

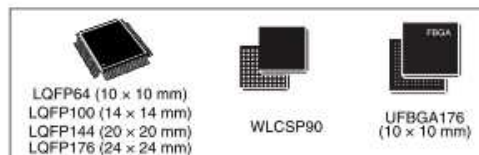
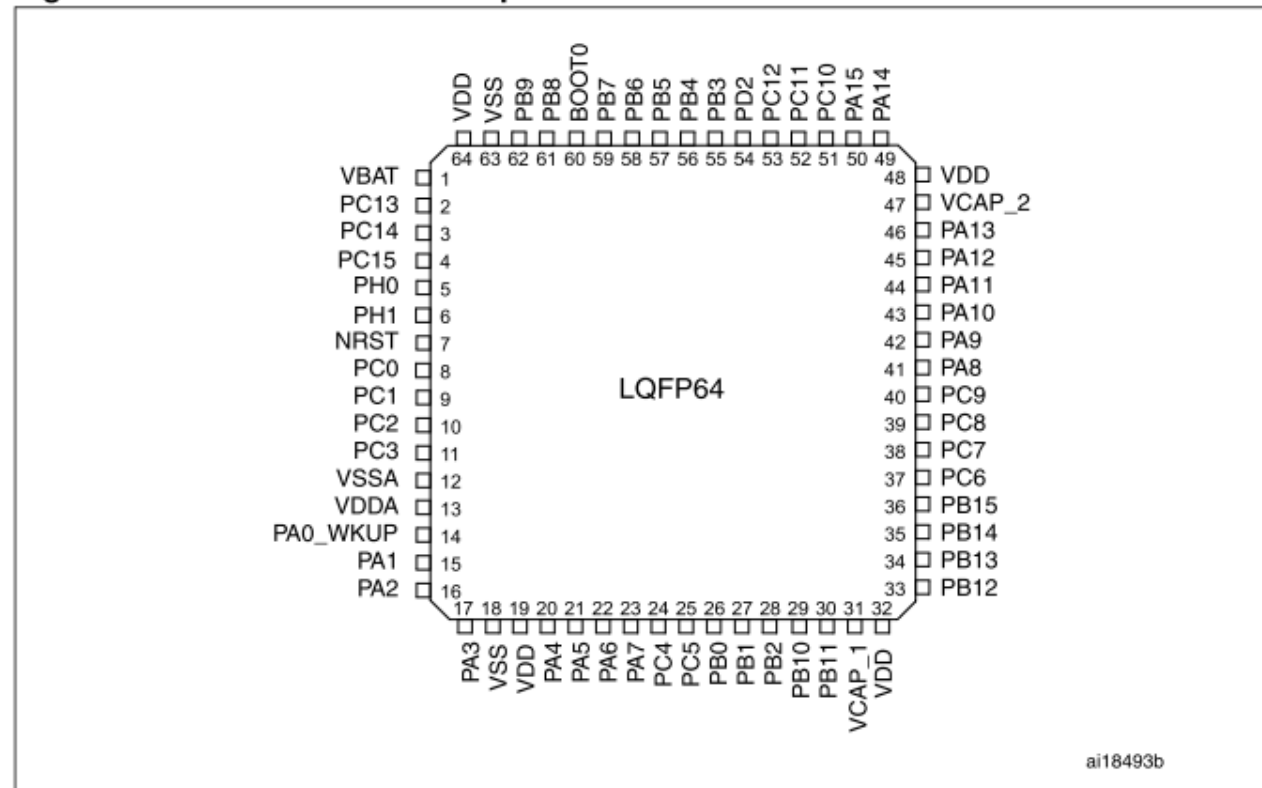


Table 1. Device summary

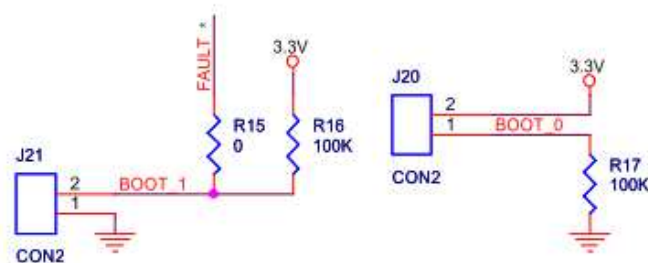
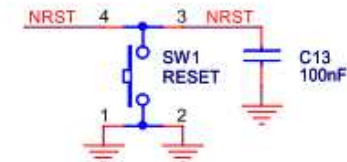
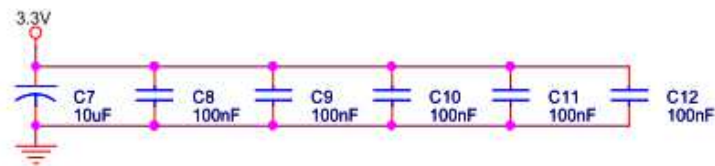
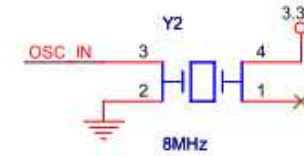
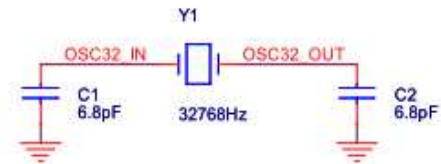
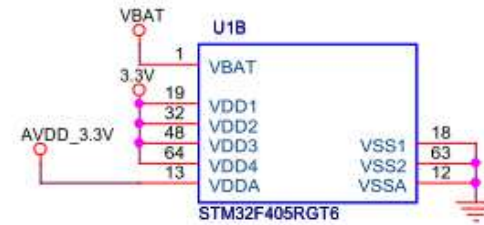
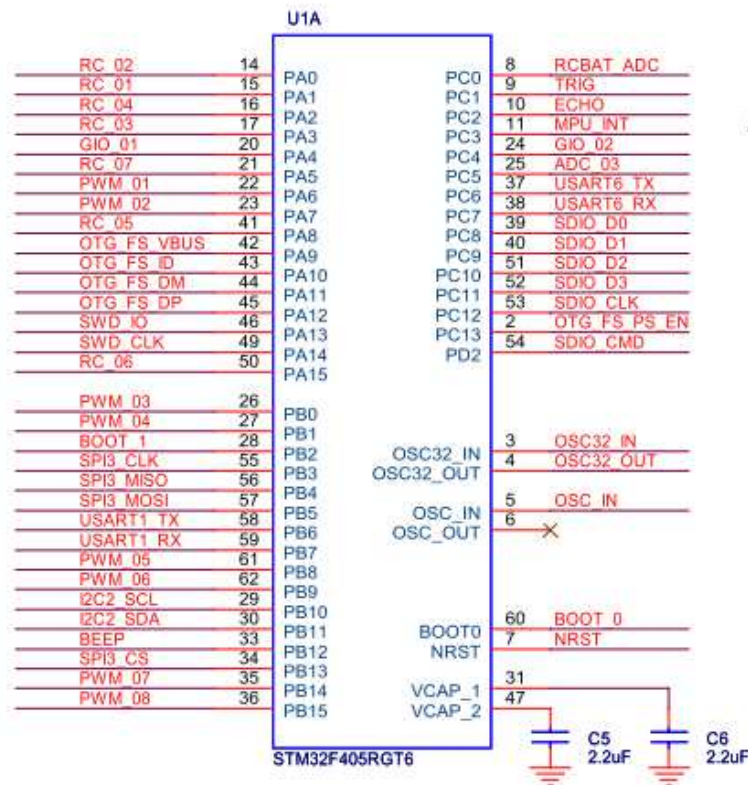
Reference	Part number
STM32F405xx	STM32F405RG, STM32F405VG, STM32F405ZG, STM32F405OG, STM32F405OE
STM32F407xx	STM32F407VG, STM32F407IG, STM32F407ZG, STM32F407VE, STM32F407ZE, STM32F407IE

Pinouts and pin description

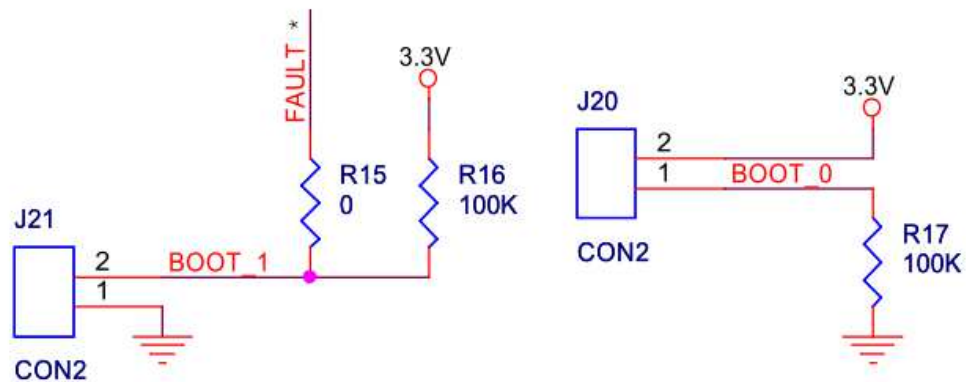
Figure 10. STM32F40x LQFP64 pinout



STM32F4



MODE	BOOT1	BOOT0
FLASH	OPEN	OPEN
RAM	OPEN	CLOSE
DFU	CLOSE	CLOSE



MODE	BOOT1	BOOT0
FLASH	OPEN	OPEN
RAM	OPEN	CLOSE
DFU	CLOSE	CLOSE

Table 4. Boot modes

Boot mode selection pins		Boot mode	Aliasing
BOOT1	BOOT0		
x	0	Main Flash memory	Main Flash memory is selected as the boot space
0	1	System memory	System memory is selected as the boot space
1	1	Embedded SRAM	Embedded SRAM is selected as the boot space

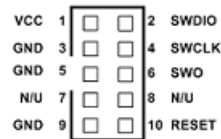
Serial Wire Debug (SWD)

Serial Wire Mode Interface

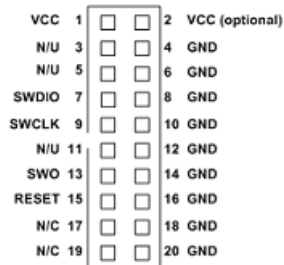
The Serial Wire (SW) mode is a different operating mode for the JTAG port where only two pins, TCLK and TMS, are used for the communication. A third pin can be use optionally to trace data. JTAG pins and SW pins are shared.

- **TCLK** is **SWCLK** (Serial Wire Clock)
- **TMS** is **SWDIO** (Serial Wire debug Data Input/Output)
- **TDO** is **SWO** (Serial Wire trace Output)

ARM 10-Pin Connector



ARM 20-Pin Connector

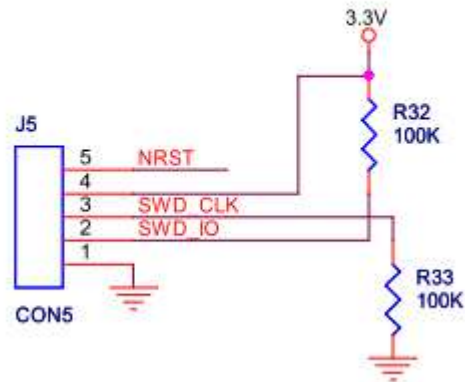


Signal	Connects to...
SWDIO	Data I/O pin. Use 100K Ohm pull-up resistor to VCC.
SWO	Optional trace output pin.
SWCLK	Clock pin. Use 100K Ohm pull-down resistor to GND.
VCC	Positive Supply Voltage — Power supply for JTAG interface drivers.
GND	Digital ground.
RESET	RSTIN/ pin — Connect this pin to the (active low) reset input of the target CPU.

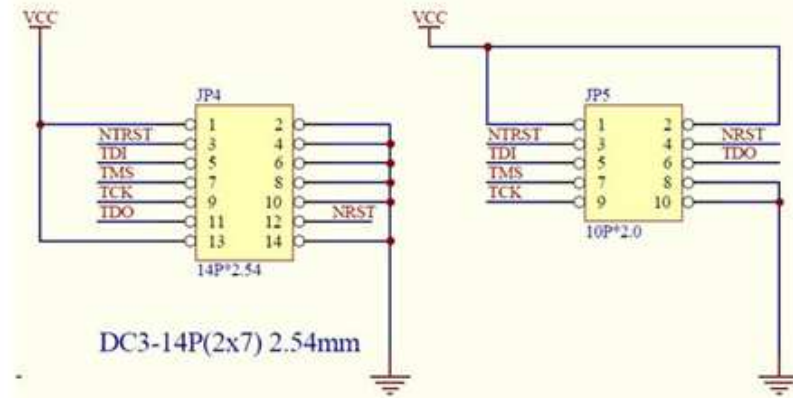
Additional ARM 10-pin cables with connectors are available directly from Samtec:

- 6" Cable (Samtec P/N: FFSD-05-D-06.00-01-N)
- 12" Cable (Samtec P/N: FFSD-05-D-12.00-01-N)

SWD



14PIN 2.54mm和10PIN 2.0mm

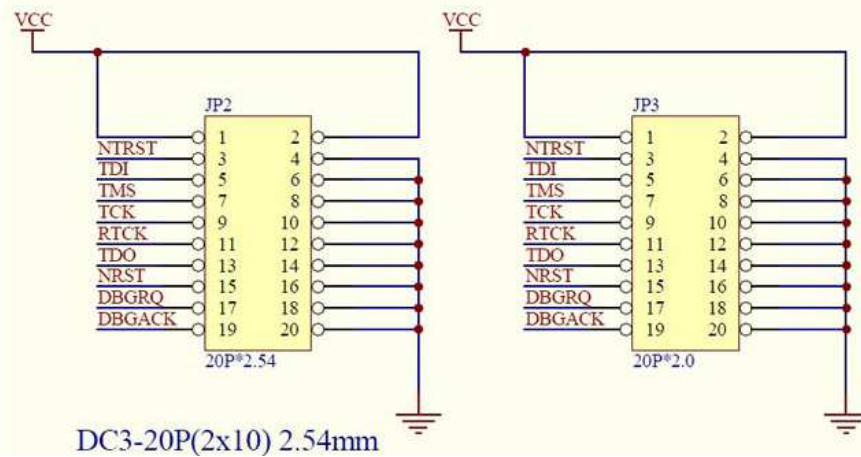


FC型扁平电缆连接器 (IDC2.0MM) 10P

DC3-2.0-10P

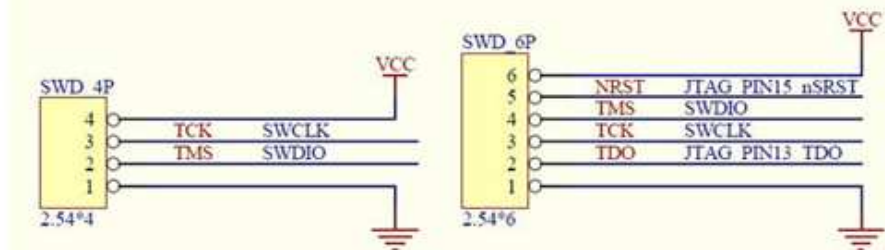
接口定义如下:

20PIN 2.54mm 和 20PIN 2.0mm



DC3-20P(2x10) 2.54mm

SWD 4PIN 2.54mm 和 SWD 6PIN 2.54mm





RF Interface

Wireless UART Module

APC250

20dBm ISM RF Transceiver Module

V1.21

Features

- GFSK transceiver Module
- ISM frequency bands
- 19.2K bps data rate
- Multiple channels
- 20dBm Max. output power
- Baud rate configurable
- 256 bytes data buffer
- Standby current < 3uA
- Supply voltage 3.4~5.5V

Application

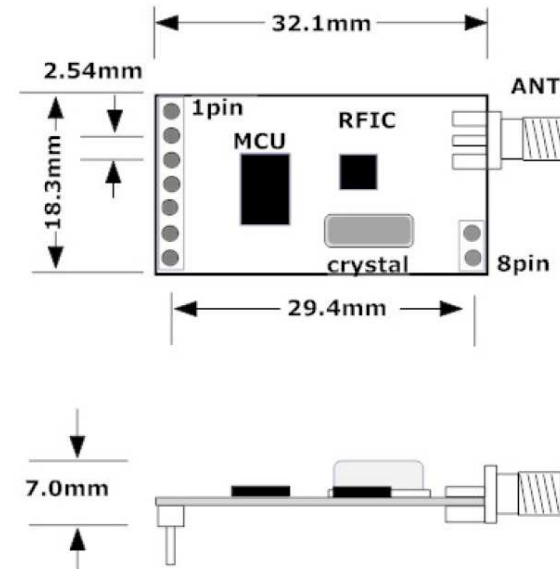
- Home automation
- Security alarm
- Telemetry
- Automatic meter reading
- Contactless access
- Wireless data logger
- Remote motor control
- Wireless sensor network

DESCRIPTION

APC250 is a low-cost sub-1 GHz transceiver module designed for operations in the unlicensed ISM (Industrial Scientific Medical) and LPRD bands. GFSK (Frequency Shift Keying) modulation/demodulation, multi-channel operation, high bandwidth efficiency and anti-blocking performance make APC250 modules easy to realize the robust and reliable wireless link.

The module can be configured to work in different channels with 200k Hz space. It adopts high efficient looped interleaving EDAC (Error Detection and correction) coding with coding gain up to 3dB which keeps in advance in EDAC and coding efficiency over normal FEC (Forward Error Correction). Because of its high reliability in correction, modules can filter error and fake information automatically and realize truly transparent wireless link, which makes APC250 very suitable in the rigid communication environment.

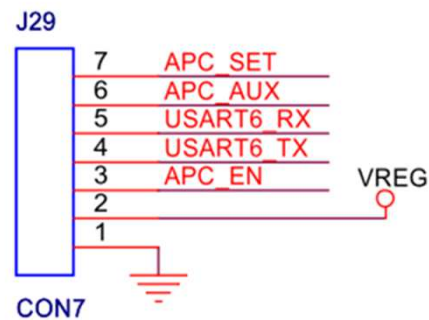
APC250 integrates 256 bytes buffer. When the buffer is empty, users can transfer 256 bytes data per time and even limitless data transfer can be achieved as long as RF data rate (RF module to RF module) is configured to be faster than UART data rate (MCU to RF module). The module provides standard UART/TTL interface for selection. Users can choose seven data rates and three parity checks which make APC250 possibly tailor-made for different applications. APC250 operates at 3.4~5.5V with extra low standby current which makes it suitable for battery powered-up applications.



APPCON Technologies

APC250

RF



PIN FUNCTIONS

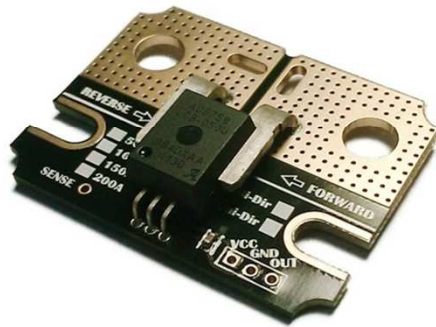
PIN	Name	Function	Description
1	GND	Ground	Ground (0V)
2	VCC	Power	Power supply
3	/ EN	Input	Enable pin (≤ 0.5): work mode; ($\geq 2.0V$): sleep mode
4	RXD	Input	UART input, TTL level
5	TXD	Output	UART output, TTL level
6	AUX	Output	Data In/Out indication
7	SET	Input	Data / Field strength pin
8	NC	---	No connection
9	NC	---	No connection

Table 1 APC250 Pin Functions

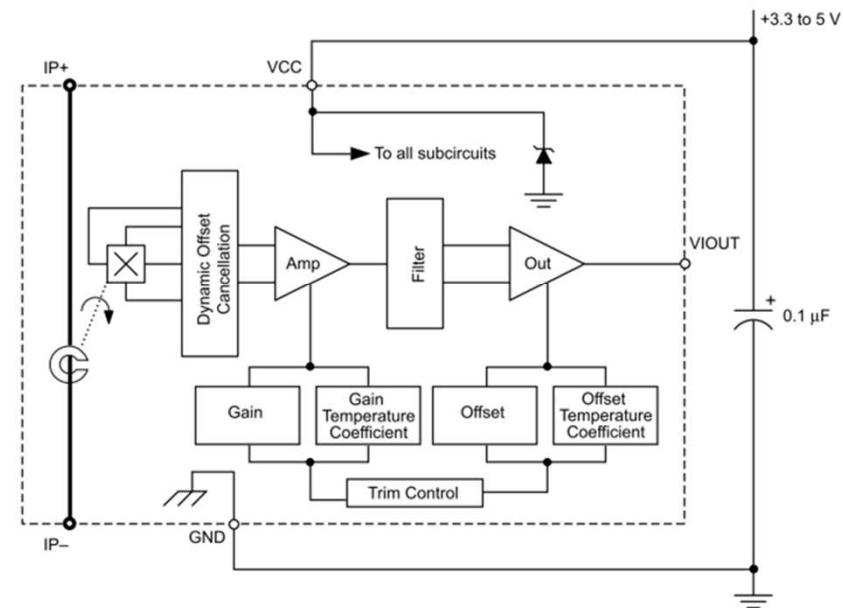
Bluetooth Module (UART)



Watt Meter Interface



Functional Block Diagram





ACS758xCB

Thermally Enhanced, Fully Integrated, Hall Effect-Based Linear Current Sensor IC with 100 $\mu\Omega$ Current Conductor

Features and Benefits

- Industry-leading noise performance through proprietary amplifier and filter design techniques
- Integrated shield greatly reduces capacitive coupling from current conductor to die due to high dV/dt signals, and prevents offset drift in high-side, high voltage applications
- Total output error improvement through gain and offset trim over temperature
- Small package size, with easy mounting capability
- Monolithic Hall IC for high reliability
- Ultra-low power loss: 100 $\mu\Omega$ internal conductor resistance
- Galvanic isolation allows use in economical, high-side current sensing in high voltage systems
- 3.0 to 5.5 V, single supply operation
- 120 kHz typical bandwidth
- 3 μ s output rise time in response to step input current
- Output voltage proportional to AC or DC currents
- Factory-trimmed for accuracy
- Extremely stable output offset voltage
- Nearly zero magnetic hysteresis

Description

The Allegro® ACS758 family of current sensor ICs provides economical and precise solutions for AC or DC current sensing. Typical applications include motor control, load detection and management, power supply and DC-to-DC converter control, inverter control, and overcurrent fault detection.

The device consists of a precision, low-offset linear Hall circuit with a copper conduction path located near the die. Applied current flowing through this copper conduction path generates a magnetic field which the Hall IC converts into a proportional voltage. Device accuracy is optimized through the close proximity of the magnetic signal to the Hall transducer. A precise, proportional output voltage is provided by the low-offset, chopper-stabilized BiCMOS Hall IC, which is programmed for accuracy at the factory.

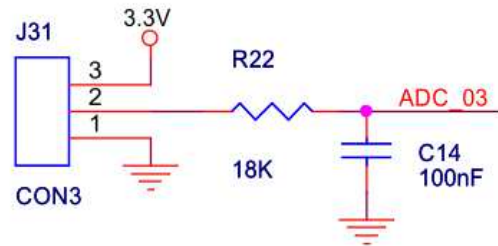
High level immunity to current conductor dV/dt and stray electric fields, offered by Allegro proprietary integrated shield technology, guarantees low output voltage ripple and low offset drift in high-side, high voltage applications.

The output of the device has a positive slope ($>V_{CC}/2$) when an increasing current flows through the primary copper conduction path (from terminal 4 to terminal 5), which is the path used for current sampling. The internal resistance of this conductive path is 100 $\mu\Omega$ typical, providing low power loss.

The thickness of the copper conductor allows survival of the device at high overcurrent conditions. The terminals of the conductive path are electrically isolated from the signal leads (pins 1 through 3). This allows the ACS758 family of sensor ICs to be used in applications requiring electrical isolation without the use of opto-isolators or other costly isolation techniques.

The device is fully calibrated prior to shipment from the factory. The ACS758 family is lead (Pb) free. All leads are plated with 100% matte tin, and there is no Pb inside the package. The heavy gauge leadframe is made of oxygen-free copper.

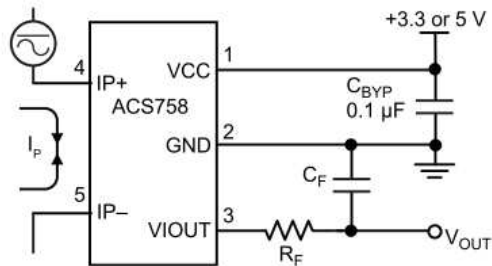
Watt Meter



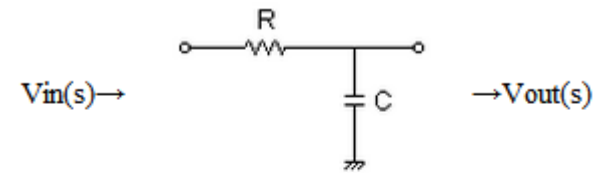
LPF : Cut-off frequency
 $f_c = 88.4194128288\text{Hz}$ (18K ohm)

LPF : Cut-off frequency
 $f_c = 194.091394015\text{Hz}$ (8.2K ohm)

Typical Application



Application 1. The ACS758 outputs an analog signal, V_{OUT} , that varies linearly with the uni- or bi-directional AC or DC primary sampled current, I_P , within the range specified. C_F is for optimal noise management, with values that depend on the application.



Transfer Function:

$$G(s) = \frac{555.555555556}{s + 555.555555556}$$

Cut-off frequency
 $f_c = 88.4194128288\text{[Hz]}$

CR Filter

Rise/Fall time of step response

R = Ω C = F

Stead-state value: % \rightarrow %

tr = [sec]

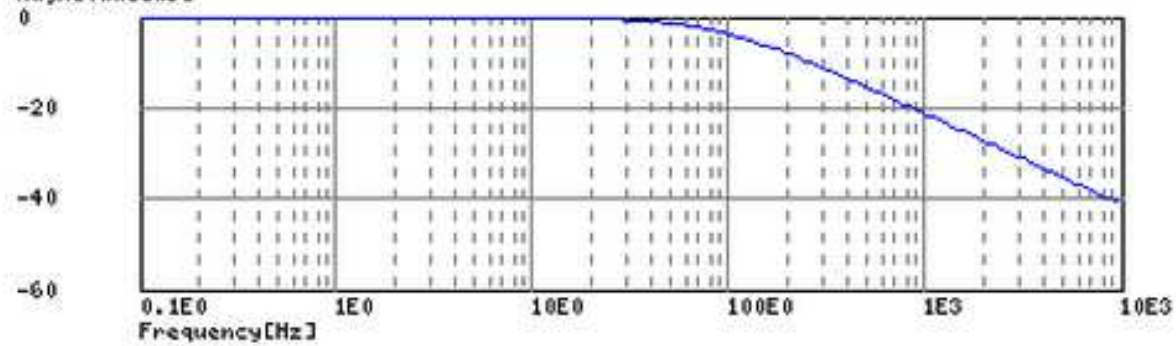
Pole(s)
 $p = -88.4194128288\text{[Hz]}$
 $|p| = 88.4194128288\text{[Hz]}$

Final value of the step response (on the condition that the system converged when t goes to infinity)
 $g(\infty) = 1$

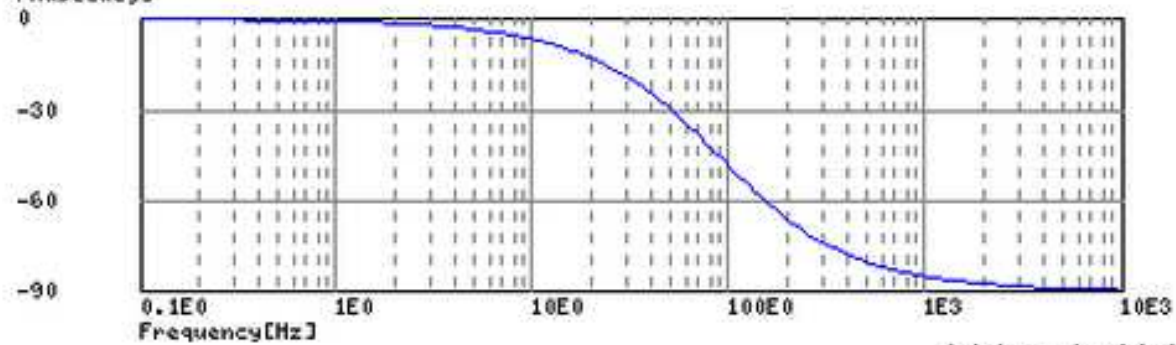
Frequency analysis

BodeDiagram

Magnitude[dB]



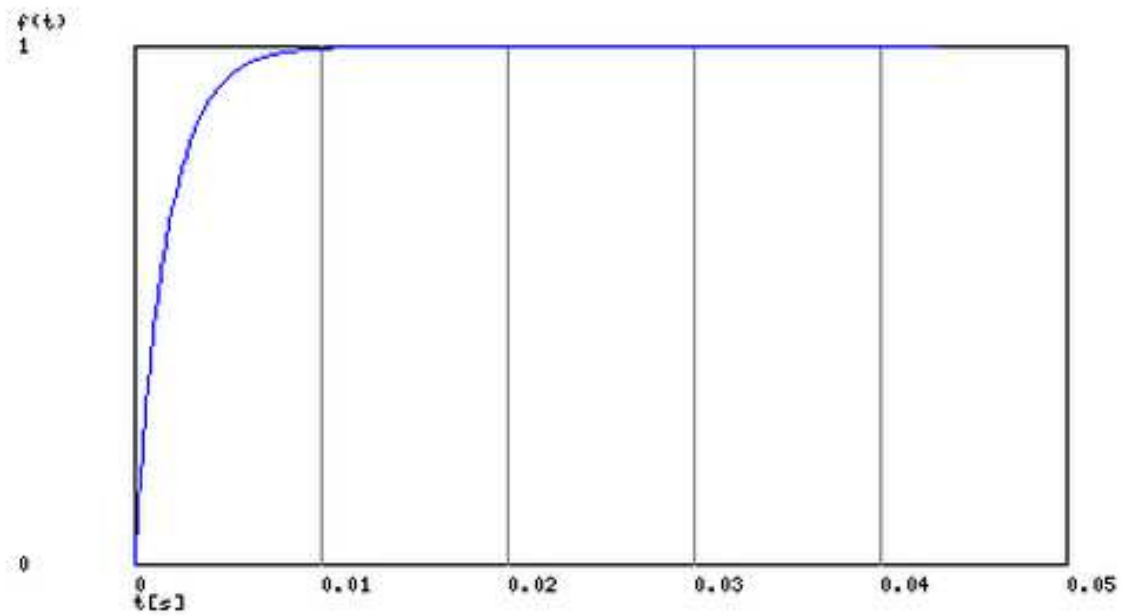
Phase[deg]



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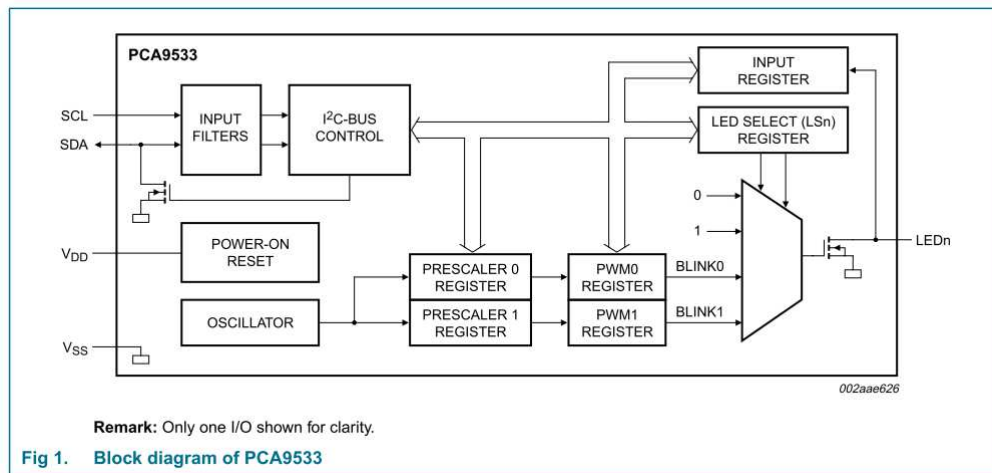
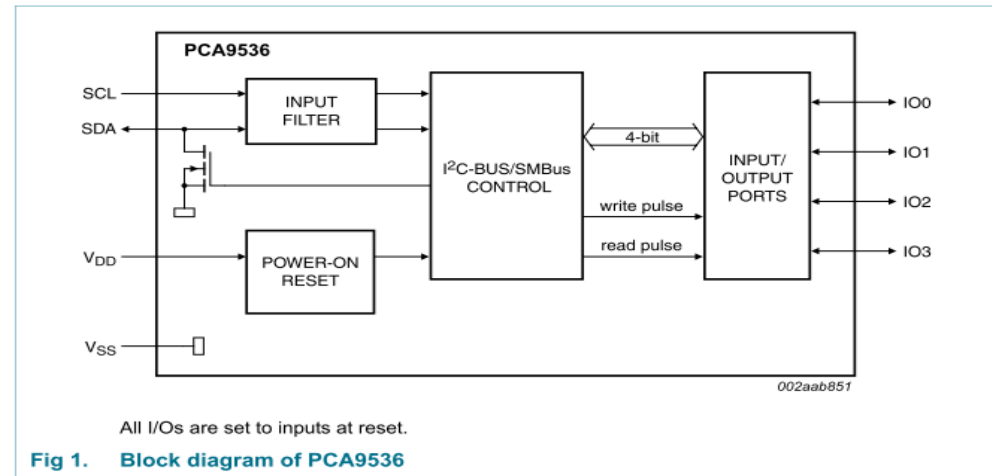
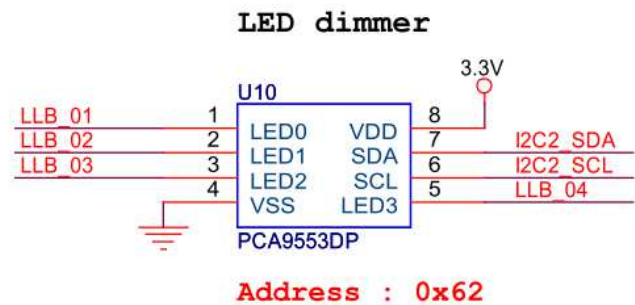
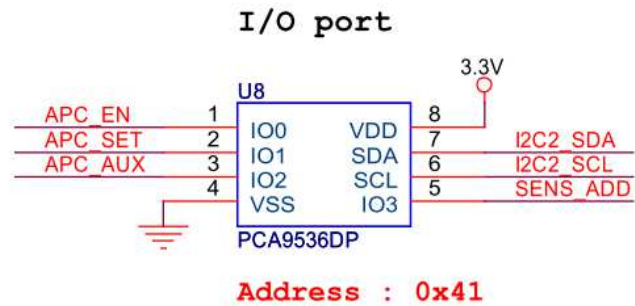
Transient analysis

StepResponse



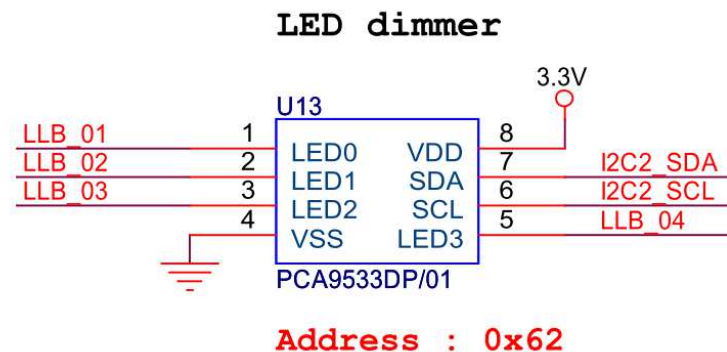
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GPIO & PWM Expanders



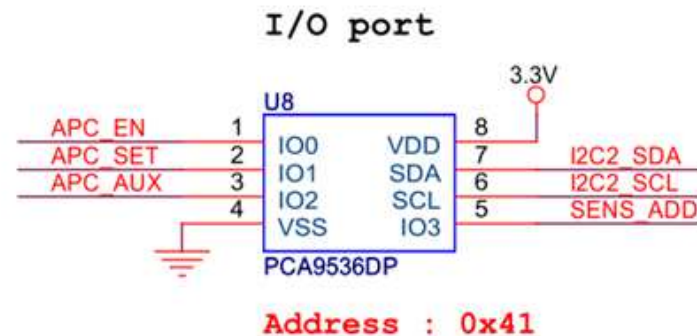
Features

- 4 LED drivers (on, off, flashing at a programmable rate)
- Two selectable, fully programmable blink rates (frequency and duty cycle) between 0.591 Hz and 152 Hz (1.69 second and 6.58 milliseconds)
- 256 brightness steps
- Input/outputs not used as LED drivers can be used as regular GPIOs
- Internal oscillator requires no external components
- I²C-bus interface logic compatible with SMBus



Features

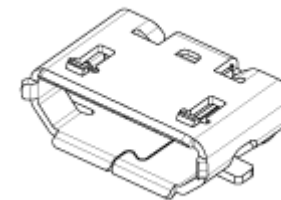
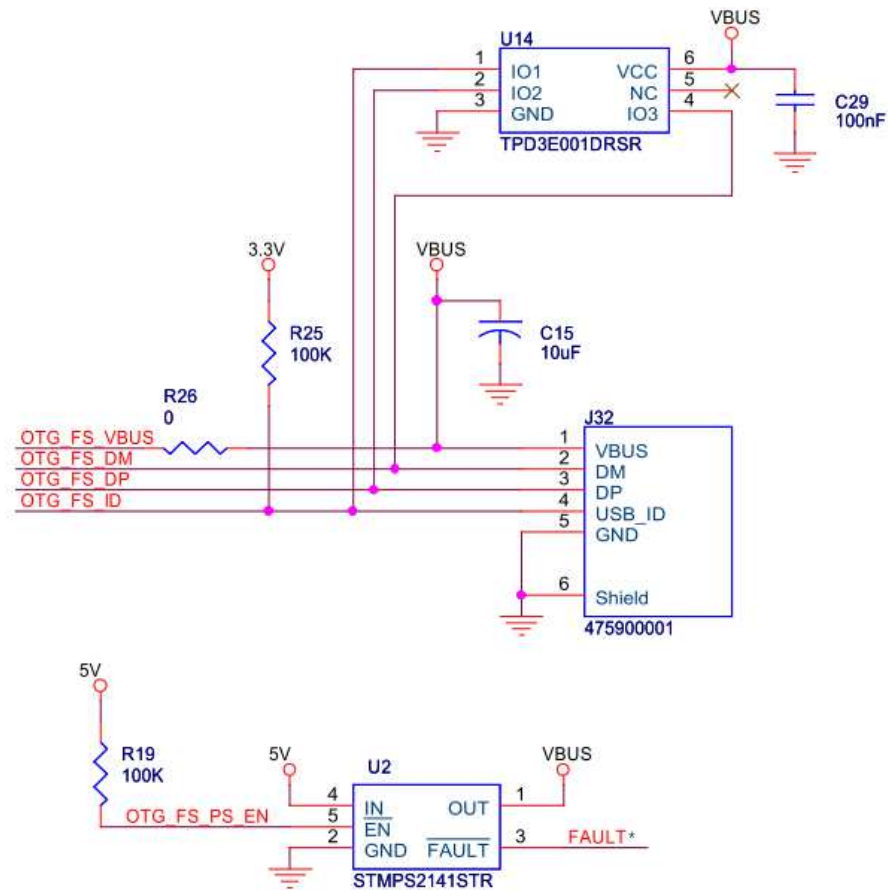
- 4-bit I²C-bus GPIO
- Operating power supply voltage range of 2.3 V to 5.5 V
- 5 V tolerant I/Os
- Polarity Inversion register
- Low standby current
- Noise filter on SCL/SDA inputs
- No glitch on power-up
- Internal power-on reset
- 4 I/O pins which default to 4 inputs with 100 k Ω internal pull-up resistor
- 0 Hz to 400 kHz clock frequency
- ESD protection exceeds 2000 V HBM per JESD22-A114, 200 V MM per JESD22-A115 and 1000 V CDM per JESD22-C101
- Latch-up testing is done to JEDEC Standard JESD78 which exceeds 100 mA
- Packages offered: SO8, TSSOP8 (MSOP8), HVSON8



USB OTG FS 2.0

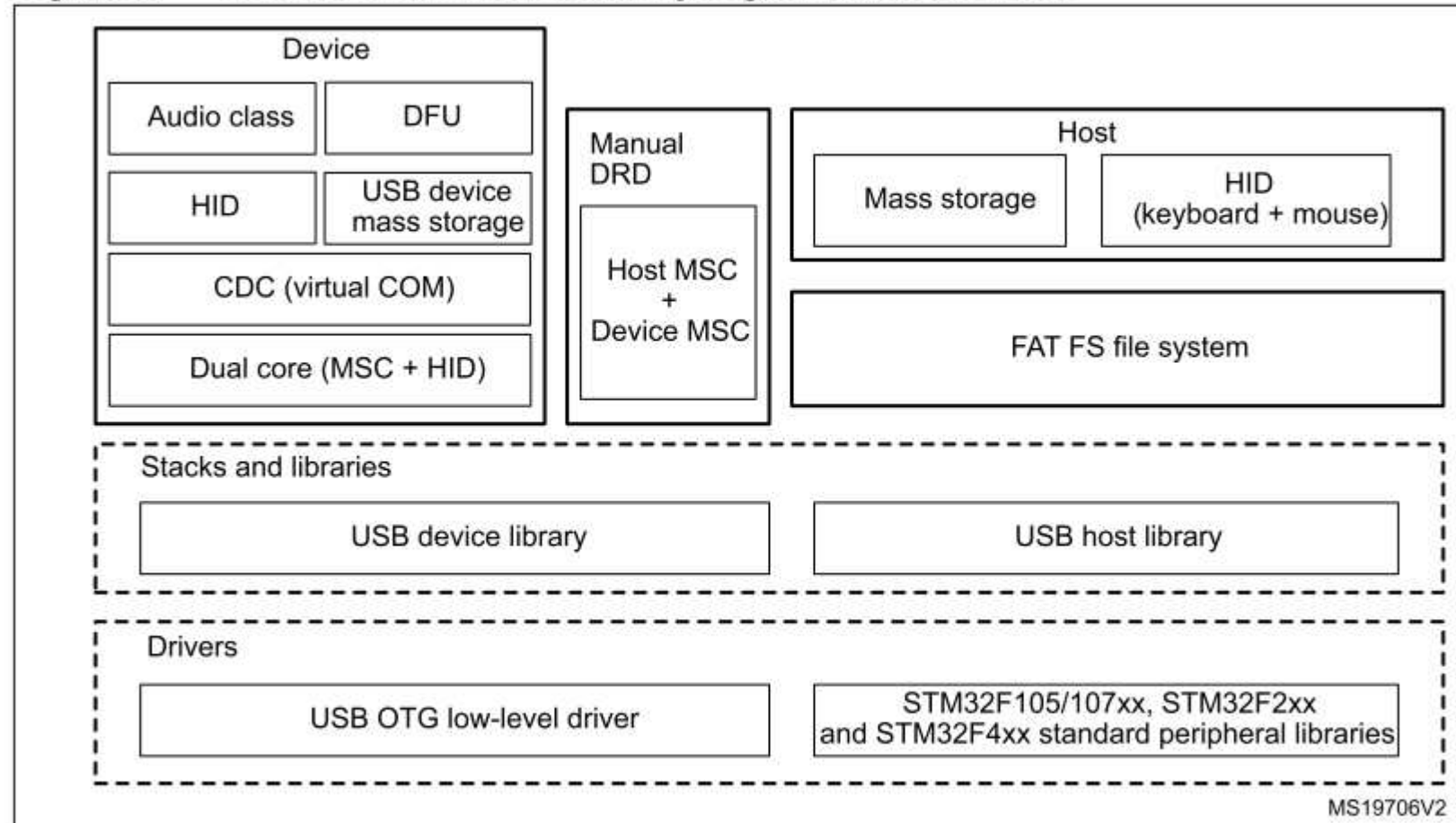
With ESD Protected

USB OTG FS



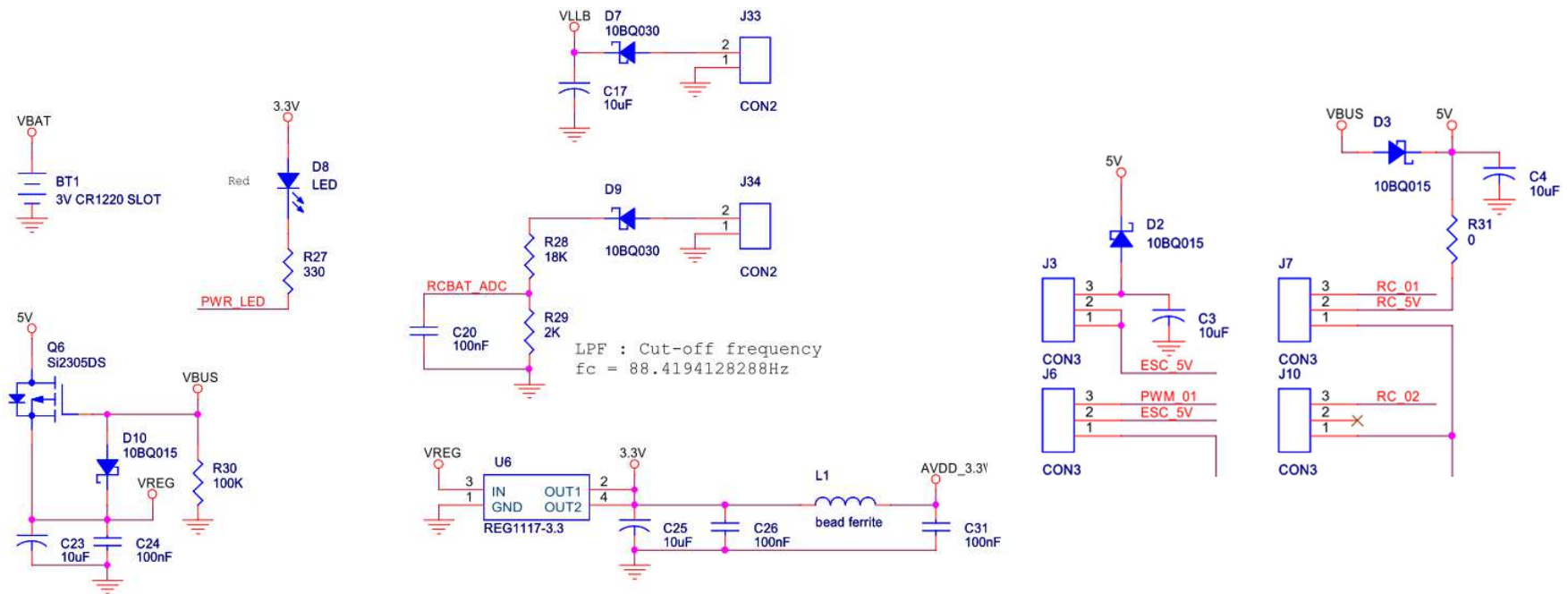
The following figure gives an overview of the USB host and device libraries.

Figure 1. USB host and device library organization overview

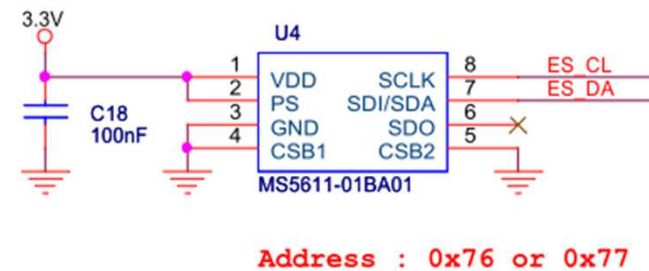
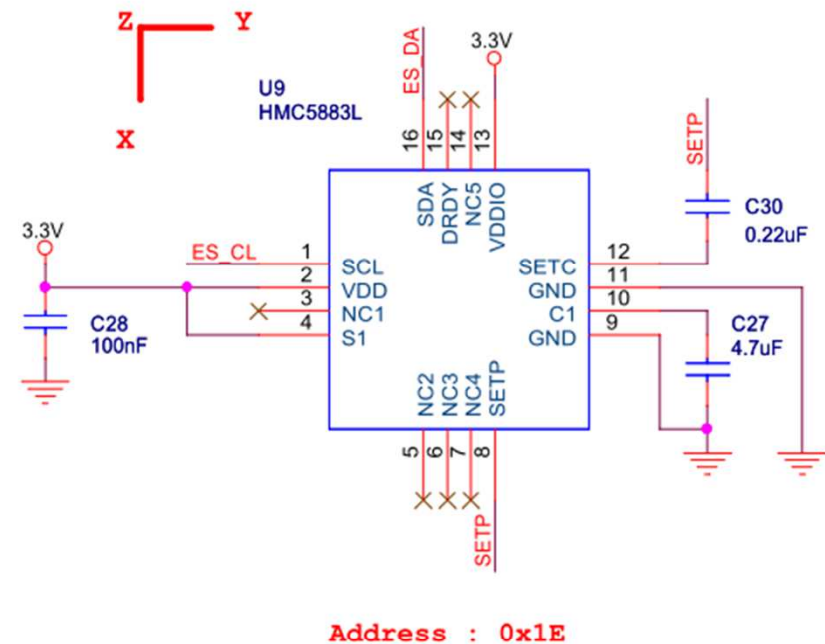
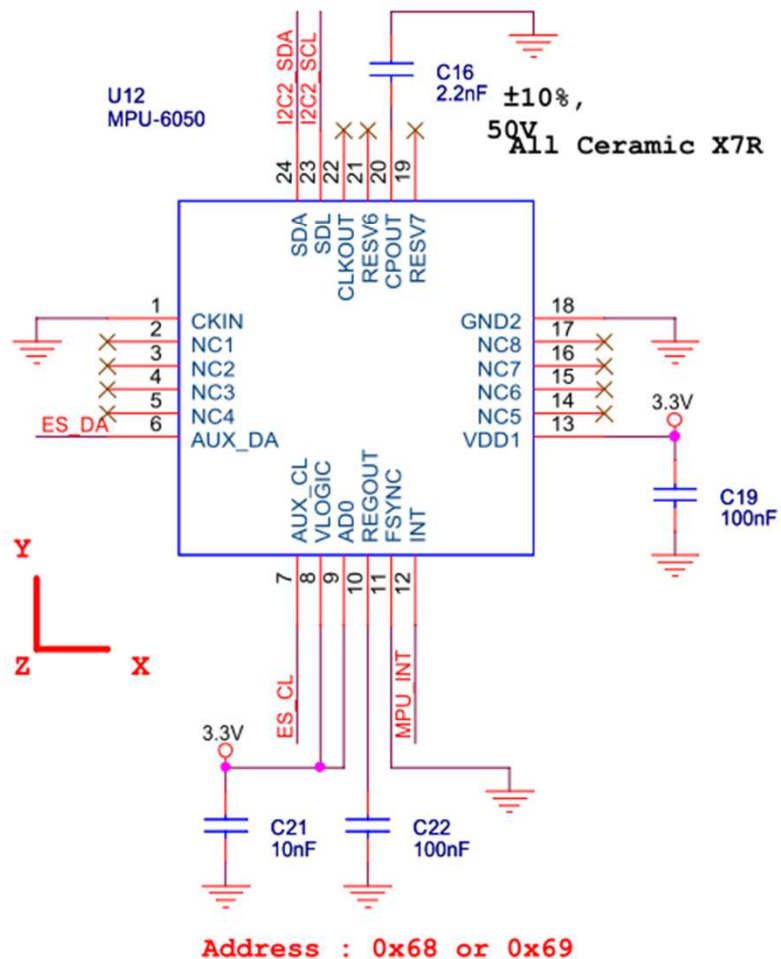


The USB host and device libraries are built around the common STM32 USB OTG low level driver and the USB device and host libraries.

System Power



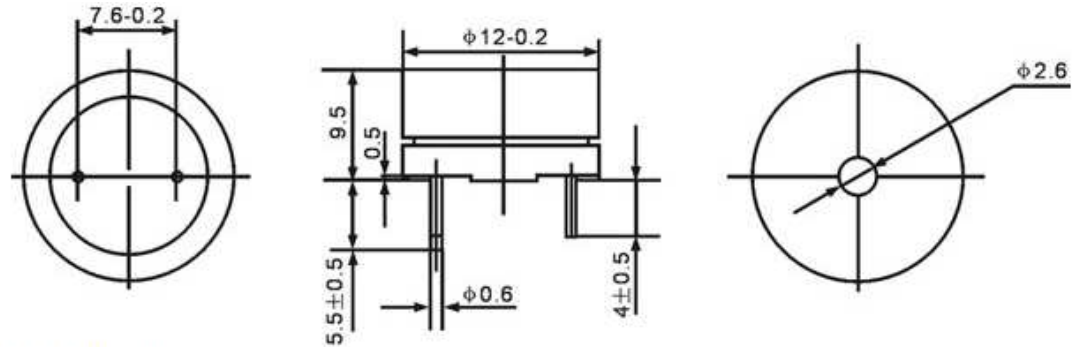
10 DOF IMU



Indicators

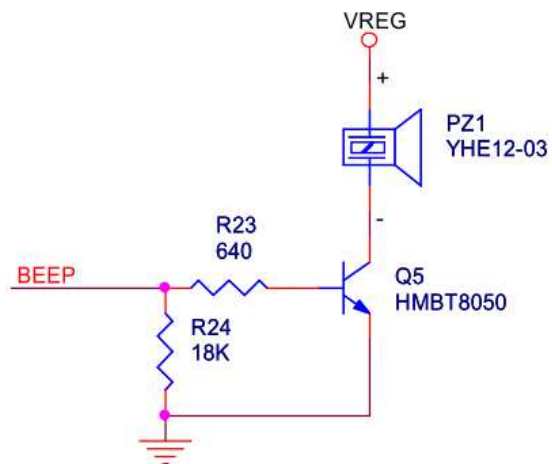


Buzzer

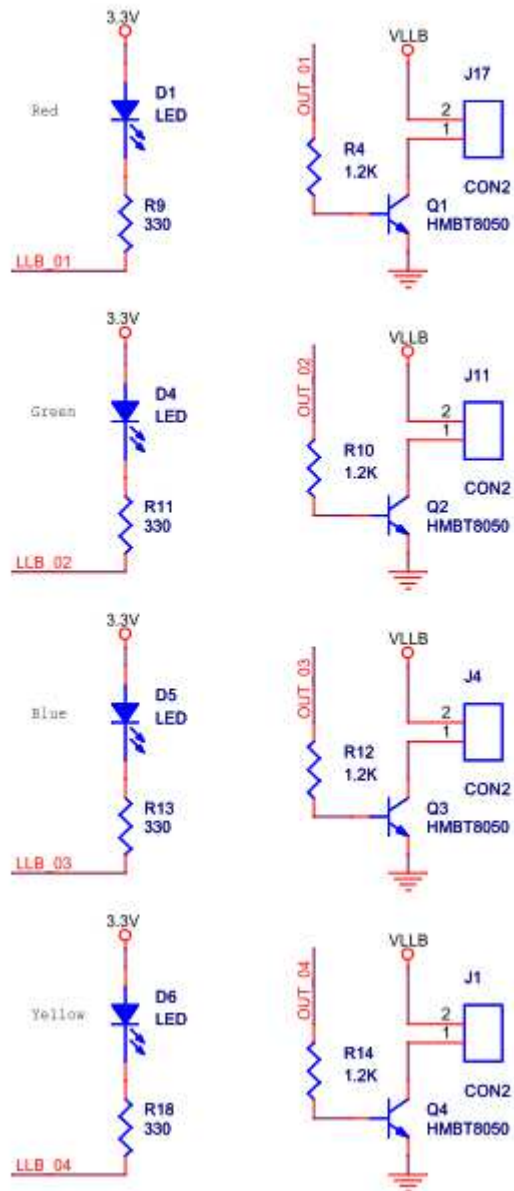


SPECIFICATIONS

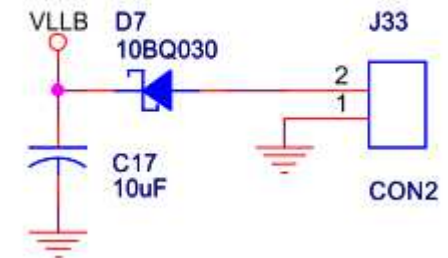
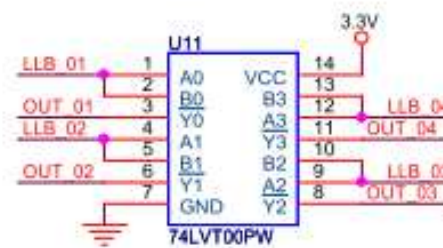
Type	Unit	YHE12-01	YHE12-03	YHE12-05	YHE12-09	YHE12-12
Rated Voltage	V	1.5	3	5	9	12
Operating Voltage	V	1-2	2-5	4-8	7-12	8-15
* Rated Current(MAX)	mA	20	30	30	30	30
* Min Sound Output at 10 cm	dB	75	80	85	85	85
* Resonant Frequency	Hz	2300±300				
Operating Temperature	°C	-20~+70				
Storage Temperature	°C	-30~+105				
Weight	g	2				



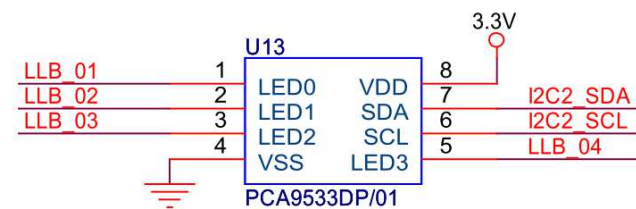
LED Light Bar - 1



LED Light Bar - 2



LED dimmer

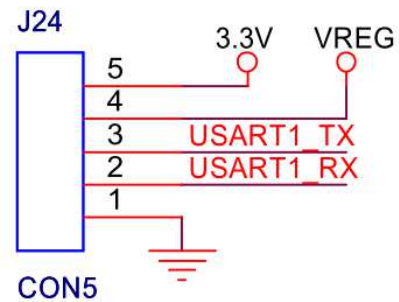


Address : 0x62

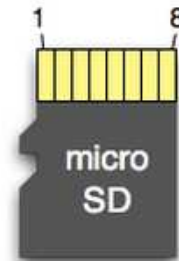
GPS Interface (UART or I2C)



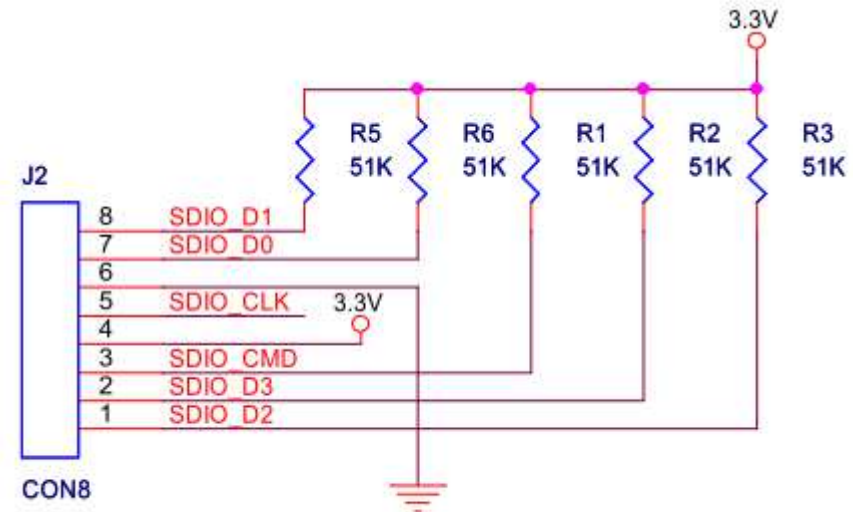
GPS (UART or I2C)



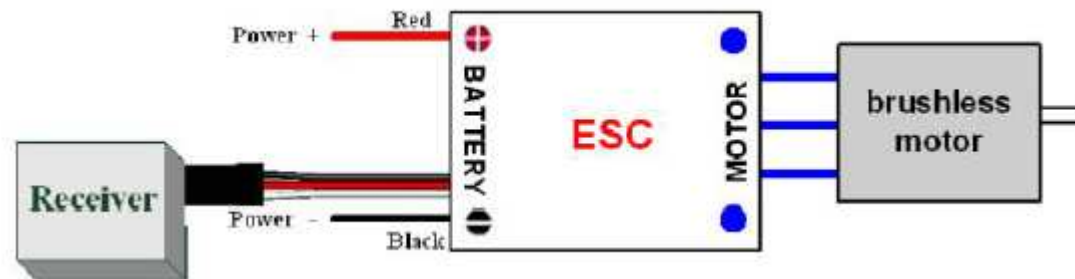
4 Bit mode SD Card Interface

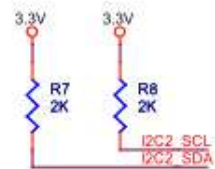
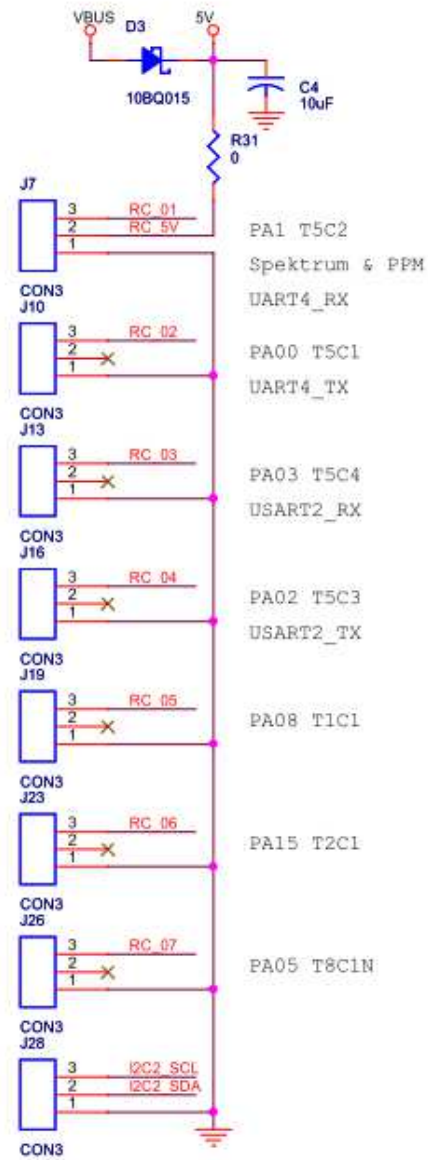


Pin	SD	SPI
1	DAT2	X
2	CD/DAT3	CS
3	CMD	DI
4	VDD	VDD
5	CLK	SCLK
6	VSS	VSS
7	DAT0	DO
8	DAT1	X

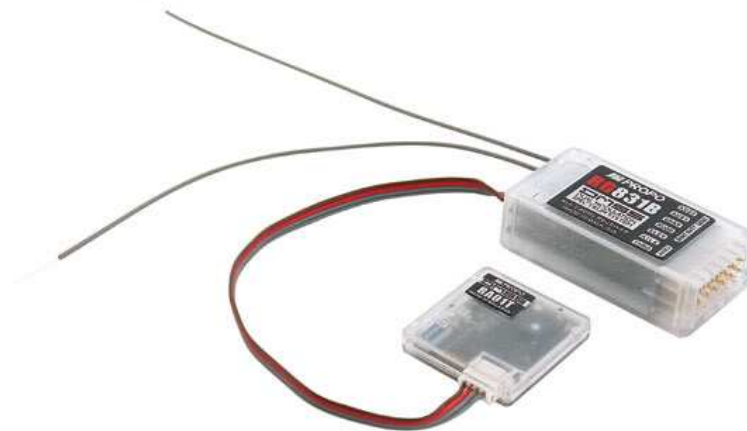


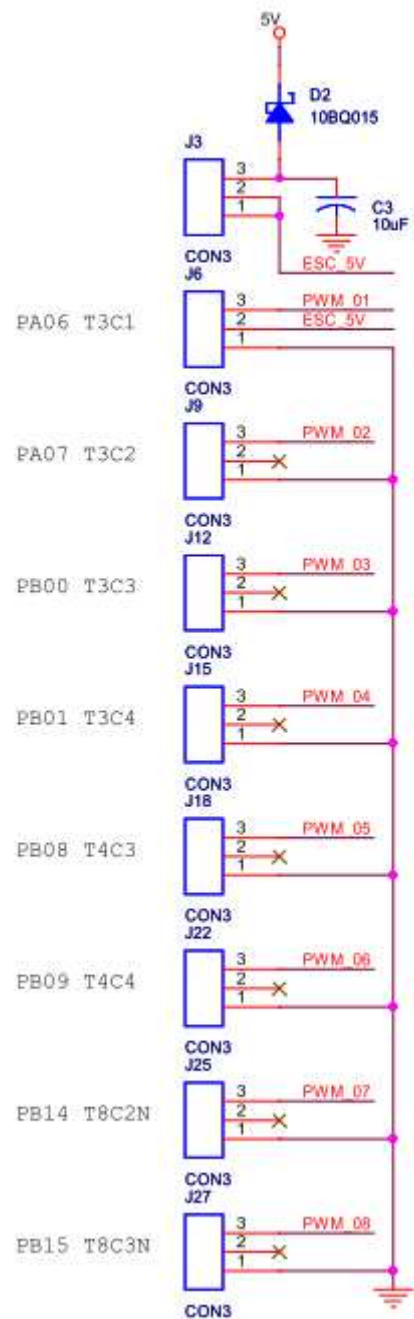
ESC (Electronic Speed Controller)





TX / RX System





RC Battery

